Improving safety on construction sites by changing personnel behaviour

Phase Two

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The research described in this report is the second phase of a five-year programme to develop, test and implement methods of goal-setting and feedback in improving safety behaviour on construction sites. In Phase One of the programme these methods were designed and tested on six construction sites. Measures of safety performance were developed and used before, during and after the introduction of goal-setting interventions, in order to test their effectiveness in improving safety behaviour. The measures included four categories of safety performance: access to heights; site housekeeping (site tidiness); scaffolding; and use of personal protective equipment (PPE). A baseline measure of safety performance was taken and goal-setting meetings held, to determine acceptable goals for improvement. Performance monitoring continued and the levels of performance were posted on feedback charts. Statistically significant improvements in safety performance were achieved. The research in Phase One demonstrated that: safety performance levels on construction sites can be objectively and reliably measured; goal-setting and feedback can be used to produce large improvements in safety performance; and suggested that management commitment is an important factor in the success of the intervention. All the safety measurement, goal-setting and feedback activities in Phase One were undertaken by the research team.

In Phase Two the responsibility for these activities was transferred to construction company personnel, with the objectives of: developing these methods from a research-based technique into a practical and effective management tool; and, evaluating the relationships between management commitment and safety performance. Twenty-six sites, representing thirteen construction contractors, participated in this phase of the study. Contractors implemented the techniques themselves, while the research team monitored progress, investigated any problems, and developed a fuller understanding of the most effective ways of embedding these methods in site organisations. The site safety performance measure also included a fifth performance category, plant operation.

The commitment of site management was measured on five dimensions. Fifteen sites continued the intervention up to completion of the research programme, the other eleven withdrawing for a variety of reasons, including lack of managerial commitment to the research programme.

A statistically significant increase in average safety performance was achieved across all categories for all completed sites. The average safety score improved from 82.5% to 86.5%, representing a proportional decrease in unsafe behaviour (17.5% to 13.5%) of 22.9%, from pre-intervention levels. In the individual categories of safety performance, the maximum reduction in unsafe behaviour was 28% for scaffolding, and the minimum 14% for plant operation. On individual sites, this varied from a reduction in the overall safety performance measure of 2.7%, to an increase, on the most improved site, of 13.8%, representing a 60% reduction in unsafe behaviour. This was almost entirely explained by the variation in management commitment.

The research demonstrated that an approach based on goal-setting and feedback and an effective measure of safety behaviour will, if properly applied by a committed management, improve safety performance.

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EXECUTIVE SUMMARY
Introduction

The Manchester School of Management and Department of Building Engineering, UMIST, have undertaken a five-year programme of research, in two phases, for the Health & Safety Executive. In Phase One the effectiveness of goal-setting and feedback in improving safety behaviour on construction sites was demonstrated. In Phase Two the practical problems of the use of these methods by construction contractors' own personnel have been studied. This report describes the research undertaken in Phase Two.

Background - Phase One

In Phase One of the programme, goal-setting and feedback methods were designed and tested, in various combinations, on six construction sites in the North West of England. Measures of safety performance were developed and used before, during and after the interventions in order to test their effectiveness in improving safety behaviour. The measures included four categories of safety performance: access-to-heights; site housekeeping (site tidiness); scaffolding; and, use of personal protective equipment (PPE).

Safety performance data were collected by an observer, two or three times a week, on each site. After an initial period of data collection the average safety score was calculated, to provide a baseline figure for the safety performance of the site. At this point all site personnel attended a safety goal-setting meeting, at which the safety performance measures were explained, current levels of safety were discussed and targets, or goals, for improvement set. Performance monitoring continued and the current levels of performance and targets were presented graphically, on feedback charts. These were located in prominent positions and updated weekly (Picture 1).
Picture 1: Example of a Graphical Feedback Chart

The intervention process was carried out for three categories of activity: scaffolding, access to heights, and general housekeeping, whilst the fourth category, P.P.E., was monitored as a control. The experimental procedure involved: measuring safety performance for eight weeks to provide a baseline measure; introducing the intervention for eight weeks and measuring the change in performance; terminating the intervention and measuring performance for a further four weeks.

The research in Phase One demonstrated that:
- safety performance levels on construction sites can be objectively and reliably measured, producing data which could be used in many different safety management strategies, such as performance auditing, training design and incentive system design, in addition to goal-setting;
- goal-setting and feedback can be used to produce large improvements in safety performance;
- commitment of site management seems to enhance the effectiveness of the goal-setting and feedback approach.
A more detailed report on this phase of the research is available (HSE Contract Research Report, CRR 51/93), through Her Majesty's Stationery Office.

**Phase Two**

All the safety measurement, goal-setting and feedback activities in Phase One were undertaken by the research team. In Phase Two the responsibility for these activities was transferred to construction company personnel, with the objectives of:

- developing these methods from a research based technique into a practical and effective management tool;
- evaluating the relationships between management commitment, operative commitment and safety performance;
- measuring the cumulative effect of continuous efforts to improve safety through goal-setting and feedback, over extended periods.

Twenty-six sites, representing thirteen major construction contractors, participated in Phase Two of the study. Contractors implemented the techniques themselves, while the research team monitored progress, investigated any problems, and developed a fuller understanding of the most effective ways of embedding these methods in site organisations. The sites varied in size of labour force, from 15 to over 200 operatives, and included new-build, refurbishment and civil engineering projects.

The experiments were carried out and all data collected prior to the introduction of the Construction (Design and Management) Regulations.
Research Methods

The experimental methods used in Phase Two were essentially the same as those described for Phase One. There were, however, two significant differences in their implementation:

- the contractors’ own personnel took the role of site ‘observers’, measuring safety performance, running the goal-setting sessions and updating the feedback charts, after training from the research team;

- the behaviour improvement measures were applied, uninterrupted, until the site construction activity ran down.

On some sites, in addition to goal-setting sessions, the management instituted subsequent goal-review sessions to discuss performance, review and, if necessary, modify goals. Members of the research team visited sites approximately once a month to observe important events, such as goal-setting and goal-review sessions, and to collect data returns.

The site safety performance measure was expanded to include a fifth safety performance category, 'plant operation', in order to accommodate the needs of the civil engineering sites.

Experimental Measures

1. Commitment

The commitment of both observers and site management was measured by researchers, using a variety of pre-determined criteria, over the duration of the project.
2. Effectiveness

Each goal-setting session was observed by a researcher and rated for its organisational effectiveness on five different scales.

3. Awareness

Operative awareness of the intervention was tested by interviewing at least 10% of operatives on each site on five issues related to their knowledge of, and response to, the intervention.

4. Success

All observers and a cross section of operatives were interviewed, at the end of the research, about the perceived success of the intervention, its operational details and possible improvements.

5. Reliability

The reliability of the safety performance measures, taken by the site observers, was regularly checked by the research team.

**Phase Two Results**

**Safety Performance**

Fifteen of the twenty-six sites continued the intervention up to completion of the research programme, the other eleven withdrew, primarily because of a lack of managerial commitment to the research programme.
Figure 1 - Mean Safety Performance Improvement for All Sites

Figure 1 summarises the mean safety performance results for all sites that completed the intervention programme. Analysis of the data demonstrated a statistically significant increase in the average safety performance measure across all categories of behaviour for all completed sites (1% confidence intervals). The average safety score improved from 82.5% to 86.5%, representing a 23% relative decrease in unsafe behaviour, from pre-intervention levels.

The maximum decrease in unsafe behaviour for individual categories of safety performance was 28% for scaffolding, while the minimum was 14% for plant operation. These figures disguise a wide range in performance improvement on individual sites. This varied from a reduction in the safety performance measure, over all categories, of 2.7% to an increase, on the most improved site, of 13.8%. The latter improvement, from a baseline of 77.2%, represents a 60% relative decrease in unsafe behaviour.
Management and Observer Commitment

The role of management commitment to the intervention is vitally important, impacting on all aspects of the methodology. The commitment measures showed a statistically significant, positive correlation with safety performance improvement, accounting for 30% of the variation across sites. This is a large proportion in view of the many other organisational and environmental factors which could have impacted on performance. The commitment measures were also used to classify site management on a scale ranging from 'very high' to 'very low'. All six sites where management commitment to the intervention was classified as 'high' or 'very high' showed a statistically significant increase in safety performance and all seven sites where management commitment to the intervention was 'low' or 'very low' either did not complete, or showed no statistically significant increase in safety performance.

Observer commitment showed a positive, but weaker relationship with safety improvement than management commitment, indicating very little effect, once the effect of management commitment had been discounted.

Operative Awareness

Periodic tests of operative awareness showed that, generally, over 90% were aware of the intervention but that the majority were uncertain of the current targets and performance levels. Although this raises doubts about the mechanics of the impact of the goal-setting intervention, both qualitative and quantitative results confirm that there was a meaningful and significant increase in safe behaviour. It, therefore, seems probable that the improvements in safety performance arose, in part, from an increase in safety consciousness and attention from managers and supervisors. It also appeared that improved communication, regarding specific behaviours that cause accidents, played an important role in the success of the intervention. It is important to note that the impact of the intervention on communication is congruent with the CDM regulations requiring employees be consulted and informed about safety issues during construction.
Other Lessons

The feedback charts should be visually obvious and unavoidable on site. Several charts should be used on large or dispersed sites, to provide continuing reminders that safety performance is being monitored. Effective additions to the quantitative information on the feedback charts have included a description of the items covered by each category of safety measurement and narrative charts to explain any changes in the safety score.

The role of the observer is pivotal. The disposition of the observer requires a conscientious, methodical approach and benefits from a good rapport with the operatives. The observer’s position within the organisation needs to be secure if pressures to attend to other duties, to the detriment of the safety intervention, are to be resisted.

To minimise disruption to work progress, the timing of goal-setting sessions should be directly after, but not during, other work breaks. Asking people to attend during breaks produces an unsympathetic audience and suggests a lack of management commitment.

Management should be present at goal-setting and goal-review sessions, to provide a display of commitment and to deal with any non-safety-related issues that arise. Improved communication between operatives and management is central to success and it is desirable to have someone present with sufficient knowledge, process skills and authority to provide effective support to the observer.

With the inevitable high labour turnover as site activities change, a good safety culture is vitally important and its existence may help to explain why safety scores improved, even though many sites ended the intervention with almost completely different personnel from those present at the beginning.
Conclusion

An approach based on goal-setting and feedback and an effective measure of safety behaviour, can, and if properly applied will, improve safety performance on construction sites. To maximise the impact of this effective safety management technique there are several factors that require careful attention and planning. Above all, management commitment is vital to the success of such interventions.
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MAIN REPORT
1.0 INTRODUCTION

1.1 Background

Like most countries worldwide, the UK construction industry has an unenviable safety record with construction workers approximately three times more likely to suffer serious injury than other workers. On past evidence it is likely that in the UK about 150 people will die in accidents each year and a further 2,500 to 3,000 will be seriously injured. In addition 30,000 to 40,000 will suffer lost time injuries of more than three days (Davies & Tomasin, 1990). As well as the human suffering caused by accidents, the Health & Safety Executive (HSE) calculate that construction site injuries cost the country more than £2 billion, out of a total £16 billion annual accident bill. Although HSE statistics for 1993 and 1994 did show a significant decline in death and injury, virtually all the reduction can be accounted for by the reduction in construction activity due to the recession.

A review of previous research reveals that attempts to improve site safety have had limited success. These attempts have included 'blitz' inspections by the Health and Safety Executive (HSE). During 1987 and 1988 a study of some 2,000 site inspections revealed a worrying picture - with one third of site agents and supervisors found to have inadequate knowledge of basic health and safety requirements. Importantly, during the period of the campaign there was no decrease in the number of deaths or serious injuries (HSE, 1988).

In essence, there are three elements to behaving safely: first, knowledge of how to operate safely, second (if necessary), equipment to operate safely, third, motivation to operate safely. Psychological interventions attempt to improve safety performance by addressing the last element, though findings discussed later in this report illustrate clearly that all three elements are inextricably linked. Psychological or motivational interventions have previously taken several forms.

Typically, posters and informational safety campaigns designed to improve safety through increased safety consciousness have not been consistently effective (eg Wilson, 1989; Saarela et al., 1989).
Incentives have been used successfully to improve safety behaviour (Peters, 1991) but can be expensive. Furthermore, they are apt to be successful only in the short-term as they do not necessarily encourage the internalisation of safe attitudes that lead to long term improvements, regardless of material reward. In addition, they may discourage operatives from reporting accidents and near misses.

The use of disciplinary action has shown limited success probably because punishment is widely held to be less effective than positive reinforcement (Skinner, 1953). This is because punishment tends not to be effective if it is infrequent, delayed, or of mild intensity. Whilst it can be argued strongly that safety and productivity go together, for example a safe and tidy access speeds mobility, it is often perceived by people in industry that corners have to be cut if productivity is to be maximised - leading to conflicting rewards. Summarising the issue of conflicting reinforcement Peters (1991) says “when conditions are such that an unsafe act regularly results in ... immediate positive reinforcement and any potential punishing events are irregular, delayed and generally not very intense, people are apt to get hurt”.

Another problem with punishment is that supervisors are often reluctant to use it because of fear that resentment will lead to lowered morale, lack of co-operation and loss of productivity (Peters, 1991).

Thankfully, in the vast majority of cases an unsafe act does not result in an accident. Heinrich (1959) estimated that there is only one serious injury for every 300 unsafe acts. More recent research (HSE, 1993(b)) suggests that there are 441 accidents resulting in non-serious injuries for every serious accident but that these non-serious injuries are grossly under-reported, typically by as much as 50%. These factors suggest that, though statistics such as accident incidence rates may be a satisfactory way of monitoring safety over long periods, at national or company level, such data does not provide a valid measure of site safety performance. It is because serious accidents are relatively rare, and non-serious accidents are under-reported, that it makes sense that efforts to monitor and improve safety at site level be focused on the behaviour that causes them.
1.2 Behavioural Approaches

Previous research (Shimmin et al., 1981) has shown that in a sample of accident victims two-thirds considered their accidents to be avoidable and caused by inappropriate behaviour or equipment usage. This suggests that, in the view of the workers themselves, something could be done to reduce accidents. Heinrich (1959) estimated that some 88% of accidents could be attributed to avoidable unsafe acts. One method of accident reduction could involve the use of new management systems to try to directly influence the specific behaviours involved in causing accidents. This has been the approach at the core of this research, in which the system used is measurement of safety behaviour, goal-setting and performance feedback.

Goal-Setting

The literature on goal-setting, as a procedure for managing behaviour is substantial. Wood, Mento and Locke (1987), for example, reviewed nearly 200 empirical studies. Goal-setting theory hypothesises that goals are the immediate, though not sole, regulators of human action and that performance will improve when goals are hard, specific and accepted by the subject. Goal-setting is believed to affect performance by directing the attention and actions of the individual or group, mobilising effort, and increasing motivation. In general, the literature on goal-setting supports these propositions and provides clear guidance on how to implement the theory to good effect (Locke and Latham, 1990).

Feedback

The research literature on the role of feedback in determining performance effectiveness is clear in indicating the positive effect of knowledge of the results of one's behaviour. Reviews of the research on feedback, for example Algera (1990), demonstrate that performance is enhanced when management provide clear feedback of performance related information.
**Goal-Setting, Feedback and Safety**

These techniques for modifying behaviour have already been shown to be of value in safety. McAfee and Winn (1989), for example, showed that safety behaviour can be improved by systematically monitoring safety-related behaviour and providing feedback in conjunction with goal-setting and/or training. Chhokar and Wallin, (1984) demonstrated how safety performance with feedback and goal-setting was better than that with only goal-setting in a study of US metal fabrication workers. Reber and Wallin (1984) found similar results in a study of machine manufacturers. Encouraging results have also been achieved in construction-related industries in other countries. (e.g. Mattila and Hyodynmaa, 1988). No previous attempt, however, had been made to apply the techniques in the U.K. construction industry.
1.3 UMIST HSE Funded Research - Phase One.

In Phase One of this research, fully reported in Duff et al. (1993), six construction sites in the North West of England were used as locations for an experiment in the application of goal-setting and performance feedback methods. On the six sites the following combinations of intervention were evaluated: training, goal-setting and feedback; goal-setting and feedback; and training and feedback. Safety performance was measured, prior to the introduction of the interventions, and measurement continued throughout the interventions, to evaluate their effect on safety. A detailed summary of the research methods and the findings from Phase One follows, to set the background and context for the description of Phase Two, which forms the majority of this report.

The Safety Performance Measure

In order to test the effectiveness of the goal-setting and feedback techniques, an accurate and reliable measure of safety performance was developed which could be used before, during and after their application. This was achieved by identifying contributory behaviours in the chain of events that cause accidents.

In order to produce a comprehensive list of unsafe items, a detailed literature review of construction journals, HSE publications, construction safety manuals and accident records, was undertaken. Ninety-nine items were selected and incorporated into a questionnaire, which formed the basis for a survey of construction personnel (n = 194), to determine the perceived importance, or risk level, of each item in accident causation. Respondents rated each item on three scales: frequency of occurrence, likelihood of a resulting accident and probable severity of such an accident, and these dimensions were combined to determine the relative importance of each item.

Twenty-four of the most important items were selected and incorporated into a safety audit measure, to evaluate the safety performance of construction sites in the experiments. Items were classified to form four measurement categories of safety: Scaffolding; Access to Heights; Housekeeping; and Personal Protective Equipment.
Percentage Rating

Previous research involving measures of safety performance has normally utilized an 'all or nothing' (A.O.N.) measure of safe performance, i.e. either 100% safe or 100% unsafe (Komaki et al., 1978). It is argued, however, that a 'Proportional Rating Scale' (P.R.S.) is better suited to cope with the construction industry environment. For example, a scaffold with only 75% of the required toe-boards correctly fixed would be assessed as 25% unsafe on that particular measurement item, rather than just 'unsafe' - thus permitting changes in safety performance to be measured with increased sensitivity. Further details of the advantages of this proportional scale, rather than an A.O.N. scale are given in Cooper et al., (1993). It is the far greater sensitivity of this measure over A.O.N. measures that most distinguished this intervention from those of Komaki (1978); Mattila and Hyodynmaa (1988) and others that precede it.

An eleven point rating scale was employed for each individual item, with a 'Not Seen' option used to record occasions when there was no evidence of the item, in either safe or unsafe condition. For example, if none of the operatives were engaged in activities requiring the particular form of protective equipment being observed, then the item is recorded as 'Not seen'. The scale was anchored using verbal expressions of amount which have been validated by previous research (Bass et al, 1974). Scores for each category are calculated by combining scores for the individual items observed.

Goal-setting

Goal-setting meetings were undertaken that included an explanation of who the researchers were, how the safety performance levels were determined, the current levels of safety performance of each intervention category, and how and when performance feedback would be given. These meetings were attended by all the operatives on each site.
Performance Feedback Charts

Charts showing, graphically, the results of the safety measures were mounted in locations visible to all site personnel; for example, on the wall of the operatives canteen or on a fence at the site entrance. A typical example can be seen below (Illustration 1).

![Safety Performance Levels Chart]

**Picture 1: A typical feedback chart**

Safety performance, as a percentage, is plotted against time. Coloured tapes were used to represent safety performance levels for each category of performance. Additional coloured tapes, marked 'Target Level', were used to indicate the goal to be reached.
Collective Responsibility

There was no attempt to either blame or reward individuals for their performance. The approach was to consider the site and its personnel (operatives and management) as a unit, and to give the feedback to all personnel. The philosophy was that it is the responsibility of everyone to ensure safe working practices and conditions.

Research Design

An initial period of up to twelve weeks of data collection was undertaken to dissipate any Hawthorne effects caused by the presence of observers on site. After this, the procedure involved collecting eight weeks of baseline data prior to introducing eight-week interventions for three experimental categories: Scaffolding; Access-to-Heights; and Housekeeping; while Personal Protective Equipment was monitored as a control. Feedback was then withdrawn for four weeks, to test for any relapse in safety performance. The intervention and withdrawal cycle was then repeated.

Observations

A 'double blind' methodology was used with independent observers employed to conduct the safety audits. The observers, who had no knowledge of the specific research objectives or experimental design, were trained for a period of four weeks in the use of the safety performance measure. Observations on each site were taken three times a week at differing times of the day and days of the week, to overcome any systematic time of day or week effects and to avoid any the effect of operative or management anticipation of the visits.

Observation sessions took approximately 45 minutes on each site. Each observer was allocated to specific sites throughout the duration of the research. Inter-observer reliability was monitored regularly by random checks of observations by a researcher, who would complete an independent measure for the same site at the same time.
Using the percentage agreement method developed by Komaki et al. (1978) these checks showed 92% agreement between observers and researchers.  

**Table 1 - Phase One Experiments**

<table>
<thead>
<tr>
<th></th>
<th>Site</th>
<th>Feedback</th>
<th>Training</th>
<th>Goal-setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plastic processing factory (new)</td>
<td>✔️</td>
<td>✗</td>
<td>✔️ (participative)</td>
</tr>
<tr>
<td>2</td>
<td>Extra hospital wards (new)</td>
<td>✔️</td>
<td>✗</td>
<td>✔️ (assigned)</td>
</tr>
<tr>
<td>3</td>
<td>Large office &amp; retail complex (new)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️ (assigned)</td>
</tr>
<tr>
<td>4</td>
<td>City centre apartments (new &amp; refurbished)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️ (participative)</td>
</tr>
<tr>
<td>5</td>
<td>Offices in city centre (new)</td>
<td>✔️</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>6</td>
<td>Bank premises in city centre (new)</td>
<td>✔️</td>
<td>✔️</td>
<td>✗</td>
</tr>
</tbody>
</table>

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1 The method of calculating IRR scores was changed during Phase II to include level of agreement/disagreement for each item - thus allowing more sensitivity of calculation. Using this method IRR scores for phase I are increased to 98%.
Figure 1 - Results of Phase One

Aggregate of Scores for All Sites – Baseline v. First Intervention

<table>
<thead>
<tr>
<th>Experimental Categories</th>
<th>% Safety Performance</th>
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<tbody>
<tr>
<td>Housekeeping</td>
<td>74.37</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>78.89</td>
</tr>
<tr>
<td>Access-to-heights</td>
<td>82.90</td>
</tr>
<tr>
<td>1st Intervention (8 weeks)</td>
<td>81.70</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Control Category</th>
<th>% Safety Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.P.E.</td>
<td>61.31 60.95</td>
</tr>
</tbody>
</table>
Conclusions of Phase One

The research conducted in this First Phase showed that:

- safety behaviour can be objectively and reliably measured without excessive use of managerial or supervisory resource, producing performance data which can be used in many different safety management strategies;

- goal-setting and feedback can be used to produce significant improvements in safety performance, over periods of several weeks;

- commitment of site management, demonstrated by interest in the research outcomes and attendance at goal-setting meetings, appeared to enhance the effectiveness of the goal-setting and feedback approach.

It is clear that the methods of safety improvement used during this research had significant impact. These results therefore add to the findings of Mattila and Hyodynmaa (1988) and others in suggesting that the use of goal-setting and feedback techniques can significantly improve safety behaviour on construction sites, and demonstrate that these techniques can successfully be applied in the context of U.K. site organisation and culture. They contrast with the minimal effects that previous research has recorded for other interventions such as information safety campaigns and safety training (Hale, 1984).
1.4 UMIST HSE Funded Research - Phase Two

At the start of 1993 a further two-year study was commissioned by the Health & Safety Executive to enable UMIST to continue research in this area. The objectives of this Second Phase of the research were:

1. To evaluate the effect of management commitment on the success of goal-setting and feedback interventions to improve safety behaviour on construction sites.

2. To investigate the effects of, and problems associated with, the application of these techniques by company personnel.

3. To measure the effect of applying the techniques over longer periods of site activity, in order to assess the durability of the techniques.

All the experimental work and data collection was completed prior to the implementation of the construction (Design and Management) Regulations.

Management Commitment

Although no attempt was made to evaluate the effect of management commitment as an integral part of Phase One of the research, it became apparent that this was probably having an impact upon some of the results. The two sites that showed the largest improvement in overall safety performance were those where management attended all the meetings with operatives at the commencement of the intervention. These findings were also broadly in line with an overview of a variety of managerial interventions by Rodgers et al (1993) who found that “studies have consistently reported that commitment from top management is essential” for any intervention to succeed.
Application by Company Personnel

If the goal-setting and feedback intervention is to be adopted by the construction industry, it will need to be implemented by company personnel themselves. It was felt likely that this might lead to a polarisation of performance. In 'good' companies where management commitment is strong and support and encouragement are given to able observers, the intervention should be even more successful than when facilitated by outsiders, as was the case in Phase One of the research. However, in companies where management and/or observer commitment is low or in instances where observers are given little support, it might be expected that the intervention would be relatively less successful than in Phase I.

Structure of Commitment

As commitment of the site management team, including the personnel implementing the techniques (to be called the 'observers'), is an important element of the research, it is useful to review what is already known from the literature about the structure and effects of commitment in an organisational context. A summary of the relevant research literature may be found in Appendix B.
2.0 METHODOLOGY

2.1 Summary of Sites

Twenty-six sites were involved in the research. These sites, incorporating both building and civil engineering work, varied in size from 15 to 300 operatives and covered an area of the UK from Liverpool to York and from Blackburn to Aldershot.

In summary, the sites comprised: a large leisure complex; three hospitals; three law courts; three office developments; four football stadium stands; a viaduct with twenty miles of roadworks and ancillary works; a river diversion; a retail store refurbishment; a university complex; two schools, one refurbishment, one new-build; a bus station refurbishment; an army barracks; a public housing refurbishment; a sewage sludge incinerator; a building demolition and bridge construction; and a small length of new road.

Details of one the sites and the data collected can be found in the sample case study in Appendix A.

2.2 Research Design

The longitudinal research design used in Phase Two was similar to that described, in Section 1.3, for Phase One. The differences were as follows:

1. The measures were taken, the goal-setting sessions organised and run, and the charts updated by contractors' own personnel, after training from the research team.

2. No control category of the safety performance measure was used, as the major objective was not to test whether the intervention would work, but rather to identify and evaluate the conditions under which it worked best.
3. No withdrawal period was used, as experience of application of the intervention over longer periods than in Phase One was being sought.

4. Operative awareness of the intervention was measured to try to identify the real cause and effect relationship in the intervention.

Establishing a baseline involved six to twelve safety performance observations over a period of four to eight weeks, depending on the size of the site. The goal-setting and feedback intervention was then introduced, and safety performance data collection continued until the end of the research programme experimental period, or until the site activity was running down. The effect of the intervention was measured by comparing the mean performance over the whole of this post-intervention period with the mean performance during the baseline period.

Training

Originally, observers were given a two-day programme of training at UMIST. However, the majority of observers found it difficult to be away from their other site duties for this length of time. To resolve this problem, the following training was developed.

Observers were given a half-day of training in the theory of goal-setting and feedback in a classroom setting. During this formal input observers were also introduced to the safety measurement methods, and given practice at scoring example measurement sheets. A further half-day of training in the use of the measure was given on each observer's own site, and a follow-up half-day of supervision on site a week later, to check that the method of measurement was being properly applied. Other training was given as required - but at least one visit was made prior to goal-setting to review the theory and practice of managing operative participation in such an event.

Additional Training

During the research UMIST personnel visited sites several times during baseline data collection, each visit typically containing an element of training reinforcement,
concerning either clarification of the definition of safe and unsafe behaviour or the use or scoring of the safety performance measure. This 'informal' training continued to a lesser extent during the post goal-setting phase. For example, an analysis of possible reasons for variations in scores after an inter-rater reliability check was sometimes necessary.

2.3 Data Collected

Both quantitative and qualitative data were collected. Quantitative data covered safety performance measurement, management and observer commitment, operative awareness of the intervention, and quality of goal-setting and review sessions. Qualitative data was collected from structured interviews with individual observers and semi-structured interviews with groups of operatives.

2.3.1 Safety Performance Data.

Researchers visited sites at regular intervals to collect safety scores for the measured categories: Scaffolding; Access-to-Heights; Housekeeping; and Personal Protective Equipment (PPE). In addition, on some civil engineering sites, an additional measurement category, Plant, was employed.

Apart from the introduction of the Plant measure, the only change to the measure from Phase One of the research was to the scoring of the housekeeping measure. Several observers pointed out that some infrequently observed items could have a disproportionately large impact on the final score. One observer recalled that he had been reluctant to record the incidence of a piece of timber with a protruding nail, towards the end of a measure, because it was only the second such piece of timber he had seen during the observation; and this would have changed the final score for that item from 100% safe to 50% safe. This would have overly influenced the aggregate score for that category, when compared with over 50 observations of 'openings' and 'walkways' which then collectively had the same weighting in the final score.

After consultation with other observers the scoring of the housekeeping measure was changed so that item scores were aggregated before determination of the proportional,
or percentage score. Calculating the score this way meant that no one item would have unrepresentative influence and that the scales would be automatically weighted to reflect the items most prevalent on the particular site.

For a full definition of the measures, see Appendix E.

For a full description of the development of the measures, see Duff et.al. (1993).

2.3.2 Inter-Observer Reliability

Researchers performed Inter-Observer Reliability (IRR) checks at monthly or fortnightly intervals with most observers. The frequency of IOR checks reflected the duration of the site, with sites of short duration receiving more frequent checks. During these IOR checks the observer and researcher would score the site simultaneously, without consultation. After the scores were calculated they would be compared and any discrepancies in scores analysed.

2.3.3 Observer and Management Commitment

Both observer and management commitment were rated by researchers over the duration of the project in several distinct areas. A file was kept on each site and updated after any telephone call or correspondence with the observer, after site visits and, ultimately, to include final de-briefing interviews of the observers.

Observer Commitment

Observers were scored on a 1 to 5 scale for the following four dimensions:

1. **Keeping promises.** Observers were assessed on the extent to which they prepared documents or faxes as promised, held meetings as promised and adhered to the agreed methodology. Incidents noted might be a failure to take at least one measure a week, a failure to vary the day and time of the measure or a failure to carry out timely updating of the feedback chart(s).
2. Returning calls promptly. On many occasions during the study it was necessary to telephone the observer. It is the nature of construction that the majority of times the observer would not be at his/her desk or would be in a meeting. On each occasion the speed with which calls were returned was noted.

3. Pro-active and enthusiastic behaviour during site visits. After each site visit observers were rated on this dimension. Attitude was not rated in the affective sense but rather the following behaviours were observed: being ready for the researcher at the appointed time; clearing a reasonable amount of time to spend with the researcher; frequency of pro-active interaction, such as suggesting changes to the intervention, for reasons other than reducing the observer's workload.

4. Enthusiastic response to solving practical problems. These problems might include an obstructive or unhelpful management team, illness or transfer of a co-observer, inclement weather - and on one memorable occasion the (accidental) destruction by fire of the building containing the feedback chart and other safety intervention materials. Observers were scored on a one to five scale for each 'problem' and a mean calculated.

Reliability Each researcher collected data on particular sites and made the initial evaluation of observer commitment. To assess the reliability of these measures researchers exchanged narrative data for their sites so that they could be re-evaluated by an independent person, with no knowledge of the original evaluation. Using the percentage agreement method, Inter-researcher reliability of 90% was recorded.
Management Commitment

Management commitment was rated on five dimensions, all initially on a 1 to 5 scale, though the last dimension was later given a higher weighting to account for its origin. The five dimensions were:

1. **Attitude towards the placement of feedback charts.** To assess whether managers were helpful or obstructive about the placement of the chart(s). Managers who insisted that charts be placed 'out of the way' or seemed reluctant to have them put up at all were rated low; those indifferent to the placement of the charts were rated average; and managers keen to be constructively involved in the selection of sites to place charts were rated highly.

2. **Attitude towards workers stopping work to attend goal-setting sessions.** Managers varied greatly in their attitude to stopping work. Those who were reluctant to let workers stop in working time, as opposed to break times, were given low ratings. Managers who were quite prepared to let workers stop during work time for 'as long as is needed' were rated highly.

3. **Attending the goal-setting session and acting supportively.** At the goal setting and subsequent review sessions researchers noted whether or not managers attended, and how supportive they were to the observer who was running the meeting. Non-attendance scored badly and proactive and constructive support scored high.

4. **Attitude towards observer taking time off to perform the measure.** This variable assessed the attitude of managers towards the time needed by observers to take the measures. Managers who actively discouraged observers were scored badly as were managers who made no attempt to stop other line managers from exercising their authority and making it difficult for observers to take measures when needed.
Management who intervened to ensure observers had enough time to take measures when required were scored high.

5. **An overall rating based on the observer de-briefing interview.** At the final de-briefing session each observer, or team of observers, was asked to rate the management support over the duration of the intervention. The importance of recording support in terms of behaviour rather than affect was stressed. This score was given a higher weighting, multiplied by a factor of three, than the other four dimensions, as the rating depended continuous observation by the observer(s) over the whole period of the intervention.

**Reliability.** As in the case of observer commitment, researchers collected data on their allocated sites and made the initial evaluation of observer commitment. To assess the reliability of these, researchers exchanged data so that they could be re-evaluated by an independent person. Using the percentage agreement method, inter-researcher reliability of 88% was recorded.

### 2.3.4 Goal-Setting

Each goal-setting session was attended by a researcher, to evaluate the quality of the organisation and management of the event, and rated, between zero and four, on the following dimensions:

1. **The percentage of management attending and how supportive they were.** In order to score, attendance by at least 50% of the management team was required. Beyond that, the score depended upon whether they acted in a keen, supportive and interested manner, or stood at the back conveying disinterest?

2. **The percentage of the operatives attending.** At least 90% of the operatives needed to be in attendance to score maximum marks. Marks were reduced proportionally, with 25% or less scoring zero.
3. How participative the session was. Was the observer able to instigate a debate? Was the observer apparently able to convey to the operatives that the intervention required them to be proactive in their communications and take ownership of the intervention?

4. The quality of the venue, in terms of visibility and audibility of the observer. Could all the operatives see what was occurring? Could all of the operatives hear what was being said? Both items in this dimension were scored on anchored one to five scales and a mean score calculated.

5. The performance of the observer in covering all the main points of the safety measures, intervention methods and simple philosophical background. For example: measure content; mean, highest and lowest scores during the baseline period; the methodology that would be adopted; where feedback charts would be placed. Each item in this dimension was scored on an anchored one to five scale and a mean score calculated.

The scores for the five dimensions were weighted in the aggregate score, the first three by a factor of 8, and the last two by a factor of 5. This weighting was agreed, by discussion among the research team, to represent the relative importance of the dimensions.

A copy of the goal-setting rating sheet, showing the scale structure and anchor points, can be found in Appendix D.

2.3.5 Operative Awareness of Intervention

In order to test the hypotheses that operatives would be motivated to improve their safety behaviour, in response to the feedback chart, a measure of operatives' awareness was developed.
The questions asked, and the type of data recorded, were as follows:

1. Do you know about the safety improvement campaign?
   (Yes/No)

2. Do you know where the feedback chart(s) is/are?
   (Yes/No[tested for accuracy])

3. What are the goal levels, and current performance for each category?
   (Yes/No[accurate knowledge])

4. How often are the feedback charts updated?
   (Yes/No[weekly - correct])

5. How often do you discuss the weekly performance levels with other workers?
   (Yes/No[weekly, or not])

6. How accurate do you think are the weekly scores put on the chart?
   (Very or reasonably accurate/Not accurate)

7. Are you making a greater effort to act safely because of the intervention?
   (Yes/No)

8. Do you think others are making a greater effort to act safely because of the intervention?
   (Yes/No)

A copy of the Operative Awareness Measure can be found in Appendix G.

The measure was administered by researchers, using an opportunity sample of no less than 20% of the personnel, on each of thirteen sites in the research programme. Although no formal sample distribution was made researchers were careful to stratify the sample on each site to reflect proportions of trade and direct/sub-contract operatives.

2.3.6 Qualitative Data

Additional qualitative information was collected in three ways. First, observers were asked to keep 'project diaries' where observations and information about any events
relevant to the safety intervention could be recorded. Second, researchers kept more extensive diaries of their own where events, comments and conversations were recorded after each site visit or contact with an observer. Comments made by operatives were recorded in these, as were comments by observers or management, additional to those already being covered by the commitment measures. Third, both observers and operatives were interviewed at the end of the project.

Observers

Observers were given structured interviews in which the following issues were addressed:

1. Initial impressions of the intervention. Was it fully understood? Did they think it would work?

2. Was the training sufficient?

3. How and why were they selected, or did they volunteer?

4. How difficult had it been to perform the intervention duties, if they did not perform them well, why not?

5. What was the company's attitude to safety, and the safety versus productivity trade off in general?

6. Had the intervention worked, and why? What would improve the implementation of the intervention?

7. What might be needed if the intervention were to be introduced by the company with no research team help?
Operatives

On seven sites samples of four operatives were interviewed regarding their views of the intervention. Participants were selected by management in response to the request that they should represent operatives holding either a 'positive' or a 'negative' opinion of the research. As there was the potential for selection of operatives by management acting as a source of bias, these results should be considered tentative.

The semi-structured discussion focused on the following five areas:

- Operative awareness of the intervention;
- Operative knowledge of how the intervention worked;
- Attention paid to the feedback charts and goal-setting sessions by operatives;
- The influence of the intervention on the workforce and management;
- Any suggested improvements to the intervention.
3.0 RESULTS AND ANALYSES

3.1 General

The detailed results for each site may be found in the case studies in Appendix A.

Of the twenty-six sites involved in the research: fifteen completed the full research programme; three failed to produce any baseline measures, after the training; four failed to produce measures after the goal-setting; and another four failed to complete the programme for a variety of other reasons.

Inter-Observer Reliability (IOR)

Inter-observer reliability scores for the safety performance measures of 96.1%, or above, was accepted as reliable without further investigation. This IOR score is one standard deviation below the level of inter-observer reliability obtained during Phase One of the research, in which data were collected by independent observers from the research team, thus representing a level of reliability which should be achievable by a conscientious, unbiased observer. Below this figure the data were inspected for evidence of systematic bias, between the observer’s scoring and that of the researcher.

Of the twenty-four sites assessed only five failed to reach this level. Of these five, the worst showed an IOR score of 92.1%. Four showed apparently random variation and were accepted to be valid. Only one site showed evidence of systematic bias. On this site, the researcher was consistently more lenient than the observers.

These results suggest that virtually all observers provided by the construction firms involved in the study were able to use the measure sufficiently well after the training provided.
3.2 Analytical Methods

3.2.1 Safety Improvement Analysis

In order to evaluate the effectiveness of the interventions, mean safety performance scores from the baseline period immediately preceding the intervention (mean pre-intervention score), were compared with mean scores from the post-intervention period (mean post-intervention score). The mean pre-intervention score contained between six and twelve measures of safety, collected over periods of between four and eight weeks, depending upon the size of the site and expected duration of the construction work. The mean post-intervention score contained between ten and fifty measures, generally collected weekly, the number of measures again depending upon the site duration.

Two statistical tests were used:

1. The (Student's) 't-test' (one-tailed as a clear hypothesis existed about the direction of change) was used to investigate whether there had been a statistically significant improvement in safety during the goal-setting and feedback intervention; that is between the mean pre-intervention (baseline) performance and mean post-intervention performance. The tests were made at both 1% (p<.01) and 5% (p<.05) confidence levels to protect against Type I errors.

2. In order to measure the actual size of the improvement, performance scores were used to calculate the effect size indicator, 'd'.

\[ d = \frac{\text{Mean pre score} - \text{Mean post score}}{\text{Pooled standard deviation}} \]

For a full explanation of the 'd' measure see Appendix F.

In order that they could be included in correlation and regression analyses (reported later in this report), sites that were abandoned were assigned 'd' scores slightly smaller than the lowest 'd' score obtained by any completed site, for each particular measure. All abandoned sites, therefore, were given the same very low 'd' score.
3.3 Descriptive and Bi-Variate Statistical Analyses

3.3.1 Overall Safety Improvement

Figure Two – Aggregate of Scores Across All Sites (Phase 2)

Figure Two shows aggregated scores for all categories for all sites that were not abandoned.

Analysis of the data demonstrated a statistically significant increase in the average safety performance measure across all categories of behaviour for all completed sites, assessed at 0.01 confidence intervals. Given that the average aggregated pre-intervention baseline value was calculated to be 82.5%, in terms of measured safe behaviour, there can be seen to be a 17.5% scope for improvement in terms of the measure. Alternatively, this could be seen as a measure of the extent of unsafe behaviour. Consequently, the degree of improvement in safe behaviour from 82.5% to 86.5% could also be seen as a 4% reduction in unsafe behaviour. Thus a percentage relative change (%RC) can be calculated from the proportion of 4 parts in
17.5, which suggests a reduction in unsafe behaviour of 22.9 %RC. It is logical to 
anticipate that such a reduction in unsafe behaviour, if achieved consistently, would 
result in a related reduction in the frequency of accidents associated with the same 
categories of behaviour. The fact that the reduction of 23% is an average, achieved 
over 15 widely varying sites, of differing durations and forms of contract, suggests 
that a comparable improvement could be achieved in the industry as a whole by the 
wider application of these techniques.

3.3.2 Individual Categories

Housekeeping

Housekeeping showed a statistically significant increase (p<.01) across all sites. An 
average safety performance baseline of 81.1% increased to post-intervention safety 
performance level of 84.9%. This represents a reduction in unsafe behaviour of 20 
%RC.

Scaffolding

Scaffolding showed a statistically significant increase (p<.01) across all sites. An 
average safety performance baseline of 84.1% increased to a post-intervention safety 
performance level of 88.6%. This represents a reduction of 28 %RC.

Access to Heights

Access to Heights showed a statistically significant increase (p<.05) across all sites 
(although not at p<.01). An average safety performance baseline of 85.0% increased 
to a post-intervention safety performance level of 88.4%. This represents a reduction 
in unsafe behaviour of 23 %RC.
Personal Protective Equipment

Personal Protective Equipment showed a statistically significant increase (p<.05) across all sites. An average safety performance baseline of 79.1% increased to a post-intervention safety performance level of 84.0%. This represents a reduction in unsafe behaviour of 23 %RC.

Plant

Plant showed an increase, but not a statistically significant one, across all sites. An average safety performance baseline of 86.6% increased to a post-intervention safety performance level of 88.5%. This represents a reduction in unsafe behaviour of 17 %RC.

Conclusion

Improvements in safety behaviour occurred in all categories and were statistically significant, at the p>.05 confidence level, or better, for four of the five categories. It appears that the improvement in safe behaviour was general and not confined to one or two areas of behaviour or site operation.

3.4 Observer and Management Commitment Effects

To assist in the descriptive interpretation of the effects of Observer and Management Commitment the commitment score, for each site, was graded as 'very high', 'high', 'average', 'low' and 'very low', based upon the distance of the score, measured in standard deviations, from the mean of all the commitment scores. 'Average' covered the range of half a standard deviation either side of the mean; 'high' and 'low' covered the ranges from half a standard deviation to one standard deviation, either side of the mean; 'very high' and 'very low' represented more than one standard deviation either side of the mean.
In order to evaluate the moderating effect of the variables, management commitment, observer commitment, and quality of goal-setting, on the effectiveness of the intervention, the Pearson product-moment correlation coefficient (r) was used to evaluate the correlations between each variable and safety improvement, represented by the value of 'd'. Correlations were similarly carried out between some of these moderating variables.

For all correlations one tail tests were used, given that clear hypotheses existed about the direction of the relationship between the variables involved. The critical correlation values of 'r' were 0.34 (p<.05) and 0.47 (p<.01) respectively; for n = 24, one tailed.

**Management Commitment**

<table>
<thead>
<tr>
<th>Management commitment and safety performance 'd' correlation</th>
<th>r = .55(p&lt;.01)</th>
</tr>
</thead>
</table>

This correlation is statistically significant at the 1% (p<.01, 2-tail) level of probability. All six sites where management commitment to the intervention was high or very high showed a statistically significant increase in safety performance. All eight sites where management commitment to the intervention was low or very low showed no statistically significant increase in safety performance. Of the ten sites where management commitment was 'average', six showed a statistically significant increase and four did not.

Management commitment was correlated with three of the four individual categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>r</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping</td>
<td>.48</td>
<td>(p&lt;.01)</td>
</tr>
<tr>
<td>Access-to-heights</td>
<td>.42</td>
<td>(p&lt;.05)</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>.53</td>
<td>(p&lt;.01)</td>
</tr>
<tr>
<td>Personal Protective Equipment</td>
<td>.33</td>
<td>(NS)</td>
</tr>
</tbody>
</table>
Observer Commitment

<table>
<thead>
<tr>
<th>Observer commitment and safety performance ‘d’ correlation</th>
<th>$r = .17$ (NS)</th>
</tr>
</thead>
</table>

Observer commitment showed a less clear-cut relationship with safety improvement than did management commitment. Whilst there was a positive correlation, it was not statistically significant. All three observers rated 'very highly' committed had sites which showed statistically significant improvement. However, only two out of five who were 'highly' committed and only 5 of 10 who were 'averagely' committed showed a statistically significant improvement. Of the six sites where observers were rated low or 'very low' in commitment 4 were unsuccessful but two were successful. Observer commitment does not correlate significantly with any of the individual categories.

<table>
<thead>
<tr>
<th>Housekeeping</th>
<th>$r = .18$ (NS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access-to-Heights</td>
<td>$r = .03$ (NS)</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>$r = .19$ (NS)</td>
</tr>
<tr>
<td>Personal Protective Equipment</td>
<td>$r = .02$ (NS)</td>
</tr>
</tbody>
</table>

Therefore, whilst there may be a relationship between observer commitment and 'safety performance' it was noticeably weaker than between management commitment and safety improvement.
Relationship between Management and Observer Commitment

<table>
<thead>
<tr>
<th>Observer and management commitment correlation</th>
<th>r = .59 (p&lt;.01)</th>
</tr>
</thead>
</table>

There is a statistically significant relationship between observer and management commitment at the p<.01 level. That is, on sites where management commitment is high, observer commitment is also likely to be high.

Goal-Setting Performance

<table>
<thead>
<tr>
<th>Goal-setting and performance ‘d’ correlation</th>
<th>r = .39 (p&lt;.05)</th>
</tr>
</thead>
</table>

Goal-setting quality was correlated statistically significantly, at the p<.05 level, with performance. This correlation showed that the more successful sites are those where managers attended the session and were supportive, where many operatives attended, where the discussion was participative, where the venue was adequate and where the methodology was covered thoroughly.

<table>
<thead>
<tr>
<th>Goal-setting and observer commitment correlation</th>
<th>r = .35 (p&lt;.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal-setting and management commitment correlation</td>
<td>r = .50 (p&lt;.01)</td>
</tr>
</tbody>
</table>
Goal-setting quality was more strongly correlated with management commitment than with observer commitment; though both correlations were statistically significant, observer commitment at p<.05, and management commitment at p<.01.

It is important to note that goal-setting scores were adjusted to remove the element that records management attendance at the goal-setting session. This element was included in the management commitment rating.
3.5 Operative Awareness.

Operative awareness was evaluated on seven dimensions, and expressed as a percentage of the number questioned who:

1. were aware of the intervention;
2. could identify the position of a feedback chart;
3. could accurately recall current safety performance and goals;
4. were aware that the feedback charts were updated weekly;
5. discussed the safety performance scores (at least) weekly;
6. said that others made an increased effort to act safely;
7. said that they have made an increased effort to act safely.

Scores for operative awareness, on each of these dimensions, are given below, with changes in site safety indicated as follows:

<table>
<thead>
<tr>
<th>Site</th>
<th>Question</th>
<th>Safety performance change</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>83</td>
</tr>
<tr>
<td>C</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>E</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>G</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>H</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>S</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>T</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>U</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>X</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Z</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Key: ** = t-test positive (p<.01); * = t-test positive (p<.05); NS = increase (non-significant); -ve = decrease (non-significant)
As the awareness questionnaires could only be distributed after the goal-setting session had taken place and feedback had begun, it follows that there will be a higher proportion of successful sites among this sample than overall.

Site Z was a small site where an informal review session was held weekly by the site manager. Site T was the only site to incorporate an incentive scheme.

Scores illustrate that awareness of the intervention was widespread but detailed knowledge was poor and operatives' perception of the influence of the intervention was variable.

Statistical analysis was considered inappropriate for such a small sample (n = 11). Notwithstanding the lack of statistical power, the researchers extracted some useful information. No obvious trends were discernable. However, of the three 'unsuccessful' sites none showed low awareness of the existence of the intervention or low knowledge of the mechanics of the intervention. In addition, only two of the three showed low scores for perceived increased effort, of self and others, to be safe.
3.6 Multivariate Analysis

Multiple regression analysis was used to identify features of the intervention that were linked with success.

3.6.1 Dependent Variable - Safety Performance Improvement

In the first analysis the dependent variable was safety improvement, 'd'. Multiple regression analysis was used to examine the extent to which safety improvement scores were associated with the commitment of managers, the commitment of operatives and the quality of the goal setting session.

Management commitment, observer commitment and quality of goal-setting were labelled as independent variables and performance as the dependent variable. Stepwise procedures were used. In the stepwise approach the independent variable with the strongest statistical relationship with the dependent variable is entered first. Further variables are entered into the equation only if they explain a statistically significant (p<.05) amount of additional variance.

Variables identified in the equation:

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>sig</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>commitment</td>
<td>3.5</td>
<td>.006</td>
<td>.31</td>
</tr>
</tbody>
</table>

Variables not identified in the equation:

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer commitment</td>
<td>1.10</td>
<td>.285</td>
</tr>
<tr>
<td>Quality of goal-setting</td>
<td>0.22</td>
<td>.832</td>
</tr>
</tbody>
</table>
Once management commitment was accounted for, neither observer commitment nor goal-setting explained a statistically significant amount of the variance in performance.

Results were almost identical when each of the individual categories of safety measurement were entered in the analysis as dependent variables. Management commitment was identified in all of the equations:

<table>
<thead>
<tr>
<th>Category</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping</td>
<td>.23</td>
</tr>
<tr>
<td>Access-to-Heights</td>
<td>.23</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>.27</td>
</tr>
<tr>
<td>Personal Protective Equipment</td>
<td>.18</td>
</tr>
</tbody>
</table>

Neither observer commitment nor goal-setting were identified in any of these equations.

3.6.2 Dependent Variable – Quality of Goal-Setting

In the analysis described below the dependent variable was goal-setting quality. Multiple regression analysis was used to examine the extent to which goal-setting quality scores were associated with the commitment of managers and the commitment of observers. Entering management commitment and observer commitment as independent variables and quality of goal-setting (corrected) as the dependent variable gave the following results.

Variables identified in the equation:

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>sig</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management commitment</td>
<td>2.65</td>
<td>0.15</td>
<td>.25</td>
</tr>
</tbody>
</table>
Variables not identified in the equation:

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer commitment</td>
<td>0.76</td>
<td>.455</td>
</tr>
</tbody>
</table>

Once management commitment was entered, observer commitment did not account for a statistically significant amount of the variance in quality of goal-setting.

3.6.3 **Dependent Variable - Observer Commitment.**

In the analysis described below the dependent variable was observer commitment. Multiple regression analysis was used to examine the extent to which observer commitment scores were associated with management commitment and the quality of goal-setting.

Entering management commitment and quality of goal-setting (corrected) as independent variables and observer commitment as the dependent variable gave the following results.

Variables identified in the equation:

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>sig</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management commitment</td>
<td>3.27</td>
<td>.004</td>
<td>.37</td>
</tr>
</tbody>
</table>

Variable not identified in the equation:

<table>
<thead>
<tr>
<th>Variable</th>
<th>t</th>
<th>sig</th>
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</thead>
<tbody>
<tr>
<td>Quality of goal-setting</td>
<td>0.76</td>
<td>.455</td>
</tr>
</tbody>
</table>
Once management commitment was accounted for, quality of goal-setting did not account for a statistically significant amount of the variance in observer commitment.
4.0 DISCUSSION

4.1 Introduction

The results clearly illustrate that safety interventions of this type can be used to increase safe behaviour within the UK construction industry. Twelve out of 26 sites (46%) showed a statistically significant improvement as a result of the safety intervention. Of the remaining 14: three successfully completed the intervention but failed to show a statistically significant improvement in safety performance; three failed to produce any baseline measures; four failed to produce measures after the goal-setting; and four failed to complete the programme for a variety of other reasons. These variations in the effectiveness of the techniques were informative, as they illustrated potential difficulties in their application that will need to be overcome if the intervention is to be applied generally and successfully.

4.2 Commitment

The results strongly suggest that high management commitment is likely to lead to success and low management commitment to failure. It seems that with observer commitment, however, high commitment does not guarantee success and low commitment does not guarantee failure - though both would appear to make them more likely.

Considering the interaction of observer and management commitment, the results show that on no sites was observer commitment 'low' where management commitment was 'high'. In fact on no sites where management commitment was either 'high' or 'very high' was the observer commitment average or below.

On two of the eight sites where management commitment was low, however, observer commitment was high - suggesting that observers may maintain initial commitment or develop commitment irrespective of their manager's attitude. This may be a result of personal integrity, "I said I'd do it and I will" as one observer explained, or a genuine affective commitment to the intervention and its use as a safety tool. With the former this may have resulted from a certain conscientious 'bloody-mindedness' or from a
good relationship with the researcher. Kobasa (1979) and Lee et al. (1992) have shown how the same organisational situation may be perceived differently by two individuals; what one sees as an impassable obstacle another may see as a challenge. For a full literature review of commitment, refer to Appendix B.

These findings highlight the need to select observers carefully, rather than simply handing responsibility to the most convenient employee. Obviously, this is even more essential where line management commitment is limited.

Observer Disillusionment

Very few observers were true volunteers though several said that they could have said no, but would have run the risk of incurring management displeasure. No formal analysis was made but it was apparent that these observers who expressed an element of perceived volition were more enthusiastic and receptive in the initial stages of the research.

It seemed that typically, however, observer commitment that starts high through initial enthusiasm may reduce in response to low management commitment. Much qualitative evidence of this nature was collected during the study. On several sites observers who began keen, enthusiastic and full of constructive ideas became disillusioned and actually failed to take any more measures after goal-setting sessions. On four of the sites that were abandoned observers had scored well for commitment in the initial weeks of collecting baseline data.

This was illustrated well by an observer who had run the methodology on a previous site on his own but who at his next site declined to take over from a colleague who had been transferred to another site, even though he was the nominated replacement.

"I'm sorry but I'm simply not prepared to take over the measure because of the fact that management are even less interested than last time. I would take over if there was any support or interest from management at all. You know I think it's a good thing, these charts [feedback]... but you know the situation here".
Another showed a high level of commitment up until the goal-setting session (which he ran perfectly satisfactorily). However, during the subsequent two months he managed to take only three measures and, as a result, the research on the site had to be abandoned.

"I simply did not have enough time especially with people getting at me all the time [senior site personnel insisting that he undertook his other site duties rather than facilitate the safety intervention]. I had a vast amount of work tasks to do and X [a co-observer] never takes any measures. I'm getting shouted at for not getting them done ... but I'm not getting shouted at for not doing the measures so obviously I'm going to focus on the more important stuff... well most important to the manager anyway".

These results, therefore, illustrate clearly the interaction between individual and organisational factors in determining commitment, as described by Colarelli et.al. (1987), and others.

It was suggested that a successful goal-setting session can enthuse a previously sceptical observer. Certainly, incidents of observers expressing themselves greatly encouraged by a successful goal-setting event were noted. However, regression analysis shows clearly that the influence of management commitment dwarfs that of goal-setting quality.

Responsibility for Methodology

As has been demonstrated, a dynamic or committed observer may take full responsibility for the intervention regardless, of management attitude to this role. This may be because of a deep-rooted commitment to safety, conscientiousness, or because of career ambition that might be served by running a project well.

On some sites, however, whilst there was enough support to continue the intervention, no one from the organisation appeared to take responsibility for leading the project. In such cases it was the UMIST researcher who was looked to for leadership. In these circumstances, the observers would refer problems and important decisions to UMIST
rather than deal with them themselves. For example, some felt they could not run a
goal-review session without the presence of a researcher, even though the researcher
only attended in an observational capacity.

If this intervention, therefore, is to be adopted by industry without the support of a
research team, management commitment and the selection and training of observers
will become even more important to its success.

'Fire Fighting' and Total Quality Management

One interesting qualitative finding is that managers seemed to fall into one of two
distinct types. The first type of manager, the 'fire fighter', will not tolerate safety
standards falling below a certain, often very high, level. This manager will react
strongly when standards fall too far but will pay little attention to safety if standards
are perceived to be adequate. The second type of manager, however, strives for
continuous improvement, having an attitude congruous with Total Quality
Management (TQM). It is the latter type of manager who will pay most attention to
the increased communication generated by goal-setting and goal-review sessions or
increased safety awareness.

Widespread introduction of management techniques such as the one described in this
report could facilitate the fundamental, but extremely difficult to achieve, shift in
industry culture towards TQM philosophy (Cooper and Phillips, 1994).

Control Systems and Commitment

An interesting issue is that of control systems. It was suggested, by the research team,
that observers communicate safety measures to a senior level of management, who
could intervene if the intervention appeared to be breaking down. Several observers
who had high 'affective commitment' tended to feel that such a system would be
rather unnecessary and insulting. On sites, however, where 'affective commitment'
was low it was often seen that, whilst performed adequately, the methodology was not
followed as closely as desirable, even if 'management commitment' was high. In
these circumstances, managers were often simply ensuring that the intervention was implemented, rather than following, exactly, the recommended methodology.

One observed suggested, in an inter-company discussion and to the agreement of all others in the room:

"it is absolutely imperative that it [safety intervention] comes down through senior management and not straight from the safety people, or given as an option to site management. You won't get the commitment if it is in any way seen as an option that you 'might want to adopt'... it has to be a conscious decision to do it from a high level...' 'The way to enforce this is that someone central has to get a fax every Monday - not necessarily the full report, just the scores".

This observation highlights the role that such a system may have in ensuring suitable levels of site management commitment. Whilst the use of a control system is not ideal for encouraging affective commitment to the intervention from observers, if such a system helps to keep managers motivated then it should prove a positive influence.

**Observer Organisational Position**

Where site management were not fully supportive of the intervention the observer found him/herself with little time to take the necessary number of measures. Typically, observers quickly began to take only the bare minimum number of measures on sites where management was not fully committed. In addition, the freedom to vary the time when the measure is taken becomes diminished. On many sites it is apparent that, in addition to observers taking only the minimum measures, they nearly always took them towards the end of the week, often in the face of resentment from their immediate superiors. Observers needed to be very confident of their organisational position (power) to overcome this situation.
Management Sensitivity

A different problem occurred where management were sensitive to scores, and tried to prevent bad scores from being posted. This was observed both from management who were uncommitted to the intervention and simply did not want to "look bad" and from highly committed management who "don't want to demoralise the men with bad scores and cause the intervention to fail". At this point, observers' disposition and relationship with management greatly influenced their actions. Only confident and positionally secure individuals would defy their management, usually by referring them to the research team. Without the support of the team, an enthusiastic 'champion' for the intervention, probably from senior management, would be required.

Information Overload

A further complication occurred where the intervention was so well accepted by site personnel that the observers became an effective communication link between operatives and management, for both safety and non-safety issues. Even the most committed managers were unable to address all issues raised. This resulted in some of the observers becoming frustrated. On one site an observer who took it upon himself to become almost an unofficial 'union representative' became caught between the demands of the site personnel and management practicalities with the result that he became very discouraged and agitated.

The crucial point is that if systems are not in place to deal effectively with what can be a vastly increased amount of feedback between management and operatives, the intervention can become a victim of its own success.

Commitment - Conclusions

These results very much fit with the findings of Rogers et.al. (1993) that high management commitment is essential for the intervention to succeed.
Site Management

It is possible that a variable not yet identified is causal in influencing both site management commitment and increased safety performance, so that identification of management commitment as directly causal is erroneous. It is noticeable, however, that the successful sites included both building and civil engineering sites, very large sites and very small sites, sites of long and short duration, sites that were active throughout different seasons of the year and sites that included large and small numbers of sub contractors. Despite the relative size of the research programme the actual sample size was too small to be conclusive, but it does appear unlikely that an unidentified variable is responsible for the variations in the effectiveness of the intervention.

Site management commitment appears to be central to the way in which the intervention works. If the influence of the intervention is through improved communication about safety, then management attitude to the increased communication must be crucial. It is not so much commitment to the intervention itself that is the key, but rather a genuine commitment to continuous improvement, for which the intervention is the source of valuable information.

Regional Management

It appears likely that regional management attitude to the intervention plays a large role in determining the site management's attitude. Strong commitment from regional management is likely to lead to continuous commitment from site management even if their affective commitment to the intervention is low; and, in the absence of site management commitment, provides support for a committed observer.

The implications for the introduction of the intervention in future are that whilst 'selling' the intervention is ideal the industry as it exists will respond satisfactorily to 'telling'. This can be further facilitated through the introduction of regulation and control systems.
The evidence of this research suggests rather autocratic 'theory X' picture of the UK construction industry. Even junior management would appear to take their cue largely from the attitude of the senior site management. Consideration of cultural issues and the need to 'empower' the construction industry work force are beyond the scope of this report. Hopefully, however, one of the side effects of the widespread introduction of interventions such as this will be to help change this rather 'Taylorian' situation.
4.3 Goal-Setting

The quality of goal-setting sessions was statistically significantly correlated with site safety improvement. It would be easy to assume that the two are causally linked (which fits very much with established theory). Multivariate analysis, however, suggests that the two are both determined by an underlying variable - namely management commitment - and that once its influence was removed the quality of the goal-setting session added nothing to the equation.

In addition, analysis shows that observer commitment did not add a significant amount to the quality of the goal-setting sessions once management commitment was accounted for. This was found despite the fact that observers were directly responsible for selecting the venue for the goal-setting sessions, organising attendance, writing the script, delivering the information and facilitating the participative discussion – i.e. all the items covered by the goal-setting measure.

It could be argued that management commitment scores might be influenced by an element of rationalisation on the part of the observer (“I haven't performed very well because I have not had the necessary support”). Certainly, elements of the management commitment score were determined to an extent by observers impressions and reports which might cause a spurious correlation between it and safety improvement. This cannot be said of the goal-setting scores, however, as they were recorded solely by the researcher.

Therefore, once again, these results strongly reinforce the impression that the day-to-day performance of the observer was greatly influenced by the attitude of site management. If neither the goal-setting session nor the individual(s) who arrange and run them were of significant importance, once the influence of management commitment was removed, then it is impossible to overstate its importance. Having said this, other findings remain worthy of report.
Observers Rapport with Operatives

It appears to help the observer if they have a good rapport with the operatives. Despite the widespread increase in safety consciousness a certain cynicism prevails on sites. Some operatives were wary that the intervention was a 'management trick' designed to put responsibility for safety on the operatives alone. The need for a good rapport was particularly noticeable during the initial goal-setting session where observers demonstrated a wide variation in their ability to generate meaningful discussion of the safety initiative.

If two way communication was as important to the intervention as it appears (see section 4.6) then it is imperative that the foundations of participative discussion are established as early as possible.

Non Safety Issues

It became apparent that goal-setting sessions frequently raise welfare issues. One operative illustrated the link between welfare and safety thus:

"If the state of that canteen isn't a health risk I don't know what is. I tell you, the men won't use it and they're eating their sandwiches on the roof - I slipped on an old apple core the other day and nearly fell off".

It was found that the most successful sessions were held on sites where each review session started by addressing the issues raised at the previous sessions. When a manager said 'we've done X but we simply can't afford to do Y' operatives usually accepted this, pleased that their concerns were given due consideration, rather than resentful that they had not been granted all their wishes.

It was apparent that review sessions were popular with both operatives and management. Indeed, several managers actually held more review sessions than the research team suggested, because they were so pleased with the increased communication. One manager explained:
"I get more messages from foremen and knocks on the door from operatives in 48 hours after a review session than in a normal month".

As will be discussed later it becomes almost impossible to untangle the influence of increased communication about safety and other issues from the influence of this increased communication on other aspects of site performance.

4.4 Feedback

It is worth noting that 'knowing of the intervention' and 'knowing where a chart is' appeared, from the operative awareness data, to be synonymous and underline the importance of placing the charts where they cannot be avoided.

A factor that appeared more important than first realised was the number and placement of the feedback charts. It was found that operatives were generally too busy or disinterested to seek out the charts so it seems they need to be unavoidable. This may mean using several charts, for example, one at each of the clocking-in points; thus reminding operatives of the intervention and the fact that their safety performance is being monitored on a daily basis.

Several additions to the feedback chart devised during Phase One were introduced and positively received by observers and site personnel. A summary of the methodology of the intervention and the items covered by each category of measurement was placed next to the feedback chart. This had the advantage of informing new members of the site what the intervention was about, in addition to reminding original operatives of the details. In practice, this may mean informing them for the first time: if they missed the goal-setting session; were present but unable to hear clearly; or were present but simply not paying attention. In addition, on some sites, newsletters were distributed.

Narrative charts also proved a popular innovation. These were charts (A3 size) divided into the relevant safety measure categories, on which observers wrote brief comments such as 'scaffolding pretty good except block C4 - which was very poor', and 'PPE excellent this week - well done'. The main advantage of these charts was
that they helped to counter the 'these scores are unfair ... I haven't seen anything wrong in my block' criticisms by reminding site personnel of the breadth of measurement and the fact that scores refer to the whole site.

The majority of operatives interviewed about the intervention said that they would like more such oral feedback. On one site, the observer (who was also the site manager) would make a point of discussing scores with the operatives in the canteen on Friday lunchtime. In effect this was a weekly review session. Nearly all the operatives were full-time employees with the contractor. The dynamics of this site could not have been better, and all three categories employed on this site showed a consistent and significant increase from baselines of around 90%. In addition, there was not one lost-time accident in over 13,000 working hours and the contract was completed in only 70% of the planned duration, demonstrating that high safety levels and progress need not be mutually exclusive.

4.5 Awareness and Reasons for Success

At first glance the results discussed in section 3.4 appear not to fit with the theoretical models proposed by Locke and Latham (1990) and others, which state that hard, specific goals are necessary to bring about behaviour change. The fact that participants in the study were unable to state with accuracy what the goals were, brings into question the notion that working towards specific goals is of crucial importance. The same may also be said of feedback, since detailed knowledge of this is also limited. Many operatives were unaware that scores were updated weekly. In addition, the majority of operatives on all sites said that they did not discuss the safety performance on a weekly basis.

Results showed no clear indication of individual efforts to improve safety performance. On one site (Site B) none of the sample thought that either they or others were making a greater effort to act safely, yet there was a highly statistically significant increase in safe behaviour. On another site (Site U) 40% thought others were making an increased effort to act safely, though safety scores actually decreased.
It is worth noting, however, that although very few respondents were able to accurately relate goals and performance levels, the accuracy of responses may have been higher had the question been less specific. Of those respondents who were able to demonstrate an awareness of the scores, responses tended to be in holistic terms. For example, "they [safety performance scores] are a bit up and down. Better than they were but not at the targets yet". Meaningful scores cannot be presented, however, as each researcher noted responses differently. Some probed respondents and noted comments, while others simply marked responses as incorrect.

Clearly, these findings raise the question of whether the intervention actually worked at all, or whether there was some underlying methodological weakness or structural factor that was responsible for the increase in safety performance. Two possible factors should be considered.

Observer Bias

It is possible that observers might pay more attention to unsafe behaviour whilst setting baseline scores and focus on more positive behaviours thereafter. Most observers have a vested interest (either political or psychological) in the site appearing to become safer. The best monitor of such bias was regular inter-observer reliability (IOR) checks where researchers and observers assess the site simultaneously. Results of these checks (see section 2.3.2) suggest very high reliability. Obviously, this cannot control the possibility that the researchers themselves might show a similar bias throughout the research.

Construction Phase

It could be argued that sites simply become safer with time, due to the changing construction processes. However, there is no research evidence to support this as a phenomenon. Interviews with management, observers and operatives both during and after the intervention, however, suggested an increased awareness of safety and the perception that improvements in safety behaviour had occurred.
Therefore, considering both the qualitative and quantitative findings in tandem it does appear that there was a genuine increase in safety behaviour on many of the sites and that these changes were brought about by the goal-setting and feedback intervention. The questions ‘why’ and ‘how’ remain unanswered. However, the answers appear to hinge on management attitude and its consequences, and a general awareness of feedback charts as a reflection of site safety performance.

4.5.1 Management Goals

Whilst many operatives said that they paid little attention to the specific scores on the feedback charts and could not state the precise goals there was little doubt that they were aware of the existence of the charts. The number of operatives, including recent arrivals and sub-contractors, who could accurately identify the location of feedback charts ranged from 83% to 100%. Operatives also recognised that the existence of the chart signified that someone was monitoring safety on site.

Perceived validity of feedback

Given that simple ‘awareness raising’ interventions, such as poster campaigns, have generally failed, the ‘being watched and assessed’ element is probably vital. As one operative told the researchers:

"No, we don't pay much attention to it [feedback chart] to be honest...but that said, the men were talking about safety in the van on the way home the other night - now I've been in the building game 25 years but I've never heard that before".

If this interpretation is correct, it is important that scores must be perceived to be valid and accurate even if little attention is paid to them.

In essence, then, what is supposed to be participative goal-setting of a specific kind becomes, assigned goal-setting of a general kind, about which operatives have been consulted. It is worth noting, however, that Locke and Latham (1990) suggest that where authority is considered legitimate, workers will accept and commit to an
assigned goal unless they have cause to reject it. Importantly, whilst the level of
interest at goal-setting sessions varied, as did the level of suspicion of management
motives, there was never any rejection of increased safety as a legitimate goal; nor
were there any reported instances of operatives later claiming that they had not been
consulted.

Importantly, this interpretation still fits with the basic goal-setting model of directing
attention, increasing motivation and mobilising effort.

Conclusion

Certainly, a public display of interest in safety that involves more commitment than
just putting up posters serves to stress to both direct employees and sub-contractors
that an improvement in safety behaviour is an important management goal. This
could be seen as no more than a 'Hawthorne' effect but, in fact, the findings strongly
suggest that the intervention has a more substantial impact in two distinct ways: first,
by impacting on management systems and enabling increased communication;
second, by making an impact on awareness which influences the overall safety
climate on the site.

4.5.2 Management Systems and Greater Communication

It is apparent that one of the key influences of the intervention is on management
systems. By forcing observers to make a systematic and objective assessment of the
site on a regular basis, it is likely that issues will be raised that would otherwise not
have been. On one site an observer explained that:

"It provides a very fast focus on recurring problems... I've had foremen say
'Oh no not you again' - they know better than to be mentioned in the memo too
often..."

Note: this was one of many sites where a report was circulated weekly to
management on the basis of the measures taken.
Other comments have focused on the fact that the methodology encourages a proactive attitude towards safety rather than simply reacting to obvious and serious unsafe acts and situations:

"I like the fact that it rewards safe acts - even if they're only small everyday things... it makes a change from the big stick approach and it encourages the operatives to make an effort on the little things not just try to avoid the major cock-ups".

In addition, the participative goal-setting and review sessions encourage greater discussion of general safety issues both between operatives and management and between operatives themselves. In essence, such a system is similar to a 'standard' TQM intervention (Cooper and Phillips, 1994).

An incident from a large refurbishment site illustrates the point and shows how the basic techniques are not just applicable to safety issues but to good management in general. Operatives complained at a review session that they were having difficulty obtaining the correct protective equipment. It was discovered that whilst foremen were insisting that operatives wore goggles, gloves and other PPE, operatives were finding it very difficult to get the store-man to release them. This was because the site manager, who scored highly on the commitment to the intervention measure, also strongly encouraged the store-man to minimise equipment costs. Once the conflicts of the situations were understood, the problem was quickly resolved in discussion.

As well as agreeing that PPE should never be denied to an operative, the manager decided that not buying in the best quality PPE was a false economy, as the cheap equipment was quickly damaged and in need of replacement. Lockers were also introduced so that operatives could store their (more valuable) PPE safely and penalties, agreed in discussion with operatives, were introduced to encourage them to look after their equipment. Other changes agreed at the review involved improved ventilation for a basement area and better drying facilities. This was a very productive session and by no means atypical.
DeJoy (1986) argues that employee participation in safety programmes has two beneficial side effects: more open and informal communication and an expectation that management will be receptive to employee input; and, heightened awareness and interest in safety, along with the perception that it is an important management consideration. Peters (1991) quoting Cohen and Cleveland (1983) and others stresses how good safety performance is often found where 'there is an open two way communication system between labour and management and where management encourages employees to participate in the identification and control of hazards' (p. 66). Certainly our findings appear fully congruent with this position.

In addition, research in the areas of social exchange and equity theory suggest that quality of management-operative exchange and perceived fairness both contribute significantly to 'organisational citizenship behaviours'. These behaviours include altruism, courtesy, tolerance of other workers difficulties and conscientiousness (Deluga, 1994).

4.5.3 Safety Awareness

The limited success of safety awareness campaigns has been discussed previously, as has the increased impact of the goal-setting intervention on awareness of safety, because it is being observed and scored. It is likely that a further benefit is that the intervention focuses attention explicitly on the everyday behaviours that are under operative control. For those operatives who are reasonably aware of the items included in the relevant categories the feedback charts become, in essence, a daily reminder of tool-box talks that they are likely to have attended. It is the knowledge, therefore, that even these 'everyday' behaviours are an important management concern, combined with the specific focus that raises 'safety awareness'.

A final benefit of the intervention seems to be that, by raising safety awareness on site, new operatives respond to the more safety aware 'climate' that prevails (Cooper et.al., 1995). Whilst instances of direct peer pressure not to act unsafely have been noted, in truth they appear rather rare. Such admonishment is still seen very much as a manager's job.
However, the adoption of the same behaviour as influential models (in this case operatives already on site) should be a potent force in spreading and maintaining new, safer behaviour. In the words of one operative, “When you first get on a site you do look about to see what's what.” Individuals will only work as unsafely as they feel comfortable with and feel will be tolerated by supervisors. This is vitally important, given the typically high labour turnover on most sites and helps explain why scores improved after the introduction of the measure, even though many sites finished the intervention with an almost completely changed operative population.

In the long term, however, there must be a change in industry culture, rather than just site climate, if improvements are to be lasting and widespread. McNeely and Meglino (1994) have stressed the importance of internalising values that lead to the 'organisational citizenship behaviours' discussed above. Again, however, the importance of situational factors interacting with even internalised attitudes cannot be overstated.
4.6 Other Findings

4.6.1 Tailoring the Measure to be Site Specific

On a civil engineering site, where a lot of heavy machinery was used, a 'plant' category was developed. This category addressed items such as the speed of trucks and the use of banksmen. In addition, some new items were added to existing categories. For example, the wearing of reflective vests is compulsory on road and related projects, so was included in the PPE category. Scoring of the housekeeping category was also changed to make it more appropriate for a particular site. (See section 2.3.1)

Importantly, it was found that changes such as these helped to increase the face validity of the measure with both observers and site personnel. As discussed in Section 4.5, face validity appears to be an important factor in the success of the intervention.

4.6.2 Incentives

A number of operatives said that there should be incentives for improved performance. One explained:

"It's only fair to get some sort of bonus for hitting a target even if it's only a booze-up at the end of the project".

Certainly, incentives for increased performance focus attention and appeared, in one instance, to increase the true 'psychological ownership' of scores. On Site T, the only site to use incentives, the number of operatives who said that they made an increased effort to act safely was the highest recorded; and they also had the most accurate knowledge of how often the scores were updated. Whilst there appeared to be no greater detailed knowledge of the goals and current scores than on other sites, it was noticeable that goal-setting and review sessions were very animated. Indeed, it was this site that generated so much feedback for management that it became a victim of its own success.
Although incentives have previously been used successfully (Peters, 1991), it is claimed that they can be expensive and short lived in their effect. It is very unlikely, however, that the cost would outweigh the benefits of a meaningful improvement in safety behaviour. One recently reported initiative at a large Glaxo plant in the UK, reported in Contract Journal, February 1994, involved giving away a new Volvo car every month; and management and client expressed themselves confident that they were still benefiting financially. Glaxo's resident engineer, Robert Brisker explains that:

"Even though we are spending £1M on safety it is more than recouped through the absence of delays caused by accidents and in terms of quality of work from a workforce not pushed to produce at an unsafe speed".

Perhaps a more important concern than cost is that incentives may prove successful only in the short term, as they do not necessarily encourage the internalisation of safe attitudes that lead to long term improvements regardless of material reward. If they are to be used, therefore, then it must be ensured that rewards are not seen as an end in themselves but are merely a bye-product of the far more important goal of improved safety.

In addition, incentives may encourage accident under-reporting and, of greater concern, personnel can simply expect to collect safety incentives as a matter of course, that is the incentive becomes a bonus and forms part of the company remuneration package, regardless of changes in safety performance.

An interesting development on the Glaxo site is that the 'macho' culture was being transferred to acting safely with safety stickers worn on helmets 'like badges' and groups of workers proudly wearing sweatshirts boasting of their excellent safety performance. The senior safety manager explained that: "Incentives are just one element of our safety programme. The programme would soon break down if we didn't have total commitment to safety from everyone involved in the project and the leadership from Glaxo". Sub-contractors who did not show a genuine commitment to safety at procurement were not awarded contracts.
Peters (1991) summarises the position excellently. "Incentives are most effective when used to provide an added spur to an already well designed programme". He recommends that: i) a baseline is taken; ii) a specific criterion for success is established; iii) charts should be used to provide operatives with feedback; iv) incentives should be supplemented with training that explains which acts are unsafe and why (p 58).

Clearly, this position is entirely congruent with using incentives in conjunction with the safety intervention detailed in this report.

4.6.3 Competition

Many of the operatives interviewed suggested that introducing an element of competition would greatly increase active involvement in the intervention. They suggested that this might be competition between trades or between sub contractors on site.

Whilst this would without doubt prove a great motivator, three practical problems suggest that this is not feasible. First, it would be difficult to find enough identifiable and meaningful groups, with distinguishable behaviour to measure, on all but the largest sites. Second, it would be difficult to compare directly behaviour of different groups, and weighting systems for safety measures would be complicated to develop and explain. Third, competition between operatives on the same site might become a negative influence. The potential for bias in scoring is clear. Lastly, even if neutral observers are used, actual sabotage is clearly a possibility and has been reported in such circumstances in the past.

Perhaps the fundamental problem, however, is that an intra-site competition is not wholly congruent with the philosophy that the site be scored as a whole and that individuals take responsibility for the safety of themselves and everyone else on that site. More positively, however, a 'competition' between different sites or regions would avoid several of these problems and would be very interesting to attempt; but
would present the same problems of comparability as measurement of different areas of the same site.
5.0 RECOMMENDATIONS

Evidence has been presented that the intervention appears to impact significantly on safety performance. Suggestions as to how this occurs have also been made. In this section of the report practical recommendations as to how the intervention could be most effectively implemented on any future site will be made.

5.1 Management Commitment

It appears that a high level of management commitment is absolutely crucial to the success of the intervention. One way to help ensure suitable levels of site management commitment is to ensure that incentives for safety match those for productivity. This, of-course, means true commitment to safety from all levels of the contractor’s organisation and, where appropriate, owners and shareholders. The Construction (Design and Management) Regulations will help to facilitate this, as they should reduce the pressure from clients to build faster and cheaper, at the expense of safety.

Accounting for Accidents

An additional way to influence managers is to make them financially accountable for accidents. Levitt and Samelson (1993) describe how accident costs may be allocated to an individual site, and not left as a company overhead. In one example described by Levitt and Samelson an apparently very profitable site became the least profitable in the region as a result of this accounting procedure. Immediately, a once lauded site manager came under strong censure to improve his safety performance.

Clearly, introducing a system which demonstrates that accidents reduce the profit margin is certain to have an impact.

The importance of efforts to equalise the pressures of building safely and building quickly could be argued to overshadow the merits of any 'management tool' - no matter how user friendly or effective.
5.2 Mechanics of Intervention

5.2.1 Selection of Observers

Findings from this research suggest that good observers do not need to be either 'safety experts' or site managers. Five of the most efficient observers were operatives and trainee foremen. The duties involved require conscientiousness and a methodical approach rather than great intellect, as the fundamental philosophies that underpin the intervention are basic and easy to grasp. A good rapport with site personnel is important, as it helps observers generate meaningful discussion at goal-setting and goal-review sessions.

Observers should therefore be selected for their conscientiousness and rapport, or ability to develop rapport, with the operatives. In an ideal world this would involve psychometric assessment, as well as assessment of presentation skills. Clearly, this would seldom be undertaken. More practically, managers could be exhorted to use such information in observer selection, if it had been collected for another purpose, for example during staff selection or development.

5.2.2 Training Observers

Until a distance learning training package is available, training of observers should involve a half-day of goal-setting and feedback theory, followed by practical use of the measure on an existing site. A further half-day training should be given a week later, to reinforce the correct use of the safety measure, and a final half-day after a further three weeks to prepare for the goal-setting session. In addition, observers should also be given training in the facilitation of group meetings and in public speaking.

5.2.3 Replacement of Observers

At least two fully trained observers are required on each site. These observers should share the work, rather than one being a 'back up' for times when the main observer is
unavailable. In addition, since junior management can be transferred to another site with little notice, it is important to have an experienced and committed observer who can ensure continuation of the intervention while a replacement is trained.

Working with another observer as a team and with the back up of supportive management also appears to help minimise any sense of isolation, a feeling that was expressed by some observers.

5.2.4 Monitoring Observer Performance

Observers performance should be monitored effectively in much the same way as any management function should be controlled and reviewed. Safety performance scores, along with brief details of methodology and issues that have arisen, should be sent to an off site 'co-ordinator' on a weekly basis. This person should be someone who has influence over site management, probably a line manager at head or regional office.

This process will help to ensure that site management commitment to rigorous implementation is maintained.

5.2.5 The Use of Benchmark Data

Several observers and managers suggested that the intervention should have commenced sooner than it did and that the collection of baseline data delayed its introduction unnecessarily. A way of overcoming the need for baselines might be to use 'best practice' scores from the research as a 'bench-mark' against which sites, or whole organisations, can assess their performance.

However, it is recommended that caution be exercised in adopting this solution, as it would be essential to select benchmarks appropriate to a new site.
5.2.6 Feedback Charts

It is apparent that, rather than placing feedback charts in huts where operatives can seek them out, charts should be placed in positions where the workforce would see them, at least once a day. This may involve the use of several charts, for example at each clocking-in point.

Narrative charts should also be used alongside each graphical feedback chart, to help explain and illustrate scores.

There is also doubt about the validity of the precise form of the quantitative feedback on the charts, for most effective communication. It is quite possible that some site operatives do not fully understand scores in percentages, or have the ability to interpret graphs. This aspect of the research deserves further development.

5.2.7 Goal-Setting and Review Sessions

Goal-Setting Sessions

The timing, location and co-ordination of goal-setting sessions need careful consideration. Sessions should be held during work-time, as asking personnel to attend meetings during breaks can cause resentment. If site personnel do attend, or are forced to, they are very likely to be an unsympathetic audience. In addition, insisting that personnel attend goal-setting sessions in their own time is highly likely to reflect a lack of management commitment to the intervention.

Where there are too many operatives on site to run a single goal-setting session effectively, more than one meeting should be held. In addition, management need to ensure that all noisy work in the surrounding area is halted. If this is not done, personnel can have serious problems hearing what is being said.

In addition to allowing operatives to stop work to attend the goal-setting sessions, management should be present at these sessions. As well as providing a visual display of their commitment to the intervention, managers are nearly always called
upon to deal with various site issues that occur. Having someone with sufficient process skills to intervene, and make a contribution that re-focuses the discussion, helps to support the observer. Operatives are also less likely to be openly dismissive and irreverent in the presence of senior management.

**Review Sessions**

Sessions should be held as often as management resources allow and should always start by addressing outstanding issues previously raised. Any comments made should be acknowledged and recorded.

It is worth noting that the processes detailed above, focusing on two way communication with the workforce, are congruent with CDM requirements that contractors 'monitor safety performance... and inform and consult workers' and that employees will be 'entitled to information about safety during construction' and 'able to express their views about safety to the principal contractor' (Section 18).

**5.2.8 Induction and Management Systems**

The intervention should be used in conjunction with, and in addition to, existing management systems rather than in place of them. The safety performance measure assists the management of health and safety, in that face-to-face discussions between site personnel, via the goal-setting and review sessions, facilitate effective communication.

This intervention discussed in this report should certainly be a central part of any site induction for newcomers to site and scores should be given a high profile at site safety meetings, where reasons for unacceptable scores can be discussed and remedial action authorised. A short report should be prepared weekly and circulated to appropriate management and safety personnel.
5.2.9 Incentives and Competition

Incentives can help to focus attention and develop ownership of the goals. They are likely to prove highly cost effective but organisations should be careful to ensure a reward is not seen as an end in itself as that would inhibit the internalisation of a more safety aware and conscientious attitude.

Competition within a site would probably be difficult to implement and may prove a counter-productive influence. Competition between sites, if it could be made equitable, would be likely to focus operatives on goals and performance more specifically on goals and performance and thus motivate greater effort.
6.0 FURTHER RESEARCH

Management Commitment - differing levels

Whilst it can be argued that the importance of management commitment was established quite clearly by this research, no distinction was made between affective and continuous commitment (see Appendix B) nor between the differing levels of management. Recent research, undertaken in the off-shore industry, suggests that the role of first-line management, for example supervisors or foremen, is vital for effective safety management (Mearns et al., 1994).

A fruitful area of study would be to assess regional management commitment levels and their influence on site management commitment. An area of specific focus should be the relative influence of regional line management and regional safety management on levels of site management commitment. It is likely that the former would have far greater influence at present but the impact of the CDM regulations may be changing these relationships.

Awareness

This research suggested that detailed knowledge of goals, performance levels and methodology is limited, with only a vague awareness of the intervention. It would be useful to define exactly what level of knowledge is required for goals and current performance levels to be meaningful.

This has clear implications for feedback strategies. There is doubt about the ability of some site operatives to understand feedback in the form of graphs of percentage values. There was some qualitative evidence that addition of narrative feedback information was popular. A detailed study of how quantitative and qualitative feedback interact would be helpful, as well as study of the optimum form of feedback.
Incentives

There was some qualitative evidence that the site that used an incentive scheme alongside the methodology showed one of the highest levels of interest and communication activity of any site. More detailed analysis of the impact of incentives on: i) maximising operative interest and motivation; and, ii) a possible loss of focus on the underlying philosophy; would be informative.

Stand Alone Training Package

Because researchers visited sites in an observational capacity, usually at least monthly, and these visits often contained an element of training, further research needs to be conducted into the feasibility of a distance learning training package, possibly video enhanced.

Such a package could certainly be developed on the basis of these findings but detailed research as to its effectiveness and problems relating to its implementation is of primary importance.

Other uses of the Techniques

The basic principles of identifying key behaviours, measuring them and using these measures as the basis of a goal-setting and feedback intervention are clearly applicable to many other areas of work based behaviour.

Research to investigate whether these techniques could be used to improve productivity, or reduce wastage, could have considerable commercial implications.
REFERENCES


Health and Safety Executive (HSE) (1993), The Cost of Accidents at Work, HS(G) 66, H.M.S., London.


APPENDICES

List of Appendices:

Appendix A - A Sample Case Study

Appendix B - Review of Commitment Literature

Appendix C - Measures of Commitment

Appendix D - Measure of Goal-Setting Quality

Appendix E - Safety Performance Measure

Appendix F - Safety Improvement Measure

Appendix G - Awareness of Intervention
Appendix A: A Sample Case Study.

Appendix A contains a sample case history of a research site. The case study provides general background information; presents the safety performance levels (SPL) in graphical form; provides in-depth information regarding the observer, management commitment measures, the quality of the goal-setting session and the operative awareness of the intervention; additional information and site specific conclusions and recommendations are also provided.
Site C - Law Courts (North West 2).

1.0 DETAILS OF SITE AND SUMMARY OF RESULTS.

1.1 Project:

New law court facility in a North West of England city.

Type of structure:

Complex reinforced concrete frame clad with traditional brickwork and toughened security glass panels. Due to the strong architectural statement this building is intended to make the design is very intricate requiring the cladding of many curved surfaces. All major elements were being constructed during the intervention.

Activities at beginning of research:

Groundwork and erection of concrete frame.

Employing approximately 106 persons (20 directly employed & 86 sub-contracted).

Activities at end of research:

Erection of wall structure, roofing trades, general finishing trades and installation & commissioning of services.

Employing approximately 190 persons (20 directly employed & 170 sub-contracted).

For more detailed representation of activities and numbers employed in the construction process during the intervention period, refer to Figure C.1.

1.2 Summary of results:

Safety performance scores increased statistically significantly (an overall increase of 13.8% from a baseline average of 77.2% across the four intervention categories). Awareness of the intervention was high, though detailed knowledge was limited.
Figure C.1.
Number of operatives (direct & sub-contract).

Main activities during research period.

Data not collected during intervention, site numbers generated via contractor's records.
Changes in mean safety performance scores.

% Safety Performance.

- **HOUSEKEEPING**
  - t-value = 5.04
  - statistically significant.

- **SCAFFOLDING**
  - t-value = 4.50
  - statistically significant.

- **ACCESS-TO-HEIGHTS**
  - t-value = 2.58
  - statistically significant.

- **P.P.E.**
  - t-value = 8.00
  - statistically significant.

**Total Pre & Post intervention scores.**

- **HOUSEKEEPING**
  - mean = 77.2%
  - sd = 6.0
  - n = 7

- **P.P.E.**
  - mean = 91.0%
  - sd = 2.3
  - n = 45

Pre-intervention
Post-intervention
Sum of all categories.

Goal-setting intervention.
Baseline.
Intervention.

Observation number.
Safety performance scores for each category.

Housekeeping.

Scaffolding
Access-to-heights.

Goal-setting intervention.
Baseline.
Intervention.

P.P.E.

Goal-setting intervention.
Baseline.
Intervention.
3.0 Review of scores - Site C - Law Courts (North West 2).

Site Safety Scores:

<table>
<thead>
<tr>
<th>Category</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping</td>
<td>+ 19.9</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>+ 10.9</td>
</tr>
<tr>
<td>Access-to-heights</td>
<td>+ 8.4</td>
</tr>
<tr>
<td>P.P.E.</td>
<td>+ 16.0</td>
</tr>
</tbody>
</table>

Attitudinal/behavioural measures:

<table>
<thead>
<tr>
<th>Measures</th>
<th>% Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer commitment</td>
<td>60.0 (Very low)</td>
</tr>
<tr>
<td>Management commitment</td>
<td>47.1 (Average)</td>
</tr>
<tr>
<td>Operative awareness of intervention</td>
<td>52.0</td>
</tr>
<tr>
<td>Goal commitment</td>
<td>80.1</td>
</tr>
<tr>
<td>Behavioural checklist for goal-setting session</td>
<td>44.4 (Very low)</td>
</tr>
</tbody>
</table>
4.0 OBSERVER COMMITMENT.

OBSERVER COMMITMENT MEASURE 60.0%

On this site there were two observers, the measure of observer commitment relates to both observers.

4.1 Keeping Promises - 2.5 out of 5.

The two observers kept some promises but failed to keep many others, for example promising to attend an observer's review session only to cancel at the last moment and postponing several meetings at the last minute.

Both observers claimed they simply did not have enough time to do what the research team asked without it affecting their other duties.

4.2 Returning Calls Promptly - 2 out of 5.

Initially both observers were very efficient at returning calls, usually as soon as they had returned from supervising the construction process on site. However, this ceased towards the middle of the research programme. The researcher responsible for this site had to leave messages and arrange site visits through the site secretary as telephone contact with the observers became impossible.

4.3 Pro-Active and Enthusiastic Behaviour During Visits - 3.5 out of 5.

Once the two observers were committed to the project they were usually quite attentive, however both were cynical at times about the whole behavioural approach.

4.4 Enthusiastic Response to Practical Problems - 4 out of 5.

If a practical problem occurred both observers would try to resolve it, for example by requesting the research safety performance measure to be used instead of their company measure. This removed any duplication whilst ensuring there was sufficient time to allow at least one observation per week for the research. They also trained an additional observer to provide cover and purchased more coloured tape when the supply provided by the research had run out.
5.0 MANAGEMENT COMMITMENT.

MANAGEMENT COMMITMENT MEASURES  47.1%

5.1 Placement of Feedback Chart - 3 out of 5.

The researcher has no evidence that the manager actively opposed or advocated the use of the two feedback charts nor was he obstructive about their placement.

5.2 Sanctioning Stoppage to Attend Goal-Setting Meetings - 3 out of 5.

The site manager allowed the goal-setting session to go ahead during work time, directly after the mid-morning break, to a 'selected' group of approximately 10% of the current workforce. This group set the goals participatively, with the majority of the personnel finding out about the intervention either by word of mouth or from the feedback charts. Both observers said that the decision to hold the goal-setting in this manner was to counteract 'logistical problems'. The researcher was unsure whether it was the site manager or the two observers who decided this.

5.3 Management Attendance at Goal-Setting Meetings - 1 out of 5.

The site manager appeared to be very interested in the intervention, however the goal-setting took place when the manager was involved in another meeting with the client. He sent his apologies to everyone.

5.4 Observers' Time Needed - 3.5 out of 5.

The researcher has no evidence that the site manager opposed or sanctioned the observers having the necessary time away from their 'normal' duties to facilitate the intervention. However, the site manager did support the request to allow the site to use the research measure of safety performance instead of the 'in-house' measure.
The project manager was not totally opposed, neither did he go out of his way to advocate the intervention. How much of this was caused by the cynicism of the observers was not clear. In the limited amount of contact the researcher had with him he seemed interested in the aims and the philosophy of the intervention, having a strong interest in motivation theory.
6.0 GOAL SETTING SESSION MEASURES.

| Goal-setting intervention | 44.4% |

6.1 Management Attendance.

| Goal-setting intervention | 0 out of 4 |

The site manager and the management team, apart from the two observers, did not attend the goal-setting session.

6.2 Operative Attendance.

| Goal-setting intervention | 0 out of 4 * |

* Less than 50% attendance hence 0 score.

Participative Nature of Goal-setting.

| Goal-setting intervention | 3 out of 4 |

For the goal-setting session representatives from each trade/sub-contractor were invited to attend (approximately 10% of the workforce). The observers held a reasonably participative session hoping the majority of the site would find out about the intervention either by word of mouth or from the feedback charts.

6.3 Venue.

| Goal-setting intervention | 2.5 out of 2.5 |

The venue for the goal-setting meeting was ideal (about 30 persons in the main conference room). In addition, the observers had arranged for coffee and bacon sandwiches to be provided halfway through the meeting. This encouraged several people to speak who had previously been silent.
6.4 Observers' Performance.

| Goal-setting intervention | 2.05 out of 2.5 |

The two observers were well prepared and covered all the main points clearly.
### Awareness of the Intervention

<table>
<thead>
<tr>
<th>Question</th>
<th>Operative awareness of intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Are you aware of the intervention?'</td>
<td>90% n = 18</td>
</tr>
<tr>
<td>'Can you tell me where the/a chart is?'</td>
<td>90% n = 18</td>
</tr>
<tr>
<td>'Do you discuss the scores (at least) weekly?'</td>
<td>0% n = 18</td>
</tr>
<tr>
<td>'Have others made an increased effort to be safe?'</td>
<td>50% n = 18</td>
</tr>
<tr>
<td>'Have you made an increased effort to be safe?'</td>
<td>30% n = 18</td>
</tr>
</tbody>
</table>

One awareness check was made, randomly selecting 10% of site personnel (n = 18). Ninety percent of the operatives interviewed knew of the intervention and could accurately identify the location of the chart. However, none of them could tell the research team the exact details of the chart and no one said they talked about the intervention at least weekly. However 50% of those interviewed believed their fellow operatives had changed their behaviour as a result of the intervention whilst 30% felt they themselves had made a greater effort to be safe because of the intervention.
8.0 ADDITIONAL INFORMATION.

8.1 Did the observers feel the intervention had worked?

When asked if the observers felt that the intervention had worked, both were unsure what had caused the improvement of safety performance scores. Other sub-contractors joining the project was given as a possible reason. Some of these, especially the mechanical and electrical sub-contractor, have their own safety department and Safety Managers. Observer One felt that the goal-setting intervention had not worked through the operatives because they had not had any involvement or input, largely caused by the number of operatives on site and the high turnover of labour. He felt it was a management tool and would have had a better chance of working if implemented on a smaller site that employed less than 50 operatives. During the course of erecting the concrete frame, which Observer One felt was the most dangerous activity, only 50 operatives were employed and he felt recording and displaying safety performance scores had improved safety.

When asked whether they would like to see the intervention being used again Observer One said no. He felt that if the site manager was committed to safety there was no need for such techniques and if he was not then the research team should focus upon management before trying to change the behaviour of the operatives. He believed managers should be allowed to manage safety, capable of managing safety and interested in the subject.

8.2 The extra demands caused by the intervention.

When asked about the extra demands required to facilitate the intervention, both observers felt that the extra time needed did present a problem. This was the result of the workload and the other roles of the two observers.
9.0 CONCLUSIONS AND RECOMMENDATIONS

More employee involvement or participation:

There should have been review sessions, throughout the intervention, similar to those held on other sites. The aim of these meetings would be to involve more people and capture new personnel joining the site. Both observers felt that there should have been regular review sessions. This is an interesting comment as on a number of occasions the researcher tried to prompt the two observers to hold review sessions.

More involvement from site management:

Site management should be more involved before trying to change the behaviour of operatives. In addition, there should be an earlier involvement of the sub-contractors, ideally at the tendering stage to get them used to the idea of the intervention, with the possibility of each sub-contractor adopting the system and producing their own feedback chart.

Communication:

Further to the above recommendation, there was the need to disseminate the aims and objectives of the intervention, to site personnel, as soon as possible. A short presentation should be available for the goal-setting sessions and possibly safety induction sessions or tool-box talks.
Appendix B: Review of Commitment Literature

Appendix B contains a review of the commitment literature.
Review of Commitment Literature.

Types of Commitment.
In simple terms commitment may be split into the two broad categories of 'affective' (or attitudinal) commitment and 'continuance' (or 'calculated') commitment. Affective commitment is the strength of the individual's identification with, and involvement with an organization or issue, whereas continuance commitment is commitment to the organization or issue due to the perceived costs of doing otherwise (e.g. loss of benefits, personal disruption, etc.). Continuance commitment is also known as 'side bets theory' (Becker, 1960). These two forms of commitment have been shown to be separable (Ferris and Aranya, 1983). However, agreement on such a simple dichotomy is not total with McGee and Ford (1987), for example, suggesting that continuance commitment can itself be split into 'low alternative' and 'high sacrifice' (the later being more colloquially known as the 'golden handcuffs syndrome'). Further, O'Reilly and Chatman (1986) have suggested that affective commitment may be multidimensional. Evidence also suggests that blue collar employees are more strongly influenced by continuance factors than white collar workers (Cohen 1992).

Other types of commitment have been identified including normative commitment (Meyer and Allen, 1991) and organizational identification (Hall, Schneider and Nygren, 1970). However, most 'other' forms of commitment have been assimilated into existing models. Organizational identification has been considered as a subdivision of affective commitment as defined by Mowday et al. (1982). Normative commitment describes a process whereby organizational actions, for example selection, socialization processes, as well as individual predispositions, for example person-organization value congruence and generalized loyalty or duty attitudes, lead to the development of organizational commitment.
**Impact of Commitment on Observer Behaviour.**

The potential impact of affective commitment levels on the initiative is self evident. The role of continuance commitment is more complicated. An observer might have a professional ambition that will be furthered by running a project well - in which case the project is valued for what it can do for the observer rather than what it is. Alternatively, they may simply not want to incur the wrath of their management. This should, however, depend largely on the commitment levels of management - it is unlikely there will be much 'pressure' perceived from management who are indifferent to an intervention.

**Behavioral Commitment.**

The behavioral view of commitment suggests that if individuals act in a certain way, if that act is important, irrevocable, explicit and of their own free will, they will subsequently seek to justify it to themselves.

According to Salancik (1977) people become committed to the implications of their actions to the extent that those actions are associated with three key perceptual states, volition (free choice), revocablity (the less revocable the higher the commitment), and 'publicness' (the more significant the others who are aware of the choice, the higher the commitment). Salancik considers commitment then to be a psychological obligation to behave in a manner consistent with the implications of prior behaviour. O'Reilly and Caldwell (1981) also found evidence in support of this theory.

The main implication for site personnel (both observers and management) is that those who feel that they had the initiative imposed on them may prove less committed than those who had an element of free choice. Other than an individual making a (genuine) public declaration that they will ensure the project succeeds the other two elements of this theory have less relevance.
It is important to distinguish between this theoretical model of behavioural commitment and the behavioural measure of commitment used in this study. Actual behaviours indicating commitment, not the psychological state of behavioural commitment, were observed and recorded as measures of commitment to success of the interventions. The measures used are described in Section 2.3.3 of the Main Report.

**Determinants of Organizational Commitment.**

Much of the research on organizational behaviour has been concerned with identifying the determinants of organizational commitment. Put simply, these factors can be grouped into two broad categories: organizational; and, individual characteristics (Mottaz, 1986) - though the two clearly interact.

Research results seeking to determine their relative importance in determining commitment are largely inconsistent. Some studies have found both sets of factors to be of approximately equal importance; for example, Brief and Aldag, (1980). Other studies suggest individual factors are of greater importance (Koch and Steers, 1978). In contrast, Angle (1983), among others, has found organizational factors to be more important. A study by Colarelli et al. (1987) found commitment was best predicted by a combination of person and situational variables.

It can be strongly argued that neither should be considered independently. Organizational factors will always be moderated by individual differences. Furthermore, it is likely that individuals, in part, select their organizational experiences so that the relationship between the two is more complex still.

**Dynamic Interaction of Organizational Factors and Commitment.**

Meyer and Allen (1988) found evidence that experiences predicted commitment for the first months of the work experience but that commitment predicted experiences after
Arnold (1990) suggests two reasons for this. First, commitment might influence individuals' perceptions of experiences. Second, commitment levels might directly influence what work experiences occur with the most committed being rewarded with the most favourable work assignments.

The importance for the current study is that 'commitment' level is not a static thing, but is dynamic, changing and partially influenced by self-fulfilling prophecy. The influence of organisational factors on continuance commitment is self evident but affective commitment can also be affected by organisational experience, as can the ease with which 'committed behaviours' can be performed.

One area of influence not very well researched is that of differing levels of commitment at different levels of an organisation. In this case it would involve the interaction of regional line management, regional safety management, site management and observer. Very little literature exists on this topic.

**Outcomes of Commitment.**

Organizational commitment shows a potentially sizeable impact on employee behaviours such as job absenteeism, tardiness, turnover (Larson and Fukami, 1984; Mathieu and Zajac, 1990) and willingness to be relocated (Mowday, Porter, and Steers, 1982). In addition, committed employees are more likely to engage in 'extra-role' behaviours, such as creativeness or innovativeness. It is suggested this is crucial in keeping an organization competitive (Katz and Kahn, 1978) but clearly may also impact on individual initiatives such as the one described above.
It can be argued, therefore, that discharging the duties of the intervention in a conscientious way is more likely by an observer high in either affective or continuous commitment. In addition, such an individual is more likely to develop innovative solutions to practical problems. It is these behaviours that are central to the measure of commitment used in the research reported in the Main Report.

**Disposition to Commitment.**
So far, it has been suggested that observers and managers are rather passive if not in initial level of commitment then in reaction to experiences. However, research by such as Lee et al. (1992) suggest that ‘commitment propensity’ might affect affective reaction in two ways. First, individuals might be selective in their focus on organizational stimuli so that individuals high in commitment propensity might focus on more positive aspects of the organizational experience and individuals low in propensity would focus on the more negative aspects. Second, when focusing on the same event, propensity will determine the subjective interpretation of that event so that individuals high in commitment propensity will view situations more favourably. This observation is very much in line with the ‘Social Information Processing Theory’ approach (Salancik and Pfeffer, 1978), that emphasises the subjective interpretation of organizational experiences.

Lee, et al., found both evidence for commitment propensity and their suggestion as to how it might take effect. They found that commitment propensity predicted subsequent commitment, turnover and affective response to environmental stimuli and feedback. They note that organizational experiences had a major effect on employees as a whole, but that within groups differentials remained.
Kobasa (1979) has suggested a personality characteristic of 'hardiness' which comprises 'commitment, control, and challenge'. For her, hardiness facilitates the kind of perception, evaluation, and coping that leads to the successful resolution of situations created by stressful events. Persons high in hardiness commit themselves to what they are doing rather than feel alienated, believe they can at least partly control events and regard change as a normal challenge or impetus to development rather than a threat. The coping styles of hardy persons also 'reflect belief in their own effectiveness as well as their ability to make good use of other human and environmental resources' (Kobasa and Puccetti, 1983, p 840).

The importance of these findings for the research is that the attitudes of individuals may determine their organisational experience and that an experience that is de-motivating for one observer may prove a challenge to another.
Appendix C: Measures of Commitment

Appendix C contains the pro-formas developed to determine the amount of commitment provided to the safety intervention by the observer/s and management.
OBSERVERS - BEHAVIOURAL COMMITMENT.

1  'Keeping Promises'.

Note whether or not a promise is kept.  
☐ Yes
☐ No

(Examples: figures & letters promised sent without needing a reminder, internal meetings organized as promised, individuals consulted, feedback charts put up etc.)

Make an effort to make a quick note and put in file - if not covered by on-going site notes.

2  Returning phone calls promptly.

(Whenever a phone call is made and the individual is unavailable)

☐ YES

☐ NO (but did ring eventually with plausible and sincere apology for delay)

☐ NO (had to ring again).

3  Spontaneous Contact from Observer.

Note that not all instances of spontaneous contact are positive. (NB cancelling meetings etc is negative). All instances that are not actually negative will be counted as positive.

☐ +ve
☐ -ve

1-3 ABOVE TO KEPT IN FILE AT UMIST - TO BE UPDATED AS APPLICABLE; 4-6 BELOW ASSESSSED EVERY FEW MONTHS FOR LONG PROJECTS OR MORE FREQUENTLY FOR SHORTER PROJECTS (AIM FOR MIN OF SIX ASSESSMENTS).
Diligent use of diary.

Many entries relating to goal setting and other issues
Some entries relating to goal setting and other issues
Some entries (but averages less than a page a month)
Very few entries (less than a page in total)
No entries at all

Pro-active and enthusiastic behaviour on site visits.

very positive and enthusiastic
generally positive and enthusiastic
non commital
an obvious lack of enthusiasm
no enthusiasm

Examples of Behaviour: has made preparation for visit. (eg planned itinerary); suggests future project related activities etc.

Enthusiastic Response to Practical Problems.

When problems arise (eg financial, managerial etc) how does the observer respond?

very positive and enthusiastic
generally positive and enthusiastic
non commital
an obvious lack of enthusiasm
no enthusiasm

not seen
SENIOR MANAGEMENT

1  Feedback chart.

Is the observer encouraged to put up the chart promptly? Are management more worried about the politics of its placement than its visibility?

1  Very poor - it appears they don't actually want the chart put up at all.
2  Poor - management appear to have some reservations about the chart/and or little enthusiasm
3  Neutral - no obvious objections, but no obvious enthusiasm either
4  Good - management show enthusiasm for the feedback chart
5  Very good - management show great enthusiasm for the feedback chart

X  Not Seen

2  Goal Setting Session.

Management attitude to letting men stop work to attend the goal setting.

1  Very poor - would simply not sanction any stoppage.
2  Poor - were very reluctant; remained keen for GS session to be held at lunchtime despite explanations
3  Average - allowed men time because they understand importance, but have clear misgivings
4  Good - happy to let men have some time to attend
5  Very good - time no object 'if that is what the project needs' (within reason)

X  Not seen

3  Observers' time needed.

Management attitude to observers taking time 'off work' to complete the checklist.

1  Very poor - N/A (project would not run!)
2  Poor - a real problem. It is obvious a less committed/weaker minded observer would give up in the face of management lack of commitment.
3  Average - somewhat of a problem. Management are torn on the issue because of some commitment to the project.
4  Good - largely happy to let observer take measure. Management commitment to the project generally over-rides time pressures.
5  Very good - time no object - within reason.

X  Not seen

Note that management on site may be 'happy' to give time only because they have been told to from 'on high'.
4 Mangement attitude to expenses.

When workers raise safety issues that require financing - what is the management attitude to spending money?

<table>
<thead>
<tr>
<th></th>
<th>Very poor</th>
<th>1</th>
<th>'no chance!'</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Poor</td>
<td></td>
<td>only if absolutely essential.</td>
</tr>
<tr>
<td>3</td>
<td>Average</td>
<td></td>
<td>if essential.</td>
</tr>
<tr>
<td>4</td>
<td>Good</td>
<td></td>
<td>if a good reason.</td>
</tr>
<tr>
<td>5</td>
<td>Very good</td>
<td></td>
<td>money no object (within reason).</td>
</tr>
<tr>
<td>X</td>
<td>Not seen.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D: Measure of Goal-Setting Quality

Appendix D contains the pro-forma developed to determine the quality of the goal-setting session. In addition to the performance of the goal-setting facilitator, the pro-forma measures the quality of the venue and the role of the senior management at the goal-setting session.
BEHAVIOURAL CHECKLIST FOR
GOAL-SETTING SESSION.

THOSE PRESENT.

Are there key senior management figures present? (Y/N)

Occupation of those present

What percentage of management are present? (Quantity Surveyors, Engineers and above).

Instructions: For the following use 1 to 5 scale:

Role of senior management at goal-setting session:

1. Extremely supportive.

2. Very supportive.

3. Supportive.

4. Present but indifferent.

5. Present but clearly not supportive.

NB. Simple contribution to the goal-setting session and how supportive is the site’s senior management or is the management using the meeting to forward some other agenda or is it apparent that they do not support/understand the principles of the intervention/research.

What percentage of sub-contractors are present?

What percentage of foreman/gangers are present?

What percentage of the operatives are present?
THE PRESENTATION.

Venue.

How quiet is the venue: .................................................................

① Not at all adequate.
   (Noise makes hearing impossible for most - in essence there was little point holding meeting but for the few at the very front).

② Not adequate.
   (Hearing impaired for many).

③ Reasonable.
   (Most of the audience could hear clearly).

④ Very good.
   (Nearly all the audience could hear clearly).

⑤ Excellent.
   (All present could hear clearly).

How suitable is the venue in terms of vision: ........................................

① Not at all adequate.
   (Vision impossible for most - in essence there was little point holding meeting but for the few at the very front).

② Not adequate.
   (Vision impaired for many).

③ Reasonable.
   (Most of the audience could see clearly).

④ Very good.
   (Nearly all the audience could see clearly).

⑤ Excellent.
   (All present could see clearly).
PERFORMANCE OF THE IN-HOUSE OBSERVER WHO LEADS THE GOAL-SETTING.

Scale:

1. Not at all - or too poorly to make any difference.
2. Makes a poor attempt only.
3. Makes a reasonable attempt that 'could be much better'
4. Makes a good attempt 'could only have been a little better'
5. Couldn't have done it better.

Instructions: Using the above scale to rate the following:

ITEMS: Does the presenter/ Do the presenters:

INTRODUCTION:

- stress that the emphasis on safety is moved to the operatives - and the general philosophy 1 2 3 4 5

- adequately describe the relevant category items (*4) 1 2 3 4 5

- state the mean scores for each category clearly. 1 2 3 4 5

- state the max and min scores for each category (if using a straight 'baseline'). 1 2 3 4 5

- adequately describe how the baselines were calculated. 1 2 3 4 5

- adequately describe how the feedback chart works. 1 2 3 4 5

- tell the operatives clearly where the feedback chart will be. 1 2 3 4 5

- when it will be updated. 1 2 3 4 5

- stress that there will be no (extra) 'come-back' on the operatives as a result of observation made. 1 2 3 4 5

- state clearly when the safety performance is going to be reviewed, i.e., 4/8 weeks. 1 2 3 4 5
GOAL SETTING.

* did the observer make all efforts to get the debate going (by asking questions of specific people and generally being participative). Not giving up in the face of apathy or hostility.

Goal-setting recording table.

<table>
<thead>
<tr>
<th>BASELINE AVE. %</th>
<th>CATEGORY</th>
<th>GOAL SET %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General Housekeeping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Personal Protective Equipment (P.P.E.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access-to-heights</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scaffolding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other ?</td>
<td></td>
</tr>
</tbody>
</table>
OPERATIVES

(For both assigned and participative sessions - make a note of all questions asked by operatives.) Note obvious signs of dissent. (E.g. shouts that are hostile rather than humorous in nature; groups talking and ignoring the meeting blatantly with no pretence at discretion etc.)

Estimate percentage of audience that paid attention throughout:


Estimate duration of talk that whole audience were paying attention:


FOR 'PARTICIPATIVE' SESSIONS ONLY

How participative is the session: Give each individual goal set a score based on the following scale:

1. Not at all/hardy at all (none or no sensible suggestions - in essence the goal had to be assigned).

2. A little (few suggestions - but the goal was set by a 'lone voice from the crowd' at least and was not simply assigned)

3. A moderate amount (there was some discussion - but the goal was set as much on random voices from the crowd as by discussion).

4. A good amount (there was discussion - but still more 'arbitrariness' than would be ideal).

5. A great deal (there was a true discussion and consensus about goals).

N.B. SCORES ON THESE ITEMS MUST, OF-COURSE, BE SEEN IN LIGHT OF THE GOAL SETTING PRESENTERS PERFORMANCE (SEE ABOVE).
Appendix E: Safety Performance Measure

Appendix E contains the enhanced safety performance measure of the previous H.S.E. research contract (reported in CRR 51/93). Some of the original items have been removed and replaced with more relevant items. In addition new categories have been developed to cover a wider range of sites and to increase the face validity of the measure. The format of the measure has also changed after discussion with some of the observers. The measure is now divided into three separate documents: raw data recording sheets, a handbook covering the safety issues of each item and transfer sheets to convert the raw data into percentage safety performance scores. When used the handbook was encapsulated in plastic to provide protection while the raw data recording sheets were bound together with a waterproof cover.
# Site: ..................................  Observer: ..................................
Start time: .....................  Finish time: .....................  Date: .....................

<table>
<thead>
<tr>
<th><strong>Housekeeping</strong></th>
<th><strong>Scaffolding</strong></th>
<th><strong>Access-to-heights</strong></th>
<th><strong>PPE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safe</strong></td>
<td><strong>Unsafe</strong></td>
<td><strong>Safe</strong></td>
<td><strong>Unsafe</strong></td>
</tr>
<tr>
<td>Nails in timbers</td>
<td>Missing boards (NOT toeboards)</td>
<td>Ladders too short - 3 rungs</td>
<td>Head protection</td>
</tr>
<tr>
<td>Unguarded holes</td>
<td>Trapped boards</td>
<td>Ladders noa</td>
<td>Eye protection</td>
</tr>
<tr>
<td>Rubbish on access routes</td>
<td>Missing toeboards</td>
<td>Safe use of ladders</td>
<td>Ear protection</td>
</tr>
<tr>
<td>Storage of materials</td>
<td>Missing guardrails</td>
<td>Broken or defective ladders</td>
<td>Protection from dust</td>
</tr>
<tr>
<td>Bombing</td>
<td>Missing baseplates</td>
<td>Safe use of mobile towers</td>
<td>Hand protection</td>
</tr>
<tr>
<td>Rubbish on scaffold lifts</td>
<td>Misuse of scaffold (access)</td>
<td>Safe use of mobile work platforms</td>
<td>Foot protection</td>
</tr>
</tbody>
</table>

Comments:

---

# Site: ..................................  Observer: ..................................
Start time: .....................  Finish time: .....................  Date: .....................

**Page two.**

<table>
<thead>
<tr>
<th><strong>Plant</strong></th>
<th><strong>'Mobile Access' Scaffolding</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safe</strong></td>
<td><strong>Unsafe</strong></td>
</tr>
<tr>
<td>Plant operated / parked next to excavations</td>
<td>Excavators used unsafely</td>
</tr>
<tr>
<td>Plant driven too fast</td>
<td>Dump trucks used unsafely</td>
</tr>
<tr>
<td>Plant with insecure loads</td>
<td>Mobile cranes used unsafely</td>
</tr>
<tr>
<td>No defined plant routes</td>
<td>Sling without packing</td>
</tr>
<tr>
<td>Illegal passengers</td>
<td>Loads without guide ropes</td>
</tr>
</tbody>
</table>

Comments:
HOUSEKEEPING CATEGORY

1. What proportion of timbers left lying around have nails left in?
   a) Look for nails that have not been taken out or bent over and hammered flat.
   b) Look for timbers with protruding nails, left lying around, but ignore timbers that are stacked neatly and/or in skips.

2. What proportion of openings are left uncovered or guarded?
   a) Look for any opening that is left uncovered/unguarded.
   b) Openings on the floor should be covered with 25mm plywood or have a guardrail around it.
   c) Openings in walls should be guard-railed off if below waist height (external) or where there is a drop next to it (internal).

3. What proportion of walkways, access routes and staircases are littered with rubbish/debris?
   a) Look for rubbish/debris on all areas of the site, including all floor levels.
   b) Walkways, access routes and staircases should be free from rubbish/debris.

4. What proportion of stored materials are stacked/stored unsafely?
   a) Look for brick pallets that are stacked higher than two.
   b) Look for timbers that are not stacked or stored neatly on 'bites'.
   c) Look for steel(s) that are not stacked neatly on 'bites'.
   d) Look for scaffold materials that are not stacked neatly.
   e) Look for materials that are stacked more than 2m (6.5ft) or a man's height.
   f) Look for materials that are stored next to open trenches or excavations.
   g) Look to make sure 'working' gaps are provided between stacks of materials.
   h) Look for overhanging materials obstructing access routes.
   i) Look for stacks that are unstable and/or overhanging.

5. What proportion of operatives who are working at heights have you seen throwing down objects?
   a) Look for any person throwing down any object.
   b) No object, of any kind, should be thrown down from a height.

6. What proportion of scaffold lifts are littered with rubbish/debris?
   a) Look for broken bricks, old mortar boards, used timbers, old paint tins, dried concrete, plastic sacks, etc.
   b) All scaffold platforms should be cleared off by the various trades.

SCAFFOLDING CATEGORY

1. What proportion of working scaffold platforms have missing boards?
   a) Look for any working platform which is not fully boarded.
   b) Do NOT include missing 'toeboards' in this question.
   c) No boards should be missing at all, including inside boards.

2. What proportion of scaffold boards are placed incorrectly, causing a trip?
   a) Look for scaffold boards not placed correctly on transoms.
   b) The ends of boards should be placed on transoms, with no more than 150mm (6") overhang, and a minimum of 50mm (2") overhang.
   c) Bevelled pieces of wood, fitted where necessary to prevent tripping.
   d) The maximum gap between boards is 25mm (1").
   e) Boards should be in good condition, i.e., no splits or warped.

3. What proportion of toeboards are missing on working scaffold platforms?
   a) Look for missing toeboards on any working platform.
   b) Toeboards should accompany guardrails.
   c) Toeboards should be 150mm (6") min high - usually a scaffold board.
   d) Toeboards should be fixed inside the standards with clips.

4. What proportion of guardrails are missing on working scaffold platforms?
   a) Look for missing guardrails on any working platform.
   b) Guardrails should accompany toeboards.
   c) Guardrails need to be provided where persons are liable to fall 2 metres (6.5ft) or more.
   d) They should be fixed at waist level height (4m or 150cm high).
   e) They should be fixed inside standards.
   f) Ladder access gaps to be no more than 750mm (2.5ft) wide.

5. What proportion of scaffolds/formwork have missing baseplates under the standards?
   a) Look for missing baseplates.
   b) All standards should have baseplates.

6. What proportion of site personnel who are working at heights are climbing up or down the outside of scaffolds?
   a) Look for anybody climbing up/down the outside of scaffolds.
   b) Everybody should use ladders or other means of safe access.
   c) No person should climb up/down the outside of a scaffold.
ACCESS TO HEIGHTS CATEGORY

1. **What proportion of ladders are too short for the job?**
   a) Look for ladders that extend less than 5 rungs above the landing place.

2. **What proportion of ladders are used without being tied or secured?**
   a) Look for ladders that are not securely fixed with clips or lashed near the top.
   b) Look for ladders not secured around the stiles.
   c) Ladders under 3m (10') do not need to be tied/footed.

3. **What proportion of ladders are used unsafely?**
   a) Look for ladders not on a firm, level base, supported on each stile and prevented from sagging or swaying.
   b) Look for more than one person on a ladder at any time.
   c) Look for people over-reaching while on ladders. This leads to over-balancing, thus, thighs and hips should be kept between the stiles.
   d) Look for persons re-positioning ladders by 'jumping', while standing on rungs.
   e) Look for people footing ladders. This is only allowed if they are under 5m (16'6") and cannot be fixed or lashed.
   f) Look for ladders not at the correct angle - (75 deg) - 1 horizontal to 4 vertical.
   g) Look for persons carrying materials up a ladder, in sack or other suitable container which does not allow at least one hand on the ladder.

4. **What proportion of ladders are placed with broken or defective rungs?**
   a) Look for any ladder with broken and/or missing rungs as they should not be used.

   (Access-to-heights continued on next page)

5. **What proportion of mobile tower scaffolds are being used unsafely?**
   a) Look at the maximum height when tower is used:
      i) Indoors, on solid level ground max height = 3.5 x smallest base width;
      ii) Outdoors, on firm level ground max height = 3 x smallest base width;
      iii) If outriggers are used, use the above rules taking into account the position of the outriggers.
   b) Look for the mobile tower being used on a ground surface which is too soft or sloping.
   c) Look for people unattaching operations which may overturn the tower, eg pushing or pulling (rocking actions) against a building.
   d) No ladders or trestles should be used on the working platform.
   e) Look for a safe method of access: Internal ladders should be used, which are fixed securely.
   f) The working platform of a mobile tower should be fully boarded.
   g) No guardrails and/or toeboards should be missing.
   h) When a mobile tower is being used the wheels should be locked.
   i) Look at the access route when a mobile tower is being moved. It must be free of holes, pits, ducts, gratings or overhead cables.

6. **What proportion of mobile work platforms (MWP) being used unsafely?**
   a) When raising the platform of a MWP site personnel should check for any overhead obstructions.
   b) Look at the distance maintained between overhead power cables and a MWP.
      No part of a MWP should be closer than 15m to an overhead line on steel towers (9m if on wooden poles) unless by arrangement with Electricity Board.
   c) Look for any site personnel not wearing safety harnesses when using a MWP.
   d) Look for any site personnel wearing safety harnesses attached to a point outside the platform.
   e) A MWP should not be used over or adjacent to a cellar, basement, sewer, drain, manhole, old trench, uncompacted backfill or anything else that might collapse.
   f) When operating on a slope a MWP should be properly levelled out on stabilisers or outriggers.
   g) Look for any site personnel travelling in a MWP with the platform raised on unsuitable ground, ie, sloping or ground which might collapse.
   h) A MWP should not be used when the wind speed is excessive.
      Maximum wind speed = a 'strong breeze' - large branches in motion.
      Umbrellas used with some difficulty (30mph).
   i) The working platform of a MWP should be free from objects which might fall, eg tools, materials, etc.
PERSONAL PROTECTIVE EQUIPMENT

1. What proportion of the site personnel on the site are not wearing hard hats?
   X] Look for anybody not wearing a hard hat.
   a] The exception is in site huts.

2. What proportion of the site personnel on the site are not wearing goggles or other items of eye protectors when using motorized cutting equipment/cartridge operated tools?
   X] Look for anybody not wearing goggles.
   a] All personnel using abrasive wheels, cutting equipment and cartridge operated tools require some form of eye protection, either goggles, face shields or visors.

3. What proportion of site personnel are not using ear defenders while using noisy equipment?
   X] Look for any person not using ear defenders while using noisy equipment.
   a] As a general rule, if a machine is so noisy that operatives have to shout to carry out a conversation, ear defenders are required.

4. What proportion of site personnel are not wearing face masks in dusty conditions?
   X] Look for any operative not wearing face masks while working in dusty conditions.
   a] Face masks should be worn in confined spaces where there is a lot of dust.

5. What proportion of site personnel are not wearing gloves while handling materials which are hot, have sharp edges and could cause skin problems?
   X] Look for operatives not wearing gloves while using releasing agents on shuttering, hot tar or similar products, and materials with sharp edges or other harmful substances.

6. What proportion of site personnel are not wearing protective footwear?
   X] Look for operatives wearing trainers/casual shoes while on site.
1. What proportion of site plant is being operated OR parked next to excavations, which are not currently being employed to dig or fill excavations or trenches?
   a) Look for any item of plant that is parked next to an open trench.
   b) Mobile cranes, concrete pumps, un-utilized excavators, air compressors etc, should be 3m (@10ft) away from excavations and trenches.
   c) Trenches and excavations should be guarded/fenced or have timber baulks placed around them.

2. What proportion of site plant is being driven too fast?
   a) Look for reckless driving.
      i) Above site speed limit i.e., 5 mph.

3. What proportion of site plant is being driven or operated with insecure loads?
   a) Look for scaffolding, timber, steel reinforcement bars, plastic pipes and similar material moved around site on dumpers OR JCB's buckets without being tied off.
   b) Materials fully inside the dumper OR JCB's bucket is considered secure.
   c) Look for plant carrying loads which make it unsafe to operate, i.e., driver cannot see over load, or cannot steer properly.
   d) Look for illegal passenger holding materials on dumper or JCB buckets.
   e) Look for insecure loads that are being lifted by a crane.

4. What proportion of access routes DO NOT have clearly defined plant and people areas?
   a) Look for separate access routes for plant operatives, i.e., keeping plant and people separate.

5. What proportion of plant are carrying 'illegal' passengers?
   a) No item of plant should carry passengers unless it was designed to do so.

6. What proportion of excavators are being used unsafely?
   a) Look for the driver/operator leaving the bucket raised whilst the machine is unattended.
   b) Look for the driver/operator swinging the bucket over a trench or excavation whilst men are working below.
   c) Look for items of plant parked in such a way that they could cause a trap hazard (against a building or other plant) when the excavator slew.

7. What proportion of dump trucks (Mosp's, Volvo's etc.) are being used unsafely?
   a) The haul gradient should be no greater than 1 in 7.
   b) Look for any dump truck being driven with the dumper skip raised.
   c) When reversing there should be clear audible and/or visual warnings given.
   d) When reversing, stops for vehicles should be put in place to prevent dump trucks toppling into excavations.

8. What proportion of mobile cranes are being used unsafely?
   When the crane is lifting a load:
   a) The outriggers should be fully extended.
   b) The lift should be 'clean' NOT snatcheted.
   c) The load should be lifted rather than dragged.
   d) The 'C' hooks should NOT face towards the inside of a load, they should always face outwards.
   e) Look for items of plant parked in such a way that they could cause a trap hazard (against a building or other plant) when the crane slew.
   f) Look at the distance maintained between overhead power cables and a crane. No part of a crane should be closer than 15m to an overhead line on steel towers (3m if on wooden poles) unless by arrangement with Electricity Board.

9. What proportion of slings are used without packing/lifting loads?
   a) Look for unprotected slings.
      i) Slings should always be protected from sharp edges with packing.

10. What proportion of large loads are lifted without guide ropes fixed?
    a) Look for large loads being lifted without guide ropes.
       i) A large load is defined as concrete slabs, compressors, shuttering etc.
ACCESS TO HEIGHTS (MOBILE SCAFFOLDING) CATEGORY.

1. What proportion of working mobile access scaffold platforms have missing boards?
   - Look for any working platform which is not fully boarded.
   - Do NOT include missing 'toeboards' in this question.

2. What proportion of toeboards are missing on working mobile access scaffold platforms?
   - Look for missing toeboards on any working platform.
     a) Toeboards should accompany guardrails.
     b) Toeboards should be 150mm (6") min high.
     c) Toeboards should be fixed inside the platform.

3. What proportion of guardrails are missing on working mobile access scaffold platforms?
   - Look for missing guardrails on any working platform.
     a) Guardrails should accompany toeboards.
     b) Guardrails need to be provided where persons are liable to fall 2 metres (6.5ft) or more.
     c) They should be fixed at waist level height (1m or 3ft high).

4. What proportion of mobile access scaffolds are being used beyond their maximum permissible height?
   - Look at the maximum height when tower is used:
     I] Indoors, on solid level ground max height = 3.5 x smallest base width
     II] Outdoors, on firm level ground max height = 3 x smallest base width
     III] If outriggers are used, use the above rules taking into account the position of the outriggers.

5. What proportion of site personnel, using mobile access towers, are undertaking operations likely to overturn the tower?
   - Look for people undertaking operations which may overturn the tower, eg pushing or pulling (rocking actions) against a building.
   - No ladders or trestles should be used on the working platform which could cause an overturning moment.

6. What proportion of mobile access scaffolds do not have a safe method of access?
   - Look for a safe method of access: internal ladders should be used, which are fixed securely.

7. What proportion of mobile access towers are being used without their wheels being locked?
   - When a mobile tower is being used the wheels should be locked.

8. What proportion of mobile access towers are being used in unsafe locations?
   - Look for the mobile tower being used on a ground surface which is too soft or sloping.
   - Look for the mobile tower being used near to holes, pits, ducts, gratings, etc or under overhead cables.
SITE ........................................... OBSERVER ..................................................

DATE ........................................... TIME OF OBSERVATION ..................................

NUMBER OF SITE PERSONNEL - (DIRECT) .................................. (SUB CONTRACT) ..................

TYPE OF SITE PERSONNEL (CIRCLE RELEVANT NUMBER/5)


[15] OTHER .................................................................

NUMBER OF SUPERVISORS / ON-LINE MANAGEMENT ..................

WEATHER (CIRCLE RELEVANT NUMBERS TO BUILD A REALISTIC STATEMENT OF THE CURRENT WEATHER)


WHAT ACTIVITIES ARE OCCURRING? (CIRCLE RELEVANT NUMBER; IF MORE THAN ONE ACTIVITY, CIRCLE MORE THAN ONE NUMBER.)


[3] SCAFFOLDING ..................................................


[6] STEEL ERECTION, WHAT FLOOR ABOVE GROUND?

[7] CLADDING, WHAT FLOOR ABOVE GROUND? PLACE NUMBER IN BOX

[8] ROOFWORK

[9] PLASTERING ..................................................

[10] FINISHING, INC. PAINTING (EXTERNAL)


[12] OTHER .................................................................

OTHER ISSUES

[1] SINCE YOUR LAST OBSERVATION HAS THERE BEEN A VISIT BY:-

COMPANY SAFETY OFFICER ............................................................... YES NO

HEALTH & SAFETY EXECUTIVE INSPECTOR ........................................ YES NO

ANY OTHER SIGNIFICANT PERSON (STATE WHO) .................................... YES NO

WHOSE VISIT MAY HAVE INFLUENCED SITE SAFETY ................................ YES NO

[2] SINCE YOUR LAST OBSERVATION HAVE THERE BEEN ANY SERIOUS ACCIDENTS? YES NO

IF YES, GIVE BRIEF DETAILS:

………………………………………………………………………………………………………………

………………………………………………………………………………………………………………

………………………………………………………………………………………………………………

………………………………………………………………………………………………………………

………………

[3] SINCE YOUR LAST OBSERVATION HAS ANY SAFETY TRAINING OR ANY OTHER SAFETY IMPROVEMENT CAMPAIGN BEEN GIVEN TO ANY SITE PERSONNEL? YES NO

IF YES, IN WHAT FORM DID THIS TRAINING OR CAMPAIGN TAKE? .................

………………………………………………………………………………………………………………

………………………………………………………………………………………………………………

………………………………………………………………………………………………………………
HOUSE-KEEPING CATEGORY
1. What proportion of timbers left lying around have nails left in?
2. What proportion of openings are left uncovered or unguarded?
3. What proportion of walkways, access routes and staircases are littered with rubbish/debris?
4. What proportion of stored materials are stacked/stored unsafely?
5. What proportion of operatives, who are working at heights, have you seen throwing down objects?
6. What proportion of scaffold lifts are littered with rubbish/debris?

\[
\% \text{ Safety Performance Level} = \frac{\text{Total safe}}{\text{Total safe} + \text{Total unsafe}} \times 100 = \% 
\]

SCAFFOLDING CATEGORY

<table>
<thead>
<tr>
<th>SAFE</th>
<th>UNSAFE</th>
<th>NOT SEEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>X</td>
</tr>
</tbody>
</table>

1. What proportion of working scaffold platforms have missing boards?
2. What proportion of scaffold boards are placed incorrectly, causing a "trap"?
3. What proportion of toolboards are missing on working scaffold platforms?
4. What proportion of guardrails are missing on working scaffold platforms?
5. What proportion of scaffold/ formwork have missing baseplates under the standards?
6. What proportion of site personnel, who are working at height, are climbing up or down the outside of scaffolds?

\[
\% \text{ Safety Performance Level} = \left[ 1 - \frac{\text{Total unsafe}}{\text{Total safe} + \text{Total unsafe}} \right] \times 100 = \% 
\]
### Access to Heights Category

<table>
<thead>
<tr>
<th></th>
<th>Safe</th>
<th>Unsafe</th>
<th>Not Seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What proportion of ladders are too short for the job?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2. What proportion of ladders are used without being tied or secured?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>3. What proportion of ladders are used unsafely?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>4. What proportion of ladders are placed with broken or defective rungs?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>5. What proportion of mobile tower scaffolds are being used unsafely?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>6. What proportion of mobile work platforms (MWP) are being used unsafely?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

\[
\% \text{ Safety Performance Level} = \left[ 1 - \frac{\text{Unsafe}}{\text{Total}} \right] \times 100 = \% \]

### Personal Protective Equipment

<table>
<thead>
<tr>
<th></th>
<th>Safe</th>
<th>Unsafe</th>
<th>Not Seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What proportion of the site personnel on the site are not wearing hard hats?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2. What proportion of the site personnel on the site are not wearing goggles or other items of eye protectors when using motorized cutting equipment/carnage operated tools?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>3. What proportion of site personnel are not using ear defenders while using noisy equipment?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>4. What proportion of site personnel are not wearing face masks in dusty conditions?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>5. What proportion of site personnel are not wearing gloves while handling materials which are hot, have sharp edges and could cause skin problems?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>6. What proportion of site personnel are not wearing protective footwear?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

\[
\% \text{ Safety Performance Level} = \left[ 1 - \frac{\text{Unsafe}}{\text{Total}} \right] \times 100 = \% \]
## Plant Category

<table>
<thead>
<tr>
<th></th>
<th>SAFE</th>
<th></th>
<th>UNSAFE</th>
<th>NOT SEEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What proportion of site plant is being operated or parked next to excavations, which are not currently being employed to dig or fill excavations or trenches?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. What proportion of site plant is being driven too fast?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. What proportion of site plant is being driven or operated with insecure loads?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. What proportion of access routes do not have clearly defined plant and people areas?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. What proportion of plant are carrying 'illegal' passengers?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. What proportion of excavators are being used unsafely?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. What proportion of dump trucks (Mitsubishi, Volvo etc.) are being used unsafely?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. What proportion of mobile cranes are being used unsafely?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. What proportion of slings are used without packing to protect them from sharp edges when cranes are lifting loads?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. What proportion of large loads are lifted without guide ropes fixed?</td>
<td>0 1 2 3 4 5 6 7 8 9 10 x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

% Safety Performance Level = \[
\left[ \frac{1 - \text{average}}{100} \right] = \%
\]
## ACCESS-TO-HEIGHTS (MOBILE SCAFFOLDING) CATEGORY

<table>
<thead>
<tr>
<th>Question</th>
<th>Safe</th>
<th>Unsafe</th>
<th>Not Seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What proportion of working mobile access scaffold platforms have missing boards?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2. What proportion of toeboards are missing on working mobile access scaffold platforms?</td>
<td>0 1 2 3 4 5 5 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3. What proportion of guardrails are missing on working mobile access scaffold platforms?</td>
<td>0 1 2 3 4 5 5 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>4. What proportion of mobile access scaffolds are being used beyond their maximum permissible height?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5. What proportion of site personnel, using mobile access towers, are undertaking operations likely to overturn the tower?</td>
<td>0 1 2 3 4 5 5 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6. What proportion of mobile access scaffolds do not have a safe method of access?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>7. What proportion of mobile access towers are being used without their wheels being locked?</td>
<td>0 1 2 3 4 5 5 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>8. What proportion of mobile access towers are being used in unsafe locations?</td>
<td>0 1 2 3 4 5 5 7 8 9 10</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{% Safety Performance Level} = 1 - \frac{\text{Total Unsafe}}{\text{Total}} \times 100 = \%
\]
Appendix F: Safety Improvement Measure

Appendix F contains the procedure for determining the amount of safety improvement.
Safety Improvement Measure

To provide a standardized indicator of the effect of the goal-setting and feedback intervention, the ‘d’ statistic was used.

In mathematical terms, for the pre-post difference:

\[ d = \frac{\bar{X}_{\text{post}} - \bar{X}_{\text{pre}}}{\text{SD(pooled)}} \]

i.e. ‘d’ is the difference in the mean scores divided by the standard deviation for the before and after scores. In less technical language ‘d’ provides an indication of whether a difference between two means is large or small in relation to the spread of scores in the sample. When the magnitude of ‘d’ is greater than 0.5 the effect is considered large (Cohen, 1987).
Appendix G: Awareness of Intervention

Appendix G contains the pro-forma developed to determine the degree of operative awareness of the safety intervention.
OPERATIVES AWARENESS OF INTERVENTION CHECKLIST.

1. Were you on this site during the goal-setting/review meeting?
   - Yes 1
   - No 2

2. If yes did you go?
   - Yes 1
   - No 2

3. Do you know about the safety improvement campaign (i.e. the chart, etc)?
   - Yes 1
   - No 2

4. Do you know where the chart/s is/are?
   - Yes 1
   - No 2

5. Ask, if not volunteered during ques. 2 and 3
   - Yes - weekly 1
   - Yes - sometimes 2
   - Yes - < once a month 3
   - No 4

6. What are the goal levels?

<table>
<thead>
<tr>
<th>Category</th>
<th>Goal level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping</td>
<td></td>
</tr>
<tr>
<td>Scaffolding</td>
<td></td>
</tr>
<tr>
<td>Access-to-height</td>
<td></td>
</tr>
<tr>
<td>PPE</td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

125
What are the current levels of performance?

<table>
<thead>
<tr>
<th>Category</th>
<th>Current performance levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping</td>
<td></td>
</tr>
<tr>
<td>Scaffolding</td>
<td></td>
</tr>
<tr>
<td>Access-to-height</td>
<td></td>
</tr>
<tr>
<td>PPE</td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

8. Do you ever discuss the weekly performance levels with other workers?
   - At least every week: 1
   - Sometimes (<once a week): 2
   - Never: 3

9. How accurate do you think the percentage scores put on the chart weekly are?
   - Very accurate: 1
   - Reasonably accurate: 2
   - Rather inaccurate: 3
   - Totally inaccurate: 4

10. Would you say you are making a greater effort to act safely because of the intervention?
    - Yes: 1
    - Remain the same: 2
    - No: 3

11. Do you think others are making a greater effort to act safely because of the intervention?
    - Yes: 1
    - Remain the same: 2
    - No: 3
Acknowledgements

The research team are very grateful to the following contractors who undertook the implementation of the management techniques which form the basis of this research and who made sites available:

Balfour Beatty Construction;
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Tarmac;
Taylor Woodrow;
Trafalgar House; and,
Wimpey.

Without their enthusiastic and constructive support, the research would not have been possible.

We are also indebted, yet again, to our colleagues from the Health & Safety Executive, who have so generously supported our endeavours, financially, morally and with advice and assistance so freely given. We hope, and trust, that they feel that their support has been rewarded, both by the immediate results of the research and by the application of its outcomes in a more enlightened and safety-conscious industry.