Safety Behaviour in the Construction Sector

Report to the Health and Safety Authority, Dublin
& the Health and Safety Executive, Northern Ireland

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Foreword by the Health and Safety Authority

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Almost two years ago, against the background of widespread concern over the level of fatal and serious accidents in the Irish Construction Industry, it was recognised that the culture in the industry generally was not conducive to health and safety. In an effort to develop a better understanding of this culture and devise practical and targeted initiatives to positively affect behaviour in the construction sector, the Health and Safety Authority and the Health and Safety Executive, Northern Ireland jointly commissioned a research project, and this document is the culmination of that research process. The research is a landmark piece of work as it is the first completed research report from the Occupational Safety and Health Institute of Ireland (OSHII), and the Authority welcomes its publication.

The Authority wishes to express its gratitude to the construction companies who participated in this study and also to the researchers, Dr Nick McDonald and Mr Victor Hrymak, the authors of this report.

The next phase

The publication of this research does not represent the completion of the task however. This work, which has been reviewed by the Board of the Authority and its Legislation and Guidance sub-committee raises many issues for discussion, consideration and future action and will be referred to both the Construction Safety Advisory Committee and the Construction Safety Partnership (CSP). The Authority particularly welcomes the fact that the report affirms a number of initiatives already underway in the Construction Safety Partnership and indeed, incorporated as legal requirements in the recent

Safety, Health and Welfare at Work (Construction) Regulations, 2001 which impose significant new legal responsibilities on project supervisors in important areas such as safety training, welfare and safety consultation. We also note the reported external perceptions of the Authority held by some of our stakeholders and recognise the challenge we face to develop a greater understanding of the complexities of the Authority's role in this sector.

The Research Process

OSHII was invited to carry out the research and a number of tenders were submitted from its constituent members which were peer reviewed by external academics and safety practitioners. The research was awarded to a joint proposal from Trinity College Dublin / Dublin Institute of Technology. Work on the project commenced in 2000 with site work being carried out from November 2000 to February 2001. A number of meetings were held between the researchers and a joint HSA / HSENI steering group at intervals in the duration of the project and a substantive draft report was made available in June 2001. This then underwent a peer review process which was completed in December 2002. Following consultation between both clients and OSHII in January 2002, a final report was issued in March 2002.

Objectives and Design

The primary goal of this research was to investigate the factors that influence safety behaviour and compliance with safety requirements on construction sites. This goal was realised through the following objectives:

- The first objective was to examine compliance with safety requirements in the construction industry.
- The second was to investigate the behaviours, perceptions and attitudes associated with safety in construction.
- The third was to investigate management practices and associated documentation relating to safety.
- The final objective was to seek to establish what factors are significantly associated with safe behaviours or safety compliance.

The high incidence of falling from heights in construction accident statistics led to a focus, particularly in the site observations and operatives' questionnaire, on factors associated with falling from heights

The design adopted was a cross-sectional one based on a comparison of a representative sample of 18 sites in Ireland. The sample included large and smaller sites, housing and general contracting, and metropolitan and regional areas in the Republic and Northern Ireland. An eighteen-item safety audit checklist was used to as a protocol for measuring safety compliance. A survey of construction operatives addressed the perception of risk, behaviour in risk situations, attitudes and safety climate. A total of 244 site operatives were surveyed. 59 site management and others (including safety representatives) who have a role in safety management were interviewed concerning a range of safety management functions and effectiveness. Safety documentation on ten sites was examined. A sample of ten inspectors was interviewed.

Dissemination of Report

The full text of this report will be displayed on the websites of the HSA and the Irish Focal Point website of the European Safety Agency. Furthermore, the HSA urges all of the stakeholders in the construction sector to consider the research findings and take on board those recommendations applicable to their particular roles which will help create safer working conditions on Irish construction sites.

Relevant Information on the Safety, Health and Welfare at Work (Construction) Regulations, 2001

These Regulations impose significant new legal responsibilities on project supervisors in important areas such as safety training, welfare and safety consultation.

The requirement for safety training is being introduced on a phased basis beginning with all employees newly recruited into the sector, who were required to have attended the FÁS SAFE PASS training course with effect from January 2002. The requirement applies to all new sites from 1st May 2002 and will apply to all remaining workers in the sector by 1st June 2003. The existing Construction Skills Certification Scheme has also been strengthened by the Regulations. From 1st January 2002, all scaffolders are required to carry a card displaying their skills details, and all Project Supervisors Construction Stage (PSCS) are required to make arrangements to ensure that only CSCS card-holders are recruited for scaffolding work. This requirement will be extended to crane drivers, banksmen, advanced scaffolders and operators of certain mechanical plant from 1st July 2002 and to a range of other trades from 1st June 2003.

Regarding safety consultation, from 1st January 2002, all sites with more than 20 workers were required to actively facilitate the appointment of a safety representative to facilitate effective consultation.

The Regulations also provide for more effective arrangements for ensuring that adequate welfare facilities are available, by requiring the Project Supervisor Construction Stage (PSCS) to co-ordinate the provision of these facilities on site.

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Executive Summary

Objectives and design

We have a poor understanding of how either individual attitudes and behaviour or management action is related to safety in the construction industry. Thus, the primary goal of this research was to investigate the factors that influence safety behaviour and compliance with safety requirements on construction sites. This goal was realised through the following objectives:

- The first objective was to examine compliance with safety requirements in the construction industry.
- The second was to investigate the behaviours, perceptions and attitudes associated with safety in construction.
- The third was to investigate management practices and associated documentation relating to safety.
- The final objective was to seek to establish what factors are significantly associated with safe behaviours or safety compliance.

The high incidence of falling from heights in construction accident statistics led to a focus, particularly in the site observations and operatives' questionnaire, on factors associated with falling from heights

The design adopted was a cross-sectional one based on a comparison of a representative sample of 18 sites in Ireland. The sample included large and smaller sites, housing and general contracting, and metropolitan and regional areas in the Republic and Northern Ireland. An eighteen-item safety audit checklist was used to as a protocol for measuring safety compliance. A survey of construction operatives addressed the perception of risk, behaviour in risk situations, attitudes and safety climate. A total of 244 site operatives were surveyed. 59 site management and others (including safety representatives) who have a role in safety management were interviewed concerning a range of safety management functions and effectiveness. Safety documentation on ten sites was examined. A sample of ten inspectors was interviewed.

Results

Compliance with safety requirements

The level of safety compliance across the sites was quite variable. In relation to the items concerning prevention of falls from heights, compliance ranged from good to poor. Thus, only two sites had full compliance on edge protections and handrails, five sites on unguarded openings. House builders tended to be generally worse than general contractors on these measures. There were ladders that were not tied in eight sites. Thus it can be concluded that there was much that could be improved in the majority of sites.

Perception of risk

How well are the risks associated with falling from heights perceived? In general nine situations concerning working with ladders, scaffolding and on roofs were perceived as high risk. However a small minority of workers in each site saw many of these situations as low risk. The frequency of these situations was generally seen to be fairly low in the construction industry, though constructions sites are generally perceived to be dangerous places.

The great majority of workers reported that they would respond constructively to risky situations, either reporting the defect, fixing it, or stopping work (depending on the situation). However, a sizeable minority (between ten and twenty percent) would just continue working (and this was between twenty and thirty percent for ladders being too short and working on roofs in bad weather). Thus there is a small minority who may not perceive risks accurately and a larger minority who say they are prepared to continue working in risky situations.

Training

Almost forty percent of operatives report that they have received no safety training from the main contractor. For a further fifty percent their safety training comprised the induction course (lasting between ten minutes and one and a half-hours). While managers consider this safety training to be necessary, many believe the way it is currently carried out is primarily to "cover themselves" in case something goes wrong. Eleven percent of the sample has received safety training lasting more than one day. Very few sites claimed to have a systematic safety training schedule for their employees, and safety training was not usually a consideration in recruiting operatives.

Thus it seems clear that for the majority of operatives the main way in which they achieve knowledge of the risks of their work is through their experience of work itself. Even where the main contractor provides induction training, this is often perceived as a formality, to protect the company, with little expectation that it would influence the knowledge and behaviour of workers. The low level of provision of safety training is particularly worrying considering that twenty five percent of the sample report that they have worked in the industry for less than one year and fifty percent less than two years. Thus their level of experience of the risks associated with the job and of how to manage them may not be that great.

Safety management

Both the management interviews and analysis of safety documentation indicated that whereas virtually all the sites had a safety plan, these were mostly generic documents that could be applied to any construction site. Thus few contained a management structure with clear delegation of responsibilities. Although half the sites had risk assessments, which were site specific, in some of these not all the relevant site activities were addressed. These documents played little or no role in ongoing management activities and their function appeared solely to meet legislative requirements.

Safety audits were conducted in all sites, mostly following a checklist method with a written audit report. However few sites documented improvement measures or actions taken to remedy audit deficiencies. Hazard reporting was rarely documented and the same was true of incidents and near misses. Communication about safety was most often informal and verbal. A quarter of the sites had regular dedicated safety meetings, though for others safety was a frequent item on site meetings.

In all but one site some or all of the management had undertaken CIF/CEF training courses. Thus, having managers with this training did not discriminate between sites which were better or worse in safety compliance. A small number of safety managers had also undertaken diploma courses in health and safety management. Six sites had a safety representative. Most often, these had been appointed by the management.

Role of inspections

The majority of sites had at some time been subject to an inspection by national authority inspectors. The primary focus of inspections concerns compliance with safety requirements and the interviews with inspectors confirm many of the findings of this study in relation to compliance levels in the industry. While site documentation is often inspected, there is no systematic methodology for auditing or assessing the safety management system as a functioning management process which is designed to ensure safety on site. Indeed, inspectors do not see it as their role to conduct such an audit. Inspections themselves do not appear to have a major direct influence on the effective management of site safety.

Factors associated with safety compliance

The presence of a safety representative on site shows the strongest relationship with safety compliance. The only other factor associated with compliance is the second safety management factor - effectiveness of response to audits and hazard reports. Although there is a tendency for safety representatives to be present in sites with better general safety management performance, it would be a mistake to conclude that this general safety management factor accounts for the relationship between safety representatives and compliance. It appears that safety representatives influence safety compliance not only through their influence on the response to audits and hazards but also through other means. Thus they encourage the reporting of hazards and help ensure that these reports lead to better safety compliance on site. Their presence also makes it significantly less likely that workers will continue to work in hazardous situations.

There is no significant association between the general *Safety management* factor and any other factor (with the possible exception of the appointment of safety representatives, which is almost significant). There is no significant correlation with *Effectiveness of the management system*, with safety compliance or the variables assessing safety behaviours. These results pose the question: why does so much activity which is undertaken in the name of safety apparently have so little influence on safety compliance and safety behaviours?

There are no significant relationships between the attitudinal variables (safety attitudes, perception or risk and safety climate) and any of the safety outcome variables (compliance,

safety behaviours). This suggests that the difficulty of getting more consistent and higher standards of safety compliance may not depend on attitudes and perceptions of workers and managers. Systemic factors are more important – having mechanisms for reporting hazards, following up on hazard reports and audits, and doing what it takes to ensure that hazard reports and audits are translated into effective compliance with safety requirements.

Recommendations

Safety Representatives

This study has demonstrated the potentially strong role which safety representatives can play in influencing both behaviour and compliance with safety requirements, and ensuring that both audits and hazard reports are effectively dealt with. All sites should have safety representatives and their role and functions should be reinforced as part of the safety management system.

Training and certification

The most plausible interpretation of the findings in relation to safety representatives is that their effectiveness is largely due to their ability to exert influence and persuasion through informal interpersonal methods. The social and interpersonal skills which this requires should not be the prerogative of safety representatives alone. There is enormous scope for improving the ability of those who have management and safety responsibilities, and indeed all those who work in construction, to manage the human relations of safety more effectively. These skills are trainable and susceptible to systematic development. They need to be clearly and systematically addressed in all training related to safety in construction.

As far as possible, training should not only seek to foster awareness of hazard and risk, but it should strengthen knowledge and skills in managing risky situations effectively. This should include the communications and interpersonal skills, which are necessary at every level to ensure that the correct influences on behaviour are consistently reinforced. Transfer of these skills to the working environment needs to be carefully fostered and monitored. All levels of training should be addressed including:

- Site induction and refresher training
- Initiation to the industry and specific crafts / trades training
- Management training. Particular attention should be paid to fostering participation in in-depth professional safety management training at diploma and masters level.

The safety management system

Clearly the requirements for safety management systems need to be radically reviewed and overhauled. It is too easy to comply with the law through having a paper system, which does not effectively operate in practice. This review should address:

- Developing stronger criteria for active and effective safety management systems. These should include design and planning, day-to-day management and monitoring and auditing practices.
- These criteria should be developed in new ways of auditing safety management systems, which can routinely and reliably assess the activity and effectiveness of the system.

- The role of safety officer should be strengthened to ensure that it is less easy to marginalise what is essentially an advisory role.
- The accountability of operational management needs to be made clearer and firmer, and this accountability needs to be tied to measurable outputs of the safety management system, including the demonstration of effective action to address identified defects and hazards.

The Construction Safety Partnership Plan

At the time that the field work for this study was collected, the Construction Safety Partnership Plan was in the early stages of its implementation. The evidence suggests that the safety representatives' scheme is highly successful. On the other hand safety training for managers does not seem to be delivering a higher standard of safety compliance on many sites. If the CSPP is to be successful in improving construction safety, it must be reviewed and adjusted to address the following issues.

- Extending the safety representative scheme to all sites. Developing effective safety representation on all sites will need more effective support from the social partners to make this work where management commitment is lower than on sites where representatives have already been appointed.
- An effective methodology for routine site audits must be developed. Auditing will not be effective unless it includes an effective system for monitoring the implementation of safety measures and response to hazard reports. The CSPP only states that the current auditing arrangements will be reviewed by early 2001. This should be strengthened to require more stringent criteria for auditing.
- The recommendations for the introduction of a Safety Management System by the Construction Industry Federation should urgently be reviewed in the light of the evidence of this report. Recommendations for Safety Management Systems must address the problem of translating a paper demonstration that there is a management system into clear evidence that that system is delivering improvements in safety on the ground.
- There is a wide range of training recommendations in the CSPP. However it is important to ensure and to demonstrate that this training is effective and that the safety messages are transferred to the site and result in safer behaviour and more effective safety management. The management training programme should be urgently reviewed in the light of the lack of evidence that it is having an impact. The other training initiatives should also be reviewed with respect to how well they address the social and interpersonal processes which are essential to ensuring that safety is effectively addressed on a day-to-day basis.
- The role and activities of Inspectors should be reviewed with a view to maximising their impact on site safety in a cost-effective manner. The advantages of developing additional methods of influence which do not require legal sanction should be explored.

The CSPP is a major social initiative with considerable resource implications for all the social partners. Yet there is no proposal to monitor whether or not this initiative will be

effective in improving safety in the construction industry. A systematic evaluation strategy needs to be developed urgently.

Literature review: Construction Related Fatality Statistics

The number of fatalities at work in the construction sector remains a matter of serious concern for the Government, employers and employees alike (HSA, 1999).

Statistics on fatalities generally places the construction sector as the second highest industry, only surpassed by the agricultural sector. Among the most common sources of fatalities in construction, falls from heights is the category that accounts for the highest proportion of deaths. A brief comment of some statistics will be given below, especially for Northern Ireland and the Republic. Some international figures for falls from heights will also be reproduced as an example of the relatively high percentage of fatalities in this category reported in the literature.

Construction Fatality Rates in Europe

The HSE (2001) reports that the European average fatality rate in construction was 13.3 per 100,000 workers in 1996. In contrast with that figure, the HSA (1999) has reported a rate of 8 fatalities for 100,000 workers for the Republic of Ireland in 1996. Although under the European average of fatalities, Ireland still shows a higher incidence than countries as France, the United Kingdom or Spain (see table 1).

Country	Year	Fatality Rate per 100,000 workers
Europe	**1996**	**13.3**
Germany	1996	15.4
Italy	1996	14.4
France	1996	12.1
RoI	1996	8.0
UK	1996	5.6
Spain	1996	4.2

Table 1: Fatality rates for selected EU Member States

Construction-related fatalities in the UK

Brabazon et al. (2000) looked at the rate of fatalities between 1993 and 1998. For the primary building trades, the rate was 1 in 11,000 per year. This is below the HSE intolerable risk criterion of 1 in 1000 and HSE guideline of 1 in 10,000. However, scaffolding trades (1 in 5,400), roofing trades (1 in 3,800), steel erectors, bar bending and structural trades (1 in 3000) were above the HSE's guideline.

Brabazon et al. (2000) noted that since the Construction Design and Maintenance Regulations were introduced in the UK in 1994, the overall fatality rate had decreased by 10%. However the downward trend in the number of injuries on construction sites, is now slowing.

Davies & Tomasin (1996) reported that 70-80% of all fatalities in the UK each year is attributed to falls. Falls from one level to another, falls on the same level and plant machinery and structures falling and striking, crushing or burying people were accounted for that percentage. On the other hand, when considering only the category "falls of people," 52% out of the 681 construction-related deaths between 1981 and 1985 were in this category.

Construction Related Fatalities in Northern Ireland

92 fatalities in the construction industry occurred in the North of Ireland between 1980 and 1998. 47 of these fatalities were due to falls. Other common causes of fatalities were due to vehicles in movement (15 fatalities), impacts or being struck (12), electrocution (9) and trespassing (5). In comparison with the others, the above figure for falls represents 51% of all the fatalities in that period.

Table 2 represents fatality rates per 100,000 workers for the years between 1997 and 2000. The table compares statistics between Northern Ireland and the rest of the UK (HSE-NI, 2001).

Year	NI	UK
1997/1998	4.0	5.7
1998/1999	3.5	4.4
1999/2000	13.2	5.3

Table 2: Comparison of Rate of Fatalities for NI & UK during 1997-2000 per 100,000 workers

Over the past three years 11 fatalities in the construction have occurred in the North of Ireland (HSE-Northern Ireland, 2001). The location of these fatalities breaks down as shown in table 3.

Construction Activity	Fatalities
Small Housebuilder	3
Small "other " sites	6
Road works	1
Medium Sized General Contractor	1

Table 3: Construction activity resulting in fatalities in Northern Ireland during 1980-1998

Construction Related Fatalities in Ireland

In spite of regulatory activity and social partner initiatives, the number of fatalities related to construction in Ireland has generally increased since the 1990's (HSA, 2000). This increase has taken place against a background of rapid expansion in the construction industry. Since 1992 the numbers involved in the construction industry has more than doubled to 166,300 in 2000 (Construction Industry Review, 2001).

During the period 1991-1999 a total of 125 construction related fatalities occurred across all work sectors in the Republic of Ireland (HSA, 2001). These fatalities accounted for 22.4% of the total work related fatalities across all sectors during that time period. The year on year figures are shown in table 4.

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Total Work Related Fatalities	**73**	**46**	**64**	**50**	**78**	**59**	**48**	**70**	**69**	**557**
Total Fatalities in Construction	**10**	**12**	**11**	**10**	**13**	**14**	**15**	**22**	**18**	**125**

Table 4: Number of fatalities in the construction Industry 1991-1999. Republic of Ireland

The most common cause of fatalities to workers in the construction sector over the past nine years were falls from heights (49.6%). Broken down, this figure reflects falls from or through roofs (17.6%), ladders (12.0%), scaffolds (11.2%), openings or stairways (4.8%), and others (4.0%).

International Construction Related Fatalities due to Falls from heights

Berg (1999) attributes falls as the leading cause of deaths in construction worldwide. Berg states the percentage of fatalities from falls on German construction sites accounts for 50% of all fatalities in that work sector.

Cattledge et al. (1996) analysed construction fatality rates in the United States between 1980 and 1989. They found that 49.6% of all occupational related fatalities due to falls occurred on construction sites. Also in America, McVittie (1995) compared the percentage of fatalities from falls to a different elevation on construction sites in Ontario (Canada) and the United States. In Ontario, between 1988 and 1992, 40% of all fatalities on building sites were due to falls, while that figure was of 30% for the United States for the period between 1985 and 1989.

In Asia, Byung Yong Jeong (1998) reported on construction related fatalities in South Korea. This study showed that falls from heights accounted for 42% of all construction related fatalities between 1991 and 1994. Tam and Fung (1998) report the fatality rate among construction workers in Hong Kong during 1985 and 1994 was 86.8 per 100,000.

Summary

Approximately fifty percent of construction fatalities have been attributed, in a wide range of studies, to falls from heights. Furthermore, scaffolders, roofers, steel and structural trades have a high risk of fatal accident, though fatalities occur across a wide range of construction occupations. The statistics also show that fatalities are spread across housing construction and general contracting, large and small companies (though much of the industry is made up of small subcontractors) and in both urban and rural regions.

Regulatory Activity in the Republic of Ireland and Northern Ireland

The Republic of Ireland

During Construction Safety Week in Ireland from the 25th to the 29th of September 2000, the HSA carried out 464 site inspections. 80% of sites visited received written advice, 37 prohibition notices and 8 received improvement notices (HSA 2000).

In excess of 5000 inspections were carried out by the HSA in the year 2000. In that year 202 improvement notices, 577 prohibition notices and 11 improvement directions were served. A further 36 sites voluntarily closed as a result of HSA high court action (under section 39 of the Safety Health and Welfare at Work Act 1989, HSA 2000).

Between 1995 and 1999 The Health and Safety Authority carried out 17,852 visits to construction sites and building sites regarding the possession of safety statements, safety representatives and safety consultation. 50% had safety statements, 41.9% were involved in safety consultation and only 4.7% had a safety representative.

		Recommended action		
	Found inadequate	**Improvement Notice**	**Improvement Direction**	**Prohibition Notice**
Management*	4769 (43.0%)	219	17	61
Scaffolding	7665 (68.8%)	289	26	1202
Edges/openings/Fencing	2657 (23.8%)	100	5	335

* Management topics include appointment of a project supervisor for design and construction stages, safety & health plan, particular risks to safety &health plan, and issues regarding the client

Table 5: Recommendations by the HSA following 11,143 inspections carried out during 1995-1999

In terms of regulatory activities between 1995 and 1999, the Health and Safety Authority carried out a total of 11,143 inspections. Among notices and directions given (see table 5), it worth highlighting here that 1202 prohibition notices were recommended to be issued regarding scaffold safety, and 335 were recommended regarding fences and openings left in an unsafe manner. In general figures show that situations and activities related with falls from heights are the ones that also receive more recommendations for improvement or prohibition notices.

Planned Regulatory Activity in 2001

The HSA has published a work programme for 2001 planning its regulatory activity for the construction sector. (HSA, 2001a). Specific objectives include:

- Codes of Practice on Roof Work and Cranes for publication in 2002.
- 7,000 inspections to enforce compliance in relation to safe working at heights and site traffic management.
- 100 inspections of Architectural and Engineering practices relating to issues arising from site inspections.

Regulatory Activity in Northern Ireland

For the year ending the 31st of March 2001 the HSE-NI carried out 1070 inspections and 250 investigations. (HSE-NI 2001).

Summary

Scaffolding safety and unguarded openings are major factors leading to prohibition and improvement notices. Inspections have shown that fifty percent or more sites have no safety statement or do not engage in safety consultation. The proportion of sites with safety representatives is less than five percent.

Safety Antecedents in the literature on Construction

While there is a good understanding of the extent and patterns of accidents in the construction industry, there is only limited evidence about the full range of factors contributing to those. From a psychosocial point of view, the available literature on safety on construction sites is relatively scarce when compared with other industrial sectors in our society. Important areas of interest when predicting individual safety behaviour and organisational safety performance are those related to compliance with procedures, effective management systems, organisational climates and cultures, and performance in the face of risks.

A review of the relevant literature addressing those areas follows. A selection of the most important research and conclusions that have guided the theoretical frame of this project is offered to outline the reasons behind this research. The main contributions to highlight from the literature review is the choice of compliance rather than safety accidents as our dependent variable, and the selection of those factors that seems to influence safety behaviour and compliance on site: individual factors, site factors and also factors outside the site boundaries.

Non-compliance versus accidents as measure of safety performance

All interventions oriented to improve safety in the workplace have accident reduction as the ultimate objective and so the criteria against which to measure the effectiveness of such interventions. According to Duff et al. (1993), accident frequency is "the most objective measure of safety performance." However the scientific literature has highlighted that an accident is, to some degree, a chance event requiring a combination of circumstances. Additionally, a HSE (1988) investigation has shown that accidents, especially less serious ones, are subject to gross under-reporting. Managers may also be careful in releasing information that could affect the future stability of their business or be used in any way against them.

Alternatively, better safety performance of a business, or progressive improvement of safety when a successful intervention has been carried out, brings the accident rate to a lower level than before, increasing the difficulties of identifying it accurately. This also decreases the accuracy in measuring the amount of improvement due to the intervention over time (Duff et al., 1993).

The combination of above features makes accident frequency difficult to measure in any research. Whatever the objective characteristics, it can be said that accident frequency cannot be considered to be a robust measure for research purposes.

Duff et al. (1993) designed an alternative measure of safety performance based on compliance with safety procedures in particular situations or by means of individual behaviour. The authors validated an observational tool that turned up to objectively and reliably measure safety performance in percentages of compliance. This tool was composed by 41 items representing critical safety standards that offer data appropriate to be used in

many different safety management strategies, such as performance auditing, training design, incentive system design, and goal-setting (Robertson et al, 1999).

Safety consequences of non-compliance with procedures

A key defence against hazards being realised in high-risk industries is the proceduralisation of tasks – defining key rules and procedures which need to be followed to ensure that the work is done both efficiently and safely. One very promising line of enquiry concerning the behavioural antecedents of accidents concerns the relationship between these procedural instructions governing work and the way in which work is done. Not following procedures has been implicated as a contributory factor in incident and accident occurrence in a wide range of industries. Some of these studies have provided measures of the normative level of procedure violations, which varies from under 20 to over 50 percent of recorded tasks. In the construction industry in the U.K., Duff et al. (1993) found percentages of non-compliance with specific categories in 6 construction sites ranging from 22-38% of non-compliance in housekeeping, from 12-43% of non-compliance in scaffolding, from 20-26% of non-compliance in access-to-heights, and from 21-65% of non-compliance in using PPE. Also from the U.K., Robertson et al. (1999) found that non-compliance was around 19% for housekeeping, 16% for scaffolding, 15% for access-to heights, 21% for P.P.E., and 13% for plant. Lingard et al. (1997) reported from Hong Kong percentages ranging from 30-49% of non-compliance in housekeeping, from 30-66% of non-compliance in bamboo scaffolding, from 50-74% of non-compliance in access-to-heights, and from 49-69% of non-compliance in PPE.

The importance of this work is that it provides a mechanism for relating observed or reported behaviour with an identifiable safety standard (the official procedure). This has opened up productive avenues for researching into the situational factors (task, organisation, resources, individual), which make such violations more likely. Not all violations are serious from a safety point of view (sometimes there are more efficient ways of working). However, it is possible to identify violations that could result in serious consequences.

Interventions to improve safety

One major goal of safety research is to support interventions that can demonstrably improve safety. However, thorough empirical studies are rare and they normally focus on changing individual behaviour.

Duff et al. (1993) and Robertson et al. (1999) carried out a two – phased study on the effectiveness of different intervention strategies. Specifically, they looked at the effects of feedback, goal setting and training, on safety performance. They found that the techniques used produced marked improvements in site safety, participative goal-setting being the more effective of the three. However, a continuous and consistent intervention along the lifecycle of the site was recommended to achieve the maximum benefit. The results also

highlighted the vital role of management commitment in the effectiveness of the intervention methods used.

Lingard and Rowlinson (1998) used a similar design to Duff et al. (1993) in the Hong Kong construction industry. They reported highly significant improvements in housekeeping with their intervention. However, in general, the intervention did not result in significant improvements in the areas of access to heights or bamboo scaffolding. Again, the main reason was the management commitment towards those two areas of activity. They concluded in relation to that in "behaviour-based safety management programs... safe behaviour can only be achieved where a basic safety infrastructure is already in place" (p. 225).

Other variables of interest, such as attitudes and safety climate, have received little attention in the literature. For example, Langford et al. (2000) carried out a research on safety attitudes in construction workers. This identified some variables that influenced the attitude of construction workers towards safe behaviour: organising for safety supervision and equipment management, industry norms and culture, attitudes to risk taking, and management behaviour. However, there are no data available for the influence of attitudes on behavioural or site performance. In her degree project, Curran (2000) researched safety attitudes and the safety climate on one construction site. However, the results cannot be generalised. To our knowledge, this is the only research on safety climate in the construction industry.

In relation to management strategies, Tam and Fung (1996), for example, looked at the effectiveness of the safety management strategies of 45 construction firms in Hong Kong. They report that most safety schemes, strategies or interventions reduced the accident rates on these sites. These schemes strategies and interventions included:

- Level of management responsibility
- Orientation programmes
- Safety personnel on site
- Safety awards and incentive schemes
- Post accident investigation and feedback
- Safety training and intensity of safety training
- Presence of safety committees

And from the site of the regulatory authorities, Berg (1999) reports on a safety campaign carried out in 9 regions in Germany during 1995 and 1996 by 50 inspectors from the relevant construction site regulatory authority. This same authority without documenting any methodologies or indicators of effectiveness other than re-inspecting sites, reports the results of this campaign as follows:

- A conviction that a substantial increase in safety and health within the region and on sites involved in the campaign has occurred.
- An opinion that the campaign helped in raising awareness of the severity of, and hence importance of falls.

- A conviction that the campaign identified fall hazards on sites to site management.
- An opportunity to provide solutions for contractors in the area of fall prevention.
- Confirmation of a partnership approach to safety and health with the participating firms.

In brief, construction has not been subject to much intervention research, largely because of the complexity of the industry (Ringen et al., 1996). Of the interventions carried out, behaviour-based programs are the most popular when attempting to change safety performance. Although positive and significant results are generally obtained, interventions can be said to be of limited success. Management commitment is identified every time as a key element in guaranteeing the successful implementation and completion of a program. However, intervention at managerial level is rare and studies carried out, while highlighting the important role of management, are exploratory and descriptive (for example, Whittington et al, 1992), rather than intervention programs to change safety performance. Safety campaigns are directed to increase worker awareness and said to be effective in improving safety performance, but systematic research suggests that posters and campaigns have limited success (Saarela et al, 1989, quoted by Duff et al. 1993), and do not make a lasting impact on the accident/injury rate. Variables such as climate, culture and attitudes, found to be of importance for safety performance in other industries, have yet not been researched in construction in a systematic way.

Functional effectiveness of safety management systems

A second level of explanation for safety failures concerns the effectiveness of the safety management system. To quote three examples, Whittington et al (1992) comment that the construction industry characteristics that lead to the poor safety record are deep rooted and complex. They go on to state that problems at site level could often be traced back to management issues such as poor contractor selection, lack of supervision or inadequate training. The European Construction Institute (ECI, 1996) reports that one of the reasons for the industry's poor safety and health reason has been the lack of a systematic approach to the management of risk. Mohamed (1999) also reports that the construction industry in general seems to suffer from an inability to manage workplace safety and health to an extent where a proactive zero accident culture prevails.

Whittington et al. (1999) indicated how the industry and potential clients were also seen to be responding to safety management demands in a fundamentally flawed manner by way of:

- Being dealt with at a late stage of the project cycle
- Undue emphasis on the failure of individual workers resulting in short term measures rather than resolving underlying organisational problems.
- Competitive tendering resulting in a failure to address safety requirements at bidding and tendering stages.
- Safety issues being inadequately addressed in planning and scheduling of work.
- Lack of safety performance monitoring and feedback.

- A lack of opportunities for formal project reviews to include organisational learning and pro-active safety management.

In order to reduce the level of fatalities injury and ill health in the construction industry, a number of safety management systems are available detailing the elements currently thought necessary to reduce risks. Publications like Successful Health and Safety Management (HSE 1997, BS8800: 1996; OHSAS: 1999; OHSAS, 2000) give good practical guidance on the requirements for effective safety management.

A number of construction specific safety management systems and codes of practice are documented. The HSE in the UK have produced a guidance document; Health and Safety in Construction. (HSE, 1997a). The HSE have also published a Code of Practice on Compliance with the UK Construction Design and Maintenance Regulations 1994 (HSE, 1994a). The HSA have produced guidelines for the equivalent Irish Legislation (HSA, 1995). It has also published a Code of Practice for Access and Working Scaffolds (HSA, 1999), and it is producing two new codes of practice on roof work and crane usage (HSA, 2001a). The Construction Industry Federation in Ireland (CIF, 2001), the European Construction Institute (1996) or authors as Clarke (1999) or Gibb (1995) also details health and safety management systems and risk assessment procedures that can be used in the construction industry. Irrespective of the number of guidelines available, research into the elements of the proposed management systems that are effective in the construction industry, still needs to be conducted.

However, a number of studies do link management commitment with particular findings, especially effectiveness of the intervention programme. For example, Duff et al. (1993) concluded that management commitment was an important moderator of the effectiveness of the intervention carried out. Six years later, in phase two of their research Robertson et al. (1999), concluded that management commitment to the intervention programme was "vitally important, impacting on all aspects of the methodology." Positive correlations appeared between management commitment and safety performance improvement on site, and between management commitment and management participation in all stages of the intervention.

Summary

While accident frequency is an objective measure in safety-related researches, measures based on compliance with procedures seems to be more appropriate for comparison between sites as is identifying change when intervention programmes are implemented. For the construction sector, Duff et al. (1993) have designed and researched a compliance-based measure that has been shown to be valid and reliable. Therefore, it has been adopted for this research.

Studies suggest that a compliance with safety procedures varies widely across categories of procedure and in different sites. For example, rates of non-compliance with scaffolding

requirements between 12% and 43% have been reported. Evaluations of a range of interventions to improve safety have addressed goal setting, training and other behaviourally based programmes. While some of these have demonstrated success in the short term, a common conclusion emphasises the importance of sustained management commitment and activity in ensuring the effective implementation of these programmes. However, there is a lack of systematic research concerning the management of safety in construction. Also, while there have been some studies of attitudes and perceptions of construction workers towards safety and safety management, they have not addressed the link between these variables and safety behaviours and compliance with safety procedures.

Therefore, it can be concluded that the factors, at both individual and management level, which influence sustained compliance with safety requirements are not well understood. This study aims to address this critical gap in our knowledge about construction safety.

Design and Methodology

The primary goal of this research was to investigate the factors that influence safety behaviour and compliance with safety requirements on construction sites. This goal was realised through the following objectives:

- The first objective was to examine compliance with safety requirements in the construction industry.
- The second was to investigate the behaviours, perceptions and attitudes associated with safety in construction.
- The third was to investigate management practices and associated documentation relating to safety.
- The final objective was to seek to establish what factors are significantly associated with safe behaviours or safety compliance.
- Furthermore the high incidence of falling from heights in construction accident statistics led to a focus, particularly in the site observations and operatives' questionnaire, on factors associated with falling from heights.

In particular, the research strategy adopted was to investigate the following aspects:

- Observation of compliance with a range of standard safety requirements.
- Perception of risk associated with certain target behaviours and situations, estimation of prevalence of these situations on this site and elsewhere, and most likely response in those situations.
- Attitudes to safety and safety climate (perception of the organisation's commitment to and involvement in safety)
- The role and activities of management and other persons with a specific safety role, and of organisational activities related to safety.
- Review of available company documentation relevant to the management of safety.

The design adopted was a cross-sectional one based on a comparison of a sample of sites in Ireland, employing measures of these dimensions.

Site Sampling

Because the goal of the research was to investigate factors influencing compliance, this required that the sample contained a variety of contrasting sites, giving sufficient variance in the factors being studied to investigate their influence. To achieve this it was not necessary to have an exactly representative sample. It was however considered desirable for the sample to be broadly representative of important parameters of the industry. In order to gain our sample of construction sites the following aspects were taken into consideration:

- Comparison of sites in Northern Ireland and Republic of Ireland
- Comparison of sites in Dublin and other urban areas in the Republic
- Comparison of small and larger building sites
- Comparison of House Building work with General Contracting work

Because the absence of a comprehensive database of the number and location of the construction sites in Ireland and the current stage of their projects, it was impossible to construct a probabilistic random sample. As a consequence, the sample was stratified according to the following criteria: from site-lists from CIS reports (dating from October 1999 to May 2000) and other sources. Sites that did not have a start date or price and any valued at less than one million Irish pounds were discarded in the selection process. The remaining sites were classified as using above criteria. Upon this classification, a sample of sites per each category was selected following a random selection and site managers were asked for participation in the research. This process was carried out until completing the pre-selected number of sites per category. In a few cases, as for Dublin, the objective site categories could not be filled accordingly to above procedure and then sites were selected on a convenience basis (mainly approaching visually located sites). The HSE in Northern Ireland were contacted and they provided the names of a number of Contractors who were carrying out work in the Belfast area.

Because of the possibility of biases in the final composition of the sample, the question of sampling will be considered again in the discussion section of this document.

Analysis of the fatality statistics allowed those sites to be chosen that most closely matched the type of contractor and the trade of recorded fatalities that most represented the characteristics of the fatalities. However due to practical limitations the sample did not represent very small sites or sites in purely rural areas.

A total of eighteen construction sites took part in this research project. Table below provides a breakdown of sites across the different areas. For the purpose of the study small sites were defined as being worth between one and five million Irish punts in the Republic of Ireland and one and five million pounds sterling in Northern Ireland. Large sites were defined as being worth over five million Irish punts in the Republic of Ireland and over five million pounds sterling in Northern Ireland.

Table 6 provides a breakdown of sites in the sample and table 7 provides a detailed description of each of the sites visited.

	Large General Contracting	**Small General Contracting**	**Large Housing**	**Small Housing**	**Total**
Dublin	4	1	2	1	8
RoI Urban	3			1	4
Belfast	3			1	4
NI Urban	1				1
NI Rural				1	1

Table 6: Breakdown of sites by type and size

SITE DESCRIPTION						
Site	**Project type**	**Location**	**Number of workers**	**Size m ^{2} ***	*Build Type*	**Main structures and activities**
01	Social Infrastructure	Dublin	80	30,000	New build	Substructure External walls to first floor level Internal walls to first floor level
02	Social Infrastructure	Dublin	80	>250,000	New build	Substructure External wall and cladding in part Roof deck
03	Social Infrastructure	Dublin	200	>250,000	New build	Substructure , external walls Steel framework Roof and roof covering
04	Social Infrastructure	Dublin	30	20,000	New build	Substructure Internal fixtures and fittings Roof and roof covering,
05	Housing	Dublin	40	50 units	New build	Substructure External & Internal walls Floor slabs in place Services in part
06	Housing	Dublin	50	250 units	New build	Substructure in part Roof and roof covering in part Internal fixtures and fittings in part
07	Housing	Dublin	60	150 units	New build	Substructure in part Roof and roof covering in part Internal fixtures and fittings in part
08	Social Infrastructure	Dublin	50	1,000	Renovation refurbishment	Internal fixtures and fittings Internal partitions Finishes
09	Social Infrastructure	Republic of Ireland	40	15,000	New build	Ground floor First floor slab Roof deck
10	Housing	Republic of Ireland	20	50 units	New build	Substructures in part Roof and roof covering in part Internal fixtures and fittings in part
11	Housing	Republic of Ireland	160	450 units	New build	Substructure External walls part Roof and covering part
12	Social Infrastructure	Republic of Ireland	150	10,000	Renovation of existing / expansion	Topped out Internal partitions fixtures and fittings Services
13	Social Infrastructure	Belfast	100	12,000	New build	Substructure Steel framework External walls, roof and covering part
14	Social Infrastructure	Belfast	50	15,000	New build	Substructure Steel framework External walls part
15	Social Infrastructure	Belfast	60	15,000	New build	Nearly complete Internal fixtures and fittings Services
16	Housing	Northern Ireland	20	50 units	New build	<10 units incomplete External walls Internal partitions and floors.
17	Housing	Northern Ireland	30	50 units	Refurbishment & development of existing structure	Groundworks Internal partitions Basement and ground floor slabs
18	Housing	Northern Ireland	20	30 units	New build	<10 units incomplete Roof and roof covering in part Internal fixtures and fittings in part

Housing could consist of residential units ranging from one bed apartments to five bed detached houses. Social Infrastructure: small less than 5000m^2/ Large over 5000m^2. Housing: small Less than 100 units/ Large Over 100 units

Table 7: Description of the characteristics of the sites in the sample.

Procedure

At least four researchers visited each of the eighteen sites and spent approximately half a day on each site. Due, primarily, to the availability of the research staff, management interviews, operative's surveys and observational surveys were conducted at the same time, independently by different research personnel, on all Dublin sites. However, on sites in the Irish Republic, outside Dublin and in Northern Ireland, management interviews and operatives surveys were conducted at the same time and site observations were conducted on a different day.

Methodology

A variety of methodologies were adopted in order to reflect the different aspects of construction sites and to reflect overall project objectives. A pilot study was carried out and the necessary amendments were made to the instruments before the main research started.

The pilot study was conducted in one large construction site. The safety compliance measure was tested using several independent ratings and criteria for ratings were agreed. The questionnaire and interview methodologies were also examined with samples of managers, workers and a safety representative. Adjustments to the procedure for administering these were made to ensure effective data collection.

The four methodologies used were:

- Site management interviews
- Analysis of documentation
- Systematic site observations
- Operative surveys

The Observational Study

Duff et al. developed a 41-item safety audit checklist for assessing safety and health performance on construction sites as part of a safety management intervention programme carried out in 1993. This tool was chosen as it had been validated in Duff et al. study and it most closely resembled the objectives and conditions preview in our research.

The safety audit checklist was piloted on a large Dublin construction site. Based on this pilot study, a modified 18-item safety audit checklist was produced covering site safety situations and behaviours encountered under the general headings of Housekeeping, Scaffolding and work platforms, Access to heights, and Personal protective equipment (see table 8 below).

Housekeeping	Item 1 Unguarded Openings Item 2 Rubbish on Access Routes Item 3 Storage of Materials
Scaffolding and work platforms	Item 4 Rubbish on Scaffolding Item 5 Missing Scaffold Boards Item 6 Trapped Scaffold Boards Item 7 Missing Toeboards Item 8 Missing Guardrails or Edge Protection Item 9 Missing Baseplates Item 10 Misuse of Scaffold
Access to heights	Item 11 Ladders Too Short Item 12 Ladders Incorrectly Tied Item 13 Safe use of Ladders Item 14 Defective Ladders
Personal protective equipment	Item 15 Hard Hat External Use Item 16 Hard Hat Internal Use Item 17 Protective Footwear Item 18 Viz Vest Wearing

Table 8: The 18 safety items that were observed for that research.

All 18 items were rated on a percentage scale of compliance with recommended site safety practice. The procedure for the observational study carried out on each site visited was as follows:

- A generalised description of the site including size, number of site personnel, stage of construction and weather conditions was carried out.
- The researcher then surveyed the site and recorded all information on the safety audit checklist. In recording the information three responses were possible and recorded in specified ways:
- Unsafe conditions or behaviours were recorded as percentage of items or operatives on site not conforming with recommended practice. Hence, the percentage of non-compliance was recorded.
- Safe items were recorded as ‘zero.’
- If the situation or behaviour was not seen, a ‘Not seen’ was recorded.

All safety items on the safety audit checklist were completed for all the 18 sites surveyed. The only exception to this procedure occurred on site 10. Due to heavy rain encountered during the observational survey period, there were no workers on site. Due to time

pressures in rearranging access, it was decided to record site conditions observed, and use them in the study. Site operative behaviour was recorded as 'Not seen.'

The Operative Survey

A total of 244 questionnaires were completed across 18 sites. At the beginning of each site visit the number of operatives and sub-contractors on site was sought. It was decided to sample approximately 20% of all operatives on site (including both company operatives and sub-contractor operatives). Two researchers were involved in administering the survey. Each researcher approached an operative, outlined the aims of the study and asked if they would be interested in participating in the survey. On each site a representative sample of both the company operatives and the sub-contractors' operatives were covered as well as all areas on the site. Completion of the survey took approximately 15-20 minutes.

An important purpose of the project was to explore the safety antecedents at the individual level. The main agents to report on safety in the workplace at that level are those people working in the 'front line', which means the operatives.

As the literature and statistics highlight the category of falls from height as accounting for the most frequent and severe accidents in the construction sector, the instrument was developed to explore this category. Three aspects of working at heights were identified as being particularly of high-risk. These are working on scaffolds, using ladders and working on roofs. From these situations our final behavioural protocol was developed. This was made up of nine high-risk situations. A brief description of the situations chosen follows:

Front-line workers (they will be referred as 'operatives' in this report) were interviewed following a structured interview protocol. A selection of nine high-risk situations was presented. Each participant was requested to give his opinion about perception of risk, frequency and preferred behaviour in the face of risk for each of the situations presented.

a) WORKING ON SCAFFOLDS:
Situation 1: Working on scaffolds not totally boarded.
Situation 2: Working on scaffolds with missing guard-rails.
Situation 3: Climbing up or down a scaffold when a ladder has not been provided.

b) USING LADDERS:
Situation 4: Using a ladder not tied or secured.
Situation 5: Using a ladder broken or somehow defective.
Situation 6: Using a ladder shorter than 1 metre above landing place.

c) WORKING ON ROOFS:
Situation 7: Working on fragile roofs without crawling boards
Situation 8: Working on roofs without edge protection (and not harness provided).
Situation 9: Working on roofs with bad weather.

For each of the nine situations, the operative was requested to analyse them on three levels. They had to:

- ✓ Offer an evaluation of their perceived level of risk of each situation (low risk, medium risk or high risk).
- ✓ State the frequency at which these situations occur in the construction sector and in the present site (rare, usual or frequent)
- ✓ Predict their probable behaviour if the situation occurred on site today (report it, fix it yourself, stop working/not use the material, or use it/ continue working).

In order to determine their level of experience operatives were asked about the frequency at which they worked on scaffolds, with ladders and on roofs. Only those operatives who reported working in the specific areas sometimes or often were allowed to answer questions on the three specific situations in the relevant categories.

Workers' attitudes and perception of the organisational system were also assessed through a 20-item questionnaire. Workers were required to agree or disagree with each of the questions in a Likert-type scale with four possible anchors from 'Strongly disagree' to 'Strongly agree' with each item.

Safety Management Interviews

A total of 59 structured interviews were conducted across 18 sites with a range of managers and personnel responsible for safety. The sample included Company Directors, Contracts Managers, Site Managers, Engineers, Safety Officers, Project Officers, Safety Reps and Foremen. Table below provides a breakdown of how many of each personnel were interviewed.

Personnel Type	Interviewed
Site Manager	9
Contracts Manager	6
Foreman	15
Engineer	8
Safety Officer (company)	4
Safety Officer (site)	3
Safety Representative	5
Project Manager	4
Company Director	1
Architect (external safety officer)	1
Human Resource Manager	2
Quantity Surveyor	1

Table 9: Breakdown of managers and safety officials interviewed.

At the beginning of each site visit relevant personnel were identified and asked if they were willing to take part in the interview. Two researchers conducted each interview, one asking questions and the other taking notes. Each interviewee was briefed on the research objectives.

The safety management system was the target of the interview, and the following areas were explored:

- Safety Plan
- Competence and Training
- Monitoring system
- Communication system
- Assumption of responsibility for safety
- Co-operation

However, each interviewee was also asked for personal and professional information:

- Background information (e.g. age, length of time in construction, safety training, etc)
- Suggestions for improvements of the safety management system.

Each of the areas of work explored also had a corresponding quantitative measure that was completed by the researchers at the end of each interview. The interviews lasted between 20 and 40 minutes.

All managers' interviews were transcribed, and a content analysis was carried out on each of them. A single and comprehensive description of the safety management system was then generated from the content analysis of all the interviews in each site.
Each interview protocol had also several quantitative measures built into the protocol. These measures were intended to translate the qualitative impressions gathered after each interview into measurable rating scales. The final ratings should be considered relative to the participant sites, rather than as an evaluation of their level of safety in absolute terms.

Analysis of Safety Documentation

The management interviews established the type and availability of safety documentation on site. After completing the interviews on each site, one of the researchers conducted a general assessment on the site safety documentation. This assessment consisted of verifying the availability of documentation.

All site safety documentation was inspected using the following assessment criteria:

- evidence of a documented site safety plan,
- evidence of documented site risk assessments,
- whether these risk assessments were site specific for identified site activities,
- evidence of a documented site accident logbook,

- evidence of documented site safety meetings,
- evidence of documented site safety audits,
- evidence of site safety training,
- overall general assessment of site safety documentation.

HSA/HSE Interviews

A group of inspectors were approached for interview. The HSA and HSE selected and provided the inspectors. In the case of the Republic, the HSA wanted to provide those inspectors with more experience in the field, while in Northern Ireland, all the inspectors in the HSE were interviewed. The sample of inspectors was not intended to be random due above constrains.

Six inspectors from the Health and Safety Authority (HSA) and four inspectors from the Health and Safety Executive (HSE), Northern Ireland, were interviewed. The interviews lasted from 40 minutes to an hour. Interviews with inspectors were conducted following the completion of data collection across all sites. A semi-structured approach was taken which covered the following topics:

- Background information of inspectors
- Site selection procedures
- Procedures used during site inspections
- Site safety
- Suggestions for improvement

Summary

The objectives of this study were to examine compliance with safety requirements, to investigate the behaviours, perceptions and attitudes associated with safety, to investigate management practices and associated documentation, and to establish what factors are significantly associated with safe behaviours or safety compliance. There was a particular focus in the behavioural ratings on factors associated with falling from heights. The design adopted was a cross-sectional one based on a comparison of a representative sample of 18 sites in Ireland. The sample included large and smaller sites, housing and general contracting, and metropolitan and regional areas in the Republic and Northern Ireland. An eighteen-item safety audit checklist was used to as a protocol for measuring safety compliance. A survey of construction operatives addressed the perception of risk, behaviour in risk situations, attitudes and safety climate. Site management and others (including safety representatives) who have a role in safety management were interviewed concerning a range of safety management functions and effectiveness and safety documentation on site was examined. Finally, a sample of inspectors were interviewed.

Results: Compliance with safety requirements

The Prevention of Falls from Heights

Unguarded Openings

Five sites out of the eighteen prevented any unguarded openings from occurring. A further six sites had less than 15% of openings left unguarded. Two sites had all openings left unguarded. Table 10 shows these incidences and how they breakdown.

Number of Sites	Percentage of Openings Found Unguarded
5	0
6	0-15
4	15-25
1	25-45
2	100

Table 10: Incidence of sites with unguarded openings

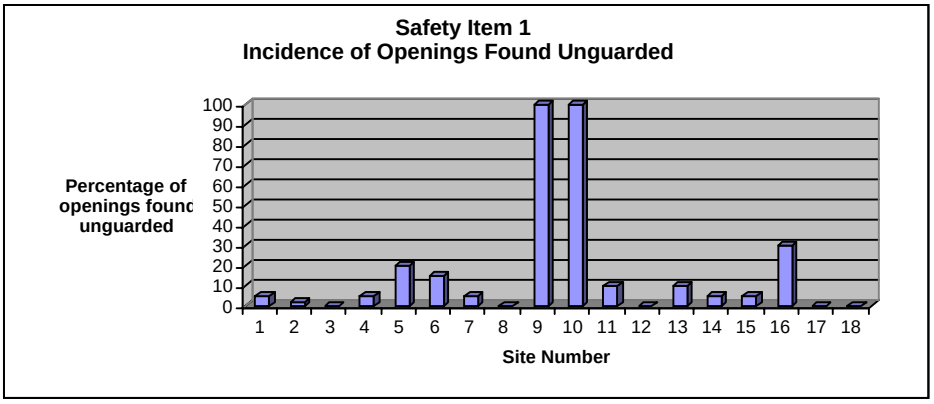

Figure 1: Incidence of openings found unguarded

Missing Guardrails and Edge Protection

Two sites out of eighteen had complete edge protection and seven sites had less than 15% of requisite guard rails or edge protection missing. Eleven out of eighteen sites had more than 15% of the guardrails or edge protection missing.

Number of Sites	Percentage of Missing Guardrails or Edge Protection
2	0
2	1-5
3	5-15
7	15-25
2	25-35
1	45-55
1	55-65

Table 11: Incidence of sites with missing guardrails or edge protection

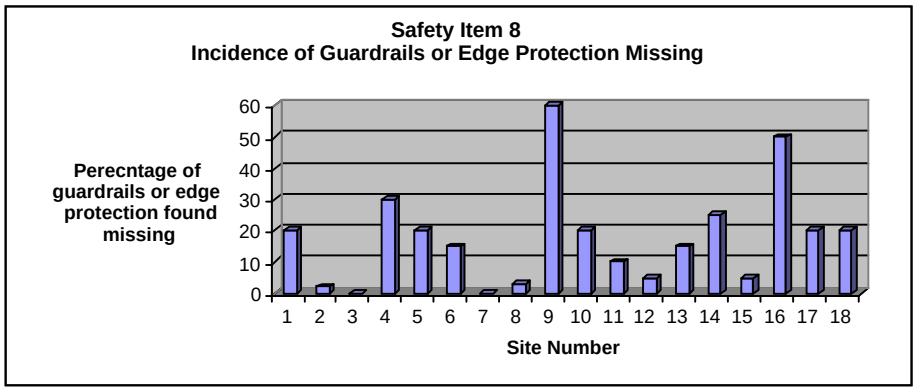

Figure 2: Incidence of guardrails or edge protection missing

Short or Defective Ladders

There were no instances of ladders being either to short for use or defective in any way.

Ladders not tied

Nine sites had ladders that were found to be incorrectly tied. Site 9, as a special case for comment, had one ladder alone on site, in use during the survey.

Number of Sites	Percentage of ladders found incorrectly tied
9	0
3	1-5
5	6-20
1	100

Table 12: Incidence of sites with incorrectly tied ladders

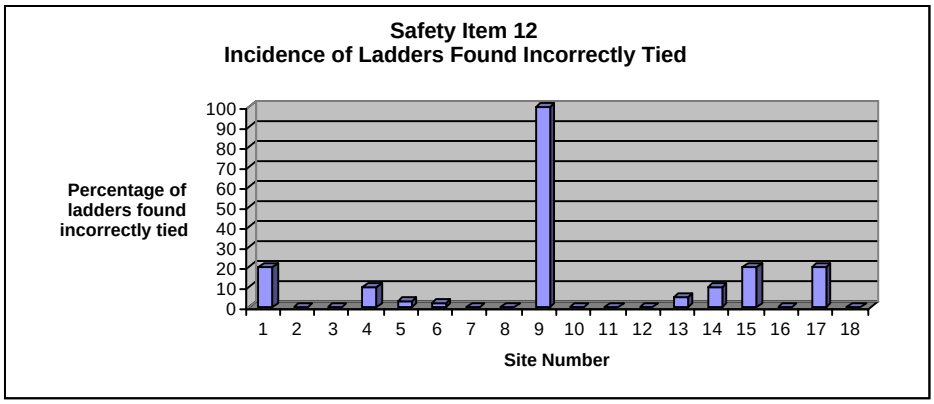

Figure 3: Incidence of ladders found incorrectly tied

Safe use of ladders

Three sites had incidences where operatives were observed using ladders in an unsafe manner. In all incidences this was the use of untied ladders.

Scaffold / Ladder Misuse

Three sites had incidences where operatives were observed mis-using scaffolding. In all incidences this was not using ladders to access scaffolding lifts on different levels.

Operatives misusing ladders or scaffold were observed on six sites. However this figure must be treated with caution due to the survey duration and the limitations of the researcher in continuously observing all operatives.

Prevention of Falls Performance by site

For the prevention of falls from height, those items in the compliance measure related to the category were averaged, and mean and standard deviations of non-compliance performance per site were calculated. This measure of falls performance can be used to rank the sites against each other (see table 13).

As can be deducted from the ranking of sites in terms of falls performance and the site characteristics, the location size or stage of construction do not show any apparent pattern with regard to ranking (an so to compliance with falls prevention).

Ranking	Site No.	Location	*Builder*	Mean Non Compliance Rate	Standard Deviation
1	3	Dublin	General Contractor	0	9.45
2	8	Dublin	General Contractor	0.43	0.98
3	2	Dublin	General Contractor	0.57	0
4	7	Dublin	Housing	0.71	10.29
5	12	RoI	General Contractor	0.71	9.27
6	18	Belfast	Housing	2.86	6.99
7	11	RoI	Housing	3.57	1.89
8	13	Belfast	General Contractor	4.29	1.13
9	15	Belfast	General Contractor	4.29	48.21
10	6	Dublin	Housing	4.86	37.29
11	14	NI	General Contractor	5.71	4.76
12	17	Belfast	Housing	5.71	1.89
13	5	Dublin	Housing	6.57	6.07
14	1	Dublin	General Contractor	8.57	9.32
15	4	Dublin	General Contractor	8.57	7.32
16	16	NI	Housing	11.43	20.35
17	10	RoI	Housing	17.14	9.76
18	9	RoI	General Contractor	37.14	7.56

Table 13: Ranking of sites by prevention of falls performance

Tables 14 and 15 break down the incidence of unguarded openings and missing handrails/edge protection for general contractor and house builders. Overall, both missing handrails and missing edge protection were higher on house building sites.

Site No.	Location	Percentage of openings found unguarded	Percentage of guardrails edge protection missing
1	Dublin	5	20
2	Dublin	2	2
3	Dublin	0	0
4	Dublin	5	30
8	Dublin	0	3
9	RoI	100	60
12	RoI	0	5
13	Belfast	10	15
14	NI	5	25
15	Belfast	5	5
Average =>		13.2%	16.5%

Table 14: Unguarded openings and missing guardrails/edge protection on general contractor sites

Site No.	Location	Percentage of openings found unguarded	Percentage of guardrails edge protection missing
5	Dublin	20	20
6	Dublin	15	15
7	Dublin	5	0
10	RoI	100	20
11	RoI	10	10
16	NI	30	50
17	Belfast	0	20
18	Belfast	0	20
Average =>		22.5%	19.4%

Table 15: Unguarded openings and missing guardrails /edge protection on housing sites.

General conclusions on Prevention from Falls from Heights

- The physical prevention of falls encountered on the sites was variable. Compliance ranges from very high to poor compliance.
- The physical condition and placement of ladders on all sites was good. There were no ladders observed in defective conditions or too short for the job.
- Two sites prevented missing handrails or edge protection
- Five sites prevented unguarded openings.
- Ladders were not tied in eight out of the eighteen sites.
- The incidence of observed scaffold or ladder misuse by operatives was low.
- In overall terms housebuilders were more likely to have a higher incidence of unguarded openings and missing guardrails/edge protection.
- In conclusion the existing sources of safety influence acting on the 18 sites produced 2 sites out of 18 with all the required edge protection and 5 sites out of eighteen with all requisite openings guarded.
- Whilst these figure would be subject to change during the life cycle of the construction phase, it points to current levels of safety influence on sites not being strong enough to prevent conditions allowing operatives to fall from heights.

A number of safety items were largely complied with across all sites in that the mean non-compliance rate was below 5%. These safety items were:

- Missing scaffold baseplates
- Misusing scaffolding
- Ladders to short for the job in hand
- Misusing ladders
- Defective ladders
- Protective footwear

Compliance with other items observed

Rubbish on access routes

There was an overall pattern with regards to amount of rubbish found: mostly all sites performed well in terms of compliance with this item. 12 sites out of 18 had 15% or less of access routes obstructed and 6 sites out of 18 had 16-30% of access routes obstructed (see fig. 4).

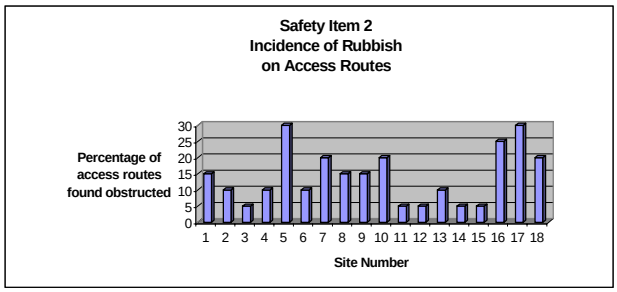

Figure 4: Incidence of rubbish on access routes

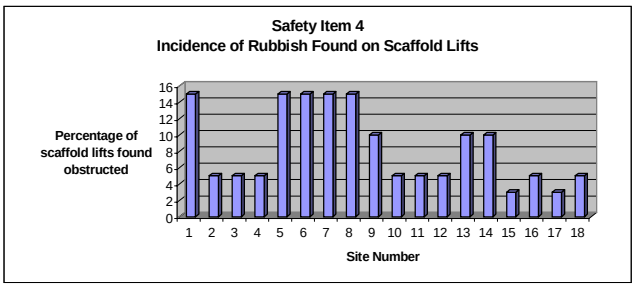

Figure 5: Incidence of rubbish on scaffold lifts

Rubbish on scaffold lifts

The second figure above shows the incidence of rubbish found on scaffolding lifts. No clear pattern here emerges with 10 out of 18 sites having 5% or less of scaffold lifts obstructed and 8 out of 18 sites having between 10 and 15 % of scaffold lifts obstructed (see fig. 5).

Trapped board and missing toe boards

Figures 6 and 7 show the incidence of trapped scaffold boards and missing toe boards per site. With regard to missing toe boards the incidence rate is generally even with a mean incidence of missing toe boards being 13.1% with a standard deviation of 6.96

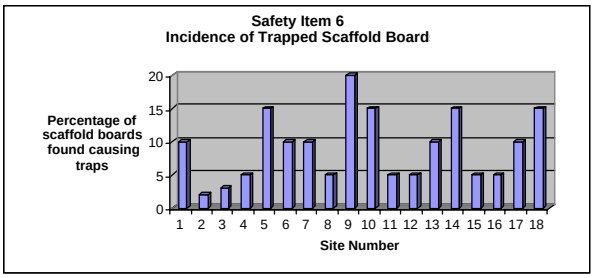

Figure 6: Incidence of trapped scaffold boards

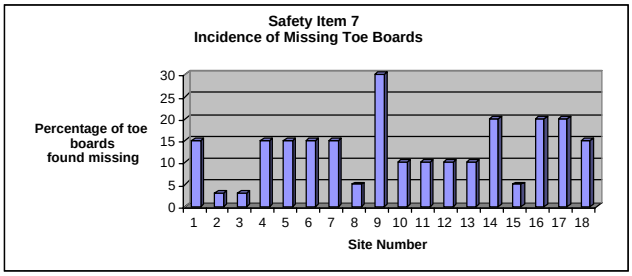

Figure 7: Incidence of missing toe boards

External hard hat wearing

With regards to wearing hard hats externally, 7 out of 18 sites had high compliance rates with 5% or less of operatives not wearing hard hats. 8 out of 18 sites had between 20% and 70% of operatives not wearing hard hats (fig. 8).

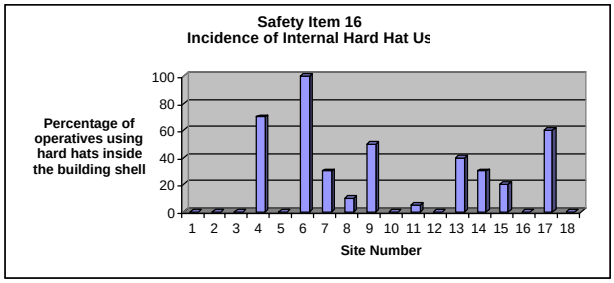

Figure 8: Incidence of internal hard hat use

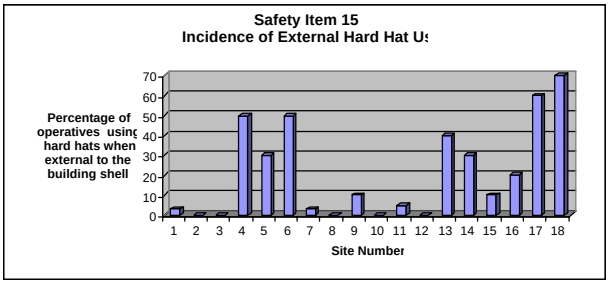

Figure 9: Incidence of external hard hat use

Internal hard hat wearing

9 sites out of 18 had 5% or less of operatives wearing hard hats internally. 7 sites out of 18 had between 15% and 60 % of non – compliance. 2 sites out of 18 had between 80-100% non – compliance.

Viz Vest wearing

Figure 10 shows the incidence of viz vest wearing and the results are variable across the sites. 8 out of 18 sites had 25% or less of operatives not wearing viz vests. 8 out of 18 sites had between 26% and 65% of operatives not wearing viz vests. 2 out of 18 sites had between 66% and 100% of operatives not wearing viz vests

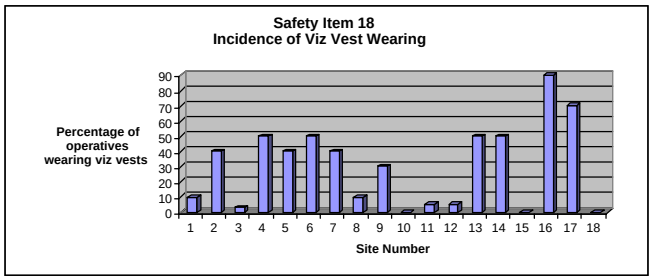

Figure 10: Incidence of viz vest wearing

With regards to hard-hat and viz vest wearing the results were variable across the sites. However those sites that had the best performance in terms of fall prevention tended to have a higher level of hard hat and Viz vest wearing.

Operative Survey Analysis

Background information

A total of 244 surveys were completed across the 18 sites. 38.5% of the sample (or 94 workers) were employed by the main contractors, while 61.5% (150 workers) were employed by sub-contractors.

It was found that the average age of the workers was 31 years, with 25% of the sample being younger than 23 years, and 50% younger than 29 years. That highlights the relatively youth of the population working in the industry.

Most of the workers had a good deal of experience working in the construction industry (for example 60% of the sample has worked in the industry for an average of 11 years). However, when considering the present job, 25% of operatives reported having worked for less than one year and 50% having worked less than two years in their present job. This finding also highlights the relatively lack of experience of the sample in terms of their job position.

It was also found that 47% of the sample were unionised, while the majority of the sample reported not being linked to any union organisation.

Safety Training

It appeared that very little time was dedicated to safety training across all sites. In 50% of the cases this training was incorporated into their safety induction courses, which ranged between 10 minutes and 1.5 hours. 39% of operatives said that they had not received any safety training from the main contractor. Another 11% of the sample reported they had received more extensive safety training than induction training (e.g., longer than one day). As represented in figure 11 below, safety training in site can be lacking effectiveness either because it is not provided or because it is rather general and short and incorporated into the induction training at commencement of work.

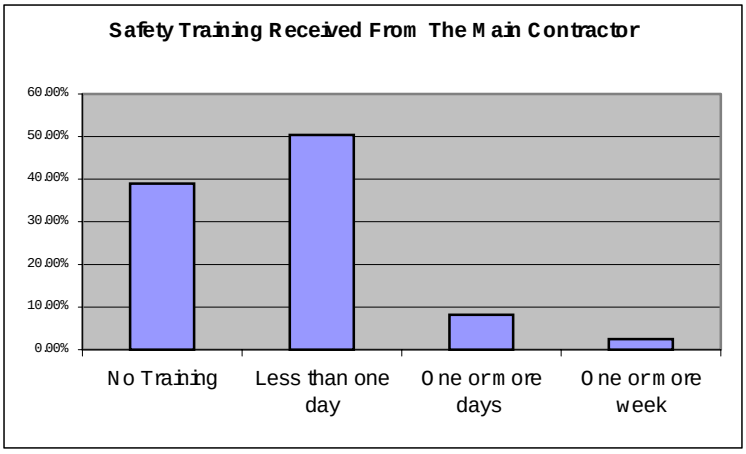

Figure 11

When operatives were questioned about training received through their subcontractor companies, almost 67% replied that they had received no safety training, while 22% of the sample received limited training of between one hour and a day (see figure 12). As with safety training provided by main contractors, 11% of operatives received more extensive training that lasted one day or longer. Again, it is evident here that the majority of subcontractors are rather negligent in providing safety training.

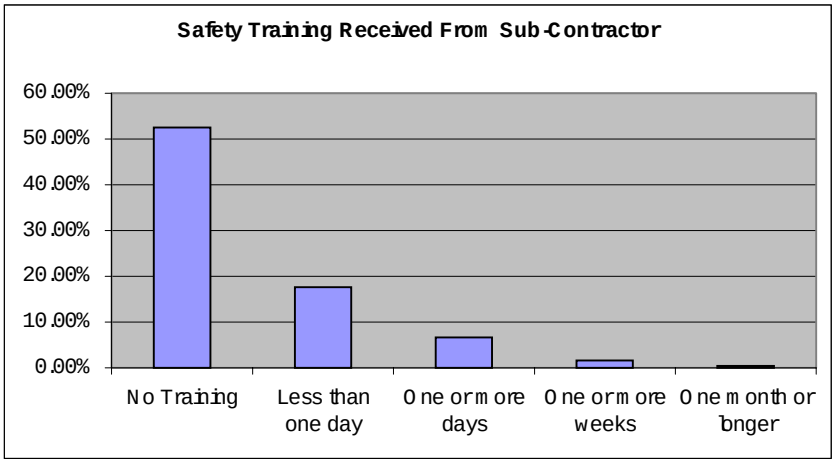

Figure 12

Experience working in high-risk situations and perception of risk

Workers in the sample reported a relatively high level of experience working on scaffolds (around 90% worked on scaffolds sometimes or often) and using ladders (98% used ladders sometimes or regularly). In relation to roofs, 50% of the sample reported working on them sometimes or regularly.

In general, all situations regarding working on scaffolds, using ladders and working on roofs (see methodology for more detail about these situations) were perceived as of high-risk. The operatives perceived working on fragile roofs and using defective ladders as being the most risky of the nine situations presented. Using short ladders for accessing upper levels was the situation that was perceived as the least risky of all nine situations. However, even this one was evaluated as being of medium risk. Three questions were asked about these nine situations –how risky the situation was, how frequently it would be found in the construction industry in general, and how frequently it would be found on the site. Figure 13 shows the average perceived risk and the perceived frequencies of these risks in construction and on site.

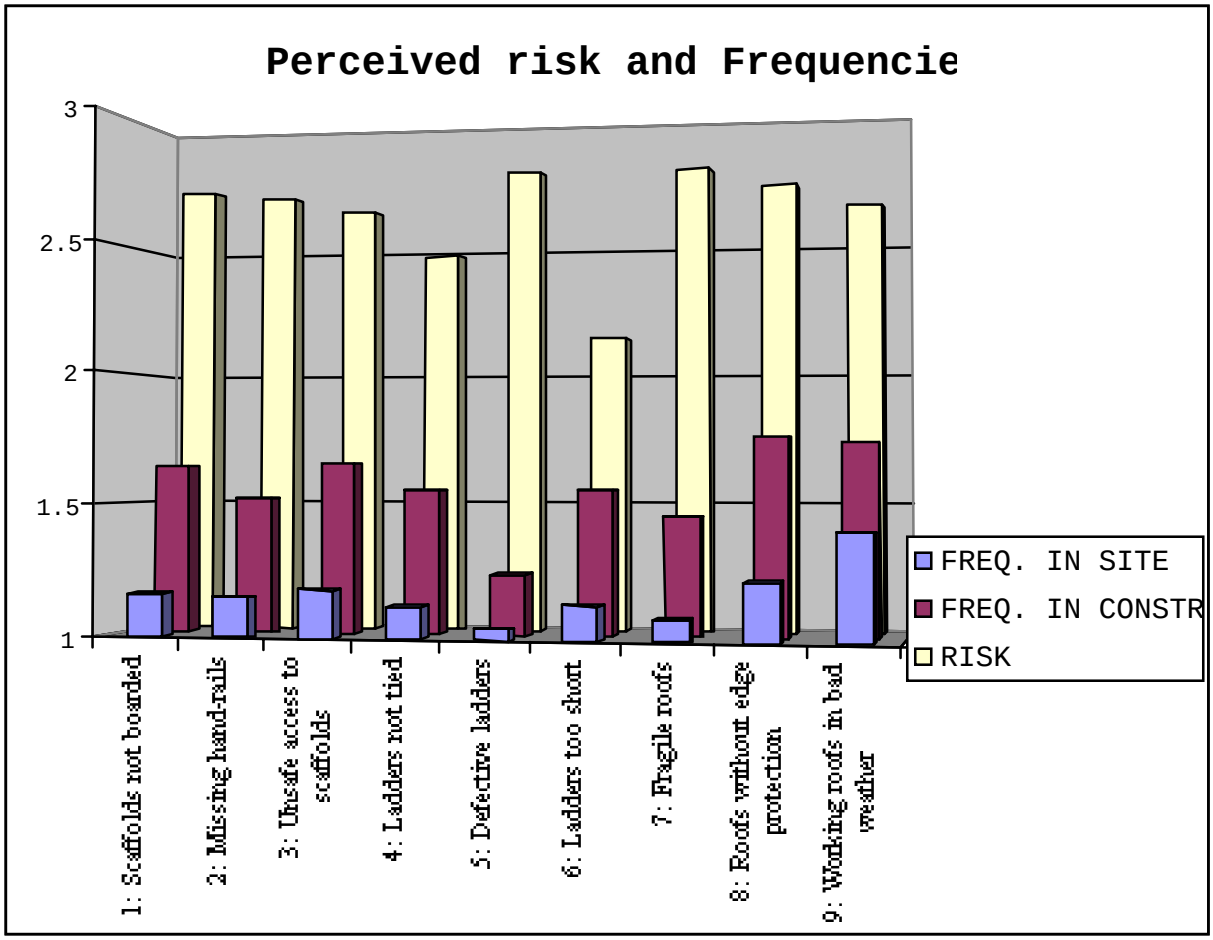

Figure 13: Perceived level of risk and Frequencies of risky situations for the nine situations of the research, in a scale from null/no risky (1) to very frequent/highly risky (3)

Even though the nine situations were generally perceived as high risk, the reported frequency of these situations actually occurring in the construction sector, as well as in site, was quite low. Those situations occurring more frequently were

- Scaffolds not totally boarded,
- Roofs without edge protection,
- Climbing up and down scaffolds in an unsafe way,
- Working on roofs with bad weather.

Consistently, the frequency of these risky situations was rated lower on the present site than in construction in general.

An interesting finding concerned the perception of risk by 3-5% of operatives in each site. Those workers reported a low perception of risk to the following situations:

- Working on fragile roofs without crawling boards,

- Working on roofs without edge protection,
- Working on scaffolds with missing handrails,
- Accessing scaffolds by climbing them up and down,
- Using ladders not tied or secured
- Using ladders too short for the landing place

The findings on risk perception for these critical high-risk situations outline that the majority of operatives do not have a misperception of the risks associated to these situations. However, there is a small percentage of workers that do misperceive them and so could be exposing themselves to risks due to this misperception.

Preferred behaviour to handle high-risk situations

When operatives were asked how they would behave in relation to those situations, their answers indicate that their preferred behaviour depends more on the actual situation than the perceived level of risk. In six out of the nine situations, operatives were more likely to report the situation to site officer, site manager or specific trades as scaffolders. These situations were:

- using defective ladders (61% would report),
- working on scaffolds not totally boarded (54%),
- working on scaffolds with missing handrails (58%),
- climbing up or down a scaffold (55%),
- using ladders too short for the landing place (46%),
- working on fragile roofs without crawling boards (46%).

In the situation of working on a roof in bad weather, 52% of operatives were more likely to stop working as preferred behavioural option.

In the situation when operatives find ladders not tied or secured, they would either report it (39%), or they would fix it by themselves (37%),

In the situation when operatives has to work on roofs without edge protection, 36% reported that they would stop working while 16% reported that they would continue to work anyway.

Figure 14 gives a graphic representation of the percentage of operatives that reported any of four possible behaviours as their probable pattern of action if facing the situations presented in our survey.

In general, we can conclude that operatives appear to have an accurate perception of risk in relation to the target situations highlighted in our research. The preferred way of dealing with risky situations is to report them. However in the case of those working on roofs their first reaction is to stop working.

However, a minority of operatives reported that they would continue working in those risk situations. The responses varied from 10% in those situations where scaffolds were not totally boarded or where handrails were missing, to 22% that will continue work on roofs in bad weather and 28% that will continue work using ladders too short for the task carried out.

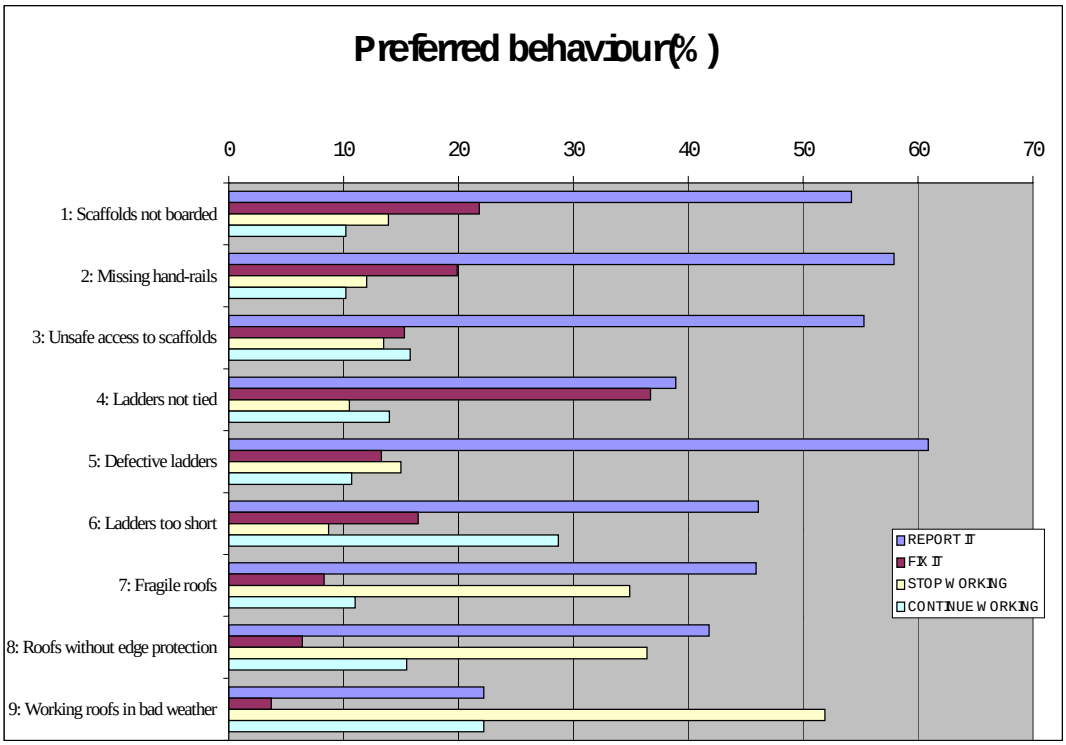

Figure 14: Preferred behaviour in the face of danger reported by workers

Safety attitudes

With regard to attitudinal aspects, five variables were selected to check different attitudes to safety. Three of the items were presented in such a way that agreement with them would represent a positive attitude toward safety and/or safety related aspects, while the other two were presented in a way that agreement would represent a positive attitude toward risk and/or disregard for safety.

In order to establish whether there was a natural grouping of these items in the way they were responded to, a factor analysis was performed. Two factors were identified. The items of positive attitude towards safety loaded in the first group, while the items of positive attitude towards risk loaded in the second. Accordingly, the factors were titled as so. Table 16 describes the attitude items grouped in their factors.

Factor 1 of attitudes
• PPE is useful in a hazardous situation • It is everybody's duty to ensure safety in what they do • Safety would improve considerably if unsafe behaviour was penalised
Factor 2 of attitudes
• I find working with a certain amount of risk exciting • I can do my job perfectly without so many safety rules

Table 16: Factors and items measuring safety attitudes.

In general, there was a good attitude towards safety on all sites. Sites 7 and 17 showed a slightly more positive attitude in comparison with the other sites. On the other hand, operatives appear to have a relatively negative attitude toward risk taking. However, operatives on site 14 appear slightly more prone to risk taking than others do.

Figure 15 below represents the site means in both factors, one against the other. Original mean values have been transformed to graphically display positive and negative directions accordingly to the disagreement-agreement scale used in the research. Overall it is expected that sites with better attitudes towards safety will show more positive rankings (agreements) in this factor and more negative ones (disagreements) in taking risks.

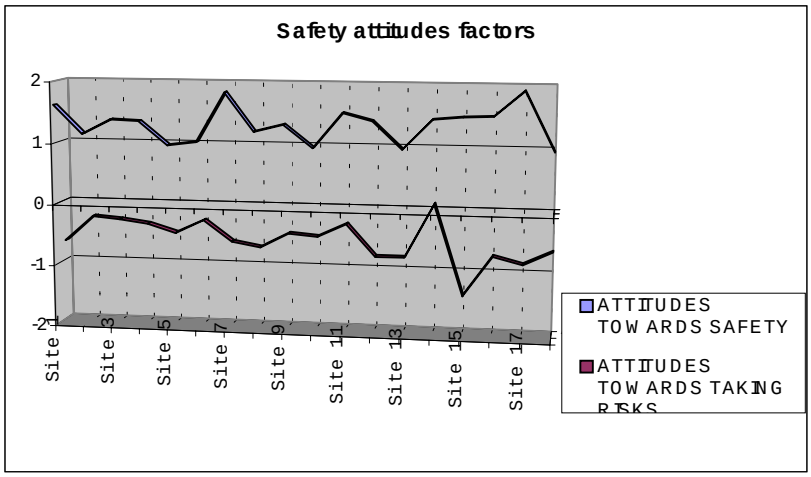

Figure 15

When looking at the attitudes across sites it can be observed that workers tend to agree with the positive items reflecting positive attitudes towards safety. However, they show rather ambivalent opinions when questioned about attitudes towards taking risks. Distributions for this factor are close to a neutral point than to the negative pole expected.

Safety Climate

Safety Climate concerns the perception of the organisation and situation with respect to safety. Fifteen variables were selected to check the perception that operatives have about their job context, especially those aspects related to safety. Some of the items were selected to collect information about the management system of each site, the level of risk of the site, and other aspects that could be affecting the safety of the workplace. Table 17 below shows the climate items in this survey grouped in their empirical factors, following a factor analysis of the data.

Factor 1 of climate: Management commitment to safety
• Site managers regularly remind the workforce about safety standards • Working safely is top priority for site managers • Managers respect safety standards and procedures • Site managers are strongly committed to follow all safety standards • Site managers regularly remind the workforce about safety standards • Site managers take the breaking of safety rules very seriously • All equipment and materials needed to work safely are available at all times • When site managers become aware of a safety problem they quickly take action • All equipment and materials supplied to work safely are in good conditions
Factor 2 of climate: Variables affecting safety in site
• It is difficult to be aware of hazards in my workplace • I am so familiar with my work that sometimes I forget to take precautions • The demands of my work make me forget about safety • It is just a matter of time before I find myself involved in an accident
Factor 3 of climate: Level of risk of the construction sector
• Construction sites are dangerous places • My job carries a considerable level of risk

Table 17: Factors and items measuring safety climate

In general, operatives perceive a moderately good management commitment towards safety. It appears that management commitment is perceived higher on site 7 while on site 18 perception of management commitment to safety is somehow lower. A graphical display of the factors shows that operatives agree that managers are committed with safety; however that perception is of a middleweight. A high management commitment is agreed in relatively few sites.

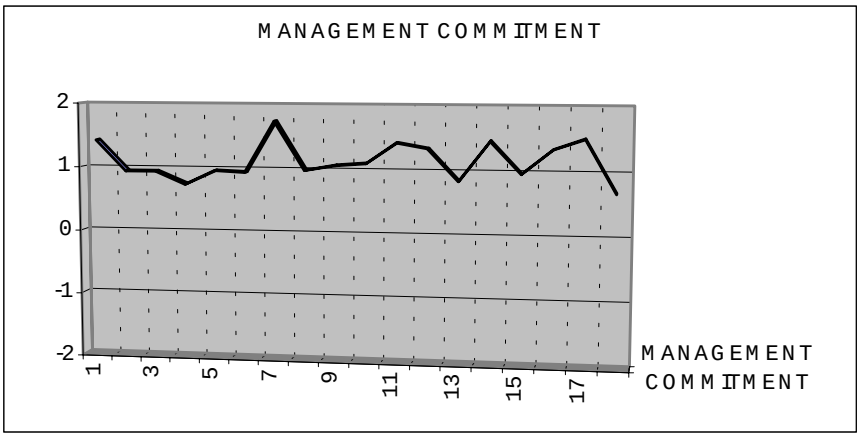

Figure 16: Management commitment with safety

A second group of variables gave information on the difficulty of being aware of hazards on site and the influence of work demands and familiarity on the level of safety. In general, operatives do not perceive those variables as affecting their safety on the job. The figure below represents the site means in the scale of disagreement-agreement used in the research. The line of mean values is clearly in the disagreement area. However it can be also appreciated that, overall, values tend to a neutral point.

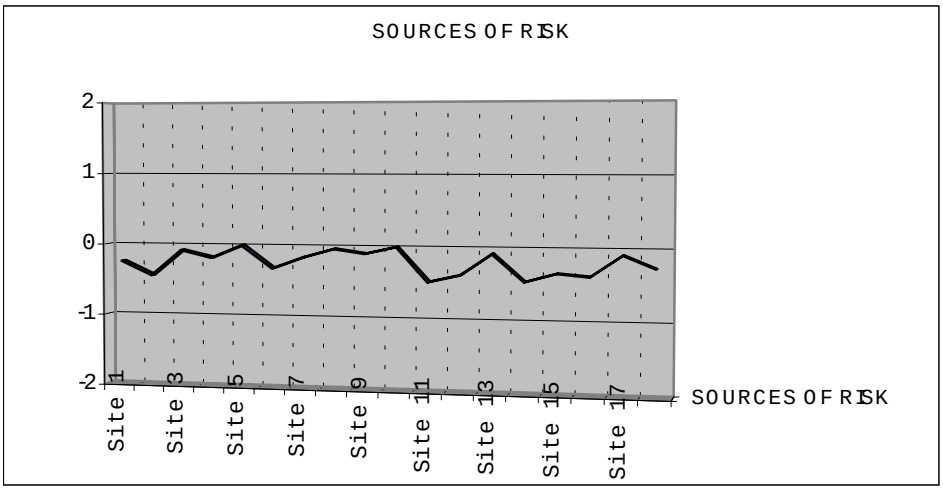

Figure 17: Perception of sources of risk influencing safety in site

In relation to the idea that construction sites are dangerous places, operatives tend to agree with that assumption. Figure below shows the results per site.

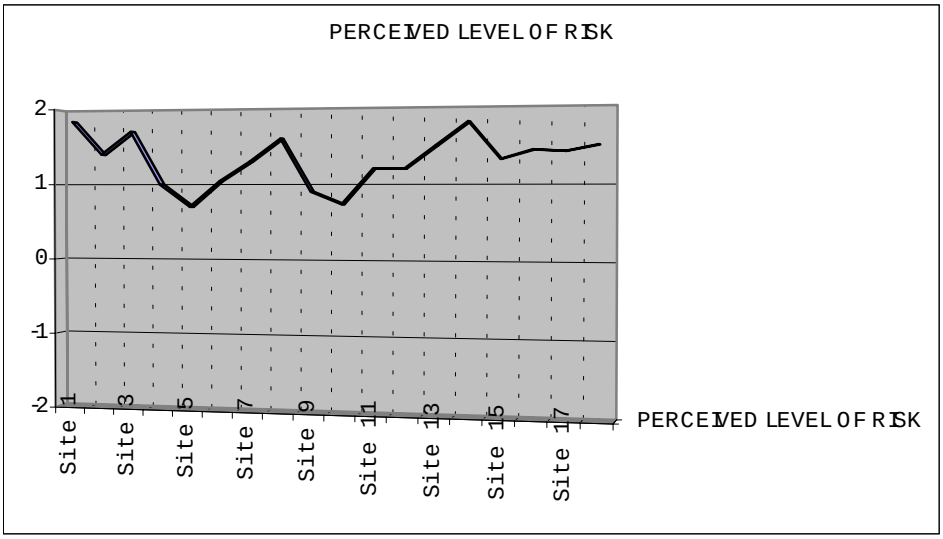

Figure 18: Perceived level of risk in site and industry

In conclusion, it seems that there is a relatively high perception of management commitment towards safety among the construction companies in the sample. There is also a high perception of risks in the industry, although the perception of this factor is much more variable among the eighteen sites. In relation to how a group of variables could be affecting safety on site, the perception is rather neutral across the sites, although with a tendency towards perceiving that those variables do not affect safety in a significant way.

Management Interviews

Reports on the safety management systems for each of the 18 sites were completed. This analysis involved both a qualitative and quantitative analysis of the key features of the safety management systems. This section of the report provides overall conclusions of the qualitative data and follows the format of the elements of the interview schedule and the applied aims of the study. A rating procedure, with explicit criteria, was adopted to translate the qualitative material from the interviews into a quantitative score for each dimension of the interview. A composite score for each site was then computed.

Safety Plan

All of the construction sites had a safety plan and risk assessments available on site. In 83% of cases it was reported that the safety plan was developed internally, with the safety officer taking the major role in this. Only one site relied completely on external expertise, and two sites developed their safety plans with both internal and external consultation. The evidence indicates that there was little or no variation in the quality or effectiveness of the safety plan whether it was developed internally or with external consultation. The majority of safety plans were generic and not site specific. Specific site hazards were not always identified or sufficiently addressed within the plan and there was no evidence of planning for reduction or elimination of identified hazards through the implementation of control measures.

Overall it appeared that the safety plan existed to meet legislative requirements and played only a minimal role in every day safety management practices. A small number of sites had a clear plan of action, however, even in these few sites the safety plan did not play an integral role in the every-day safety management of the site.

Competence/Training

Very few of the sites had a systematic safety-training schedule for their employees. When recruiting operatives, their safety backgrounds were not usually taken into consideration except for relevant certificates required for certain tasks. All sites had certified personnel for the following operations e.g. scaffolding, driving diggers and cranes, as legally held tickets were required to undertake these tasks. When recruiting management, only four of the sites considered safety training and relevant qualification as necessary for the job.

Two thirds of all sites conducted site safety induction training that lasted anything between 10 minutes and 1.5 hours. On average, the duration of the safety induction training was between 15-20 minutes and was usually conducted by the safety officer.
While everyone agreed that the induction training was necessary, a number of the managers felt that it was performed primarily to "cover themselves" just in case something did go wrong. Overall it was felt that safety induction training was not sufficient on its own and should be supplemented by refresher courses focusing on different hazards as the site progresses.

50% of the sites reported conducting toolbox talks as part of their training schedule. A number of the sites did undertake safety toolbox talks on a regular basis, and some sites reported that the toolbox talks were organised specifically after an accident or serious incident.

All but one of the sites reported their managers undertook the CIF/CEF course - Managing Safety on Construction, or an equivalent course. A small number had also undertaken diploma courses in health and safety management. Other training offered on sites included training for the Safety Reps (a 3-day course run by ICTU), first aid courses and half-day legal briefing for managers.

In Northern Ireland there was much reliance on the mobile CITB unit, which was reported to be a very beneficial and cost effective in providing a range of safety based training. Many of the sites in the Republic expressed a positive interest in the introduction of the Safe Pass Scheme. Sites reported the Safe Pass Scheme was a welcome initiative, which may improve safety behaviour and competence. Overall, sites expressed the need for additional training as well as scheduled refresher training.

While almost everyone agreed on the importance of safety training, many limitations in providing training were highlighted. For example

- Reluctance to release staff for training – "time is money", it slows down production

- Increasing time pressure, as sites were working towards very tight deadlines, difficult to conduct effective safety training due to time constraints
- Insufficient manpower
- Lack of interest by operatives to attend training

There was a general consensus by site management that the quality and quantity of the present training needed to be improved upon.

Monitoring

All sites undertook some level of monitoring safety on site, e.g. audits, hazard reporting, incident and accident reporting.

Internal audits were conducted on all sites on a regular basis. Two thirds of the sites also engaged in external audits conducted by the client, insurance companies or safety experts. Client and insurance audits were usually conducted on a six monthly to yearly basis while safety expert audits were generally conducted on a monthly basis. Management reported that the external audits were more successful in identifying and suggesting control measures, however it appeared that these control measures were not always effectively implemented.

There were two primary approaches to conducting safety audits on site - (i) visual inspection with findings not formally documented (ii) visual inspections supported by checklists and formal audit reports. All of the external audits were conducted using systematic checklists and formal audit reports. 80% of the internal audits relied on the checklist approach, the outcome of which was a regular audit report.

A number of similar trends from the audits (both internal and external) were consistent across the sites. For example

- Not wearing PPE, in particular hard hats
- Poor Scaffolding
- Missing toe boards
- Missing guard-rails / handrails
- Poor housekeeping, in particular poor stacking

While these problems were continually highlighted by the audits and were signed off on a regular basis as being dealt there were no preventative or control measures put in place to address and remedy the audits' outcomes.

One site (number 8) had an approach to safety management that was quite distinctive from the rest. The managing director of the small main contracting company also acted as the safety officer, conducting regular informal audits as well as unscheduled site visits. His charismatic style plus strict insistence on safety was reported to be very effective. This management approach was utmost entirely informal and very poorly backed up in documentation.

The relevant foreman dealt with most hazards on site and very few of the sites documented the hazards. It was reported than in most cases that the operatives were reluctant to report hazards, as it was felt that it wasn't part of their job. There was no formal documented system to record incidents or near misses in 75% of sites. Overall managers reported a low level of hazard, incident and near miss reporting.

There was a standard disciplinary procedure across all sites, which consisted of - 1 verbal warning, 1 written warning and then dismissal from site. Again site 8 was an exception to this - referral to head office and possible reassignment to another site being the reported disciplinary procedure.

A total of eleven out of eighteen sites had received an inspection by the relevant authority (9 out of 12 had been inspected by the HSA; 2 out of 6 by the HSE) on at least one occasion (see column 3 in table 18, page 48). The issues highlighted by the regulators during site inspections included, for example, poor edge protection, missing guardrails/handrails, poor housekeeping, not wearing PPE, poor covering of manholes and provision of poor welfare facilities. It was reported that two sites had been served with an improvement notice for poor housekeeping.

From the interview reports, there appeared to be no follow up from the HSA/HSE after their initial inspections to make sure that their recommendations were implemented. Two sites reported that they had received no feedback regarding the level of safety on their site following an inspection. One site expressed concern that they had received no correspondence from the HSA following a reportable accident.

There was mixed reaction across all sites in relation to both the role and the effectiveness of the HSA/HSE inspections. On eleven sites positive views were expressed about the inspectors (6 sites gave only positive views). Inspectors were considered as being helpful, understanding, giving good advice, and competent, and thus would welcome more in-depth inspections. While the Northern Ireland sites had received fewer inspections, there were relatively more positive comments about the HSE, and some reported using the HSE in an advisory capacity.

In twelve of the sites negative views were expressed about inspectors (7 sites gave only negative views). These included the view that inspectors encountered lacked specific knowledge or competence or had no standard procedure for inspections. Others felt the attitudes of inspectors were superior or arrogant. In all sites interviewees appeared to believe that inspectors targeted 'high profile building contractors' and tended to neglect small contractors and sites where the safety problems were worse. It should be noted that there was no way to check or validate these comments. They were spontaneously expressed and strongly held. Because of these views, it was considered important to interview a sample of inspectors from both jurisdictions.

Table 18 summarises the comments about inspections along general dimensions – whether there were positive or negative comments about the inspectors' role, the number of

inspections reported at this site, a ranking of the level of safety compliance found (scale of 1-5) based on the reported findings of the inspectors, and a ranking (scale of 1-5) of the reported effectiveness of the visit is stimulating organisational action to improve safety

As can be seen in table 18, the direction of the views expressed both about the role of the inspectors and about the effectiveness of the HSA/HSE to redirect organisational action does not correlate with sites being inspected or not, the number of inspections carried out or the level of safety discovered by the HSA (sites in Northern Ireland did not disclosed this information to the research team). Thus the views expressed do not simple reflect a negative reaction to an adverse inspection.

Furthermore, there was little empirical evidence of the HSA/HSE being seen to be effective in influencing organisational action. Only one site reported a positive influence, three were neutral and six were relatively negative.

	comments on HSA/HSE role by site managers	**number of inspections carried out by HSA/HSE in site**	**safety level discovered by HSA/HSE**	**effectiveness of HSA/HSE visits to redirect organisational action**
SITE 1	+	2	3	3
SITE 2	+/-	2	2	4
SITE 3	+/-	1	4	2
SITE 4	-	1	1	1
SITE 5	+	0	--	--
SITE 6	-	-	--	--
SITE 7	+/-	-	1	2
SITE 8	-	0	--	--
SITE 9	+/-	2	4	1
SITE 10	-	1	2	1
SITE 11	+	1	4	3
SITE 12	-	1	4	2
SITE 13	+	0	--	--
SITE 14	-	1	--	1
SITE 15	+/-	0	--	--
SITE 16	+	1	--	3
SITE 17	+	0	--	--
SITE 18	-	0	--	--

Table 18: HSA/HSE role in construction safety on site

Communication

In almost all of the sites there appeared to be a high reliance on an informal approach to communication. Two thirds of all sites relied heavily on individual briefings to communicate the safety message. Only 27% had a dedicated safety meeting on a regular basis. 61% of sites had regular site meetings. However safety was not always on the

agenda of this site meeting. Two out of the 18 sites incorporated poster campaigns and newsletter articles dedicated to safety.

It was agreed that the one-to-one verbal approach with operatives was the most successful means of communicating safety. Most sites had identified that their communication could be improved and viewed this as an effective means of safety management.

Co-operation

On almost all of the sites a very effective working relationship was reported between the company operatives and the subcontractors. There were usually problems at the beginning stages of work but it was felt that both the company managers and the sub-contractors were committed maintaining a high level of co-operation.

Suggestions for improvement

The following topics were suggested as areas for improvement:

- Additional Safety Representatives
- Full time Safety Officer per site
- More regular tool-box talks
- More HSA/HSE Inspections
- Involvement of HSA/HSE at design stage
- Introduce certified safety awareness course with regular brush up courses
- Full time staff dedicated to housekeeping
- Top management support and commitment
- Better planning

Documentation Analysis

Assessment of site safety documentation was conducted during the latter half of the construction project. Safety documentation was evaluated on ten of the eighteen sites visited.

Safety plan

All but one of the ten sites had a documented site safety plan. The safety plans varied considerably in length, detail and presentation. The safety plans were mostly generic and could have been applied to any construction site. Few of the safety plans assessed, contained a management structure with clear delegation of safety responsibilities. In most cases the safety plan had not been updated in accordance with the site development and progression of work. Many of the safety plans had not been "signed off" by the relevant personnel, or in some cases were out of date. Few of the safety plans contained safety statements from the relevant sub-contractors.

Risk assessments

It was evident that one of the sites did not have any documented risk assessments for site activities and associated hazards. For example this particular identified site did not have any risk assessments to address working at heights, scaffolding and ladders, all of which were everyday operations/tasks on the site. In general the risk assessments identified the site hazards, evaluated the risk in association with the people who might be harmed and the severity of the injury. Only one site had suggested documented control measures to reduce / eliminate the identified site hazard.

Site specific risk assessments

Fifty percent of the risk assessments were not site specific. These risk assessments did not address activities and hazards particular to the site in question. It can be reported that some sites had risk assessment for tasks that were not and would not be part of the scheduled construction work. Although 5 out of the 10 sites had site specific risk assessments, not all of the site activities were addressed. For example, one identified site had a specific risk assessment for working on roofs, however no risk assessment was available for working on scaffolding or using electricity.

Accident logbook

One site did not have a documented systematic approach to recording site accidents. Two sites did not have their accident logbook available for inspection. The method of accident documentation varied amongst site. Some sites had a formal systematic logbook, which recorded specific accident information e.g. activity and weather conditions. Other sites maintained a "site diary", where reported accidents were logged. This method of documentation and level of detail recorded was at the discretion of the site foreman. In general minor injuries were not recorded. Following inspection of accident logbook it can be reported that sites had few if any documented site accidents.

Safety Meetings

It was deduced that 5 out of 10 of sites did not have any documented evidence of site safety meetings. The remaining sites indicated that safety meetings were conducted in terms of minutes of site safety meetings. In many cases "safety " was also on the agenda of other site meetings e.g. production, site, company and sub-contractor meetings. Reported accidents were generally on the safety meeting agenda. Results from the safety audits were generally not discussed at the safety meetings.

Safety Audits

Eight of the ten sites had documented site safety audits, generally presented in a checklist format. Both internal and external personnel reportedly conducted the safety audits. The documented audits varied in terms of frequency, detail, audited items, rating scale and audit outcomes. The overall audit score approach was frequently used by external auditors i.e.

audit scored/rated out of a total score of 800 points. Many of the sites had scaffolding audits dedicated to inspection of site scaffolding, which utilised the C3R forms. Scaffolding was audited on a regular basis from daily, weekly to monthly. Two of the sites had no documentation relating to their auditing activities.

While eight out of the ten sites had audit documentation, which outlined the activity, the hazard and associated risk, few sites had documented improvement suggestions and/or recommended control measures. Very few documented audit outcomes were addressed at the following audit, ensuring that necessary audit items had been remedied.

Training

Seven of the ten sites indicated safety training had been conducted. This safety training varied from site induction training to specific plant/machinery training. Approximately half of the sites disseminated safety booklets to operatives at the safety induction training stage. In some cases operatives were requested to "sign off", confirming they had either received safety induction training or they had read the information booklet. Great emphasis was placed on maintaining a register of certificates indicating personnel were trained and competent to operate particular machinery and equipment e.g. certificates for crane, fork-lift truck and dumper drivers and scaffolders.

Site Number	Safety Plan	Risk assessment	Site specific risk assessment	Accident logbook	Safety meetings	Safety audits	Safety training	Overall assessment
08	Yes	Yes	No	No	Yes	No	No	poor
09	Yes	No	No	Yes	Yes	Yes	Yes	good
10	Yes	Yes	No	Yes	No	Yes	Yes	good
11	Yes	Yes	Yes	Yes	No	Yes	Yes	very good
12	Yes	Yes	Yes	Yes	No	Yes	Yes	very good
13	No	Yes	No	Yes	No	No	Yes	poor
14	Yes	Yes	Yes	---	Yes	Yes	Yes	very good
16	Yes	Yes	Yes	Yes	No	Yes	Yes	very good
17	Yes	Yes	Yes	Yes	Yes	Yes	No	very good
18	Yes	Yes	Yes	---	---	Yes	---	good

Table 19: Safety documentation in site.

Overall assessment

Two of the ten sites received an overall rating of poor, one of which did not have a safety plan. The safety plan on the other site was sub-standard and they had no documented accident logbook, safety audits, and training. Both sites' risk assessments were not site specific. Three of the ten sites received an overall rating of good as they had documented safety plans. Five of the ten sites received an overall rating of very good as they all had safety plans with site-specific risk assessment.

Although this documentation assessment indicates the quantity of safety documentation available on site, it was evident that the majority lacked quality. Safety plans were in general very broad and generic. Safety plans were poorly managed and not updated as the work on the site progressed.

Summary

Nine out of ten sites had a documented site safety plan. The safety plans were mostly generic and could have been applied to any construction site. Few of the safety plans contained a management structure with clear delegation of safety responsibilities. Fifty percent of the inspected risk assessments were not site specific. These risk assessments did not address activities and hazards particular to the site in question. Few sites documented site accidents. Five out of the ten sites did not have any documented evidence of site safety meetings. In many, however, cases "safety" was on the agenda of other site meetings e.g. production, site, company and sub-contractor meetings. Reported accidents were generally on the safety meeting agenda. Eight of the ten sites had documented site safety audits, generally presented in a checklist format. Very few documented audit outcomes were addressed by the time the next audit was carried out. Results from the safety audits were generally not discussed at the safety meetings. Seven out of ten sites indicated safety training had been conducted. The emphasis was placed on maintaining a register of certificates indicating personnel were trained and competent to operate particular machinery and equipment.

Overall Document Evaluation

Two sites received an overall rating of poor. Half of the ten sites received an overall rating of very good as they all had safety plans with site specific risk assessment. Although this documentation assessment indicates the quantity of safety documentation available on site, it was evident that the majority lacked quality. Safety plans were in general very broad and generic. Safety plan documents were poorly managed and not updated as work on site progressed.

Summary of HSE Interviews

Background

There are a total of five construction inspectors in Northern Ireland working with the Health and Safety Executive. The structure of this construction group is comprised of four full-time inspectors reporting to one principal construction inspector. All inspectors had an engineering background; one electrical, two civil and one building management. The HSE recruits employees from all sectors. The interviewees reported working as construction inspectors over a period of five years to 5 months. The inspectors had much experience working in the area, from 10-15 years in the field of inspection. All inspectors were trained to a high degree.

Inspectors had successfully completed postgraduate diploma in safety management. The HSE also offered regular training courses for inspectors including legislation, COSSH, machinery guarding. New inspectors shadowed more experienced inspectors for a short period of time, which allowed for on the job training. There was a reported high level of co-operation amongst inspectors. On occasion two inspectors conducted inspections together. Construction inspectors have their own geographical area to cover.

Over one thousand inspections are conducted annually in Northern Ireland. The principal inspector conducts approximately 100 per year.

Site Selection

The HSE inspectors had a structured systematic approach to selection of sites for inspection. Inspectors reported that up to 80% of sites notified the authority of works in progress or proposed works. The authority receives approximately 500 notification per month. It was reported that two-thirds of these would be inspected. A database of all notifications is maintained. Notifications are classified into three categories:

- Large construction works which require inspection,
- Construction works which require communication with the architect,
- Smaller construction works which will not be inspected e.g. small refurbishment's or roadworks.

Complaints, accidents, and fatalities take priority over scheduled inspection. All complaints received by the authority area dealt with within ten days. Complaints may be dealt with over the phone but may also require a site visit.

Inspectors emphasised the importance of being cost effective when planning site inspections. Sites selected for inspection were done so according to size, operation and degree of risk associated with the work. Based on experience one inspector reported the bigger the site, the bigger the risk. However other inspectors disagreed and reported that

smaller sites were more dangerous. All four inspectors agreed that the present method for site selection was a fair system and could be improved upon with more resources.

Site Inspection

Inspectors had a structured approach to site inspection. Inspectors reported they commenced their inspection on approaching the site, taking heed of any hazards visible from the road e.g. poor traffic management, poor housekeeping, dirty roadways. All four inspectors requested to speak with a member of the site management team on arrival, generally the contracts manager or site foreman.

It was reported there were very few safety officers and safety representative on site. Only one inspector reported a level of hostility on one previous site inspected. Three of the four inspectors inspected safety documentation prior to assessing site safety. One inspector stressed the importance of speaking with the site operatives asking for their opinions on safety matters relevant to the site. Inspectors always asked to be accompanied on their site inspection, generally by the site foreman. This gave the foreman an opportunity to make his/her own notes and verbally communicate with the inspector.

Safety on sites

Inspectors rated safety as low to medium on construction sites in Northern Ireland. Safety plans varied in both quality and quantity according the inspectors. Larger sites tended to have comprehensive safety plans with site-specific risk assessments. The inspectors attributed this to the fact that the safety plan was devised internally with plenty of available resources. Inspectors reported examination of sub-contractors method statements, which were considered very poor. One inspector felt very strongly about the movement of sub-contractors across the border where they have to comply with Northern Ireland legislation. Sub-contractors were unfamiliar with the legislation requirements.

In general sites were not concerned with the method statements from sub-contractors. One inspector indicated that the presence of a safety plan on site was a not a good indicator of safety performance. The inspector reported that much of the safety documentation was there to “cover management” and meet legislative requirements. Inspectors agreed involvement from sub-contractors had to be increased to improve site safety.

All inspectors believed that site safety was better with a full-time safety officer on site. Main problems reported by inspectors on sites included poor scaffolding, poor welfare facilities, falls from height, poor housekeeping, lack of documentation, site security and machinery. One inspector reported that 70% of the safety plans were generic, not site specific with the use of water and electricity not addressed in the safety plan. The inspector recommended that all safety plans should be 8/9 pages in length. Many of the safety plans were not available on site as they were held in the company’s head office. Inspectors viewed this as an indicator of how active the safety plan was on site.

All complaints were dealt with. Many of the complaints come from members of the public, which may be anonymous. Complaints regarding access to site by children, dirty roads and noise have been reported.

Following a site inspection, inspectors may issue prohibition notices (PN) or improvement notices (IN) where necessary. These notices are followed up with a letter of communication with accompanying relevant information. The inspectors also reported conducting site re-inspection one week after the PN had been served.

It was also reported that the level of management commitment to safety varied across sites. Larger sites were generally more proactive regarding safety management. All inspectors believed that management needed to take responsibility for safety and involve operatives and sub-contractors. Inspectors reported that operatives believed "they had to get the job done quickly without complaint", believing they had to work under dangerous conditions.

All inspectors stressed the importance of safety training for both management and operative levels. Training on larger sites was reported better which was attributed to access to resources e.g. mobile training unit. Some smaller sites had no safety training. All inspectors welcomed the Registered Skills Card scheme. To date up to 20% of operatives have been registered.

Inspectors attributed the main cause of site accidents to lack of resources on site, stupidity, apathy, a lack of safety ownership and management commitment to safety.

The Northern Ireland construction group has placed great emphasis on improving site safety through conducting particular campaigns. These campaigns have utilised local media to highlight the importance of secure and safe scaffolding. Inspectors noted an improvement in site scaffolding since the introduction of this campaign. Inspectors have recognised the importance of safety at the planning and intend to involve planners and architects in preventing safety problems at the early stages of design and construction.

Suggestions for improvement

- Increased resources within HSE i.e. more inspectors
- Increase the level and quality of training
- Health and safety plan must be site specific
- Need for a fundamental change in attitudes on construction sites
- Company and site management need to take responsibility for safety
- Engage other industries in safety campaigns
- More communication and feedback to lower site level

Overall conclusions

Inspectors identified the areas for improvement and development in safety management i.e. involvement of planners at early stages. They were very positive regarding their future

involvement in prevention of accidents and fatalities. Inspectors felt very strongly about the importance of safety training. There was a general consensus that larger sites were better as they had access to resources, more ownership of safety plans as they were developed internally.

Summary of HSA Interviews

HSA Construction Group Organisation

There are 16 dedicated specialist construction site inspectors in the Republic of Ireland with 14 in the Leinster region (excluding Waterford and Wexford) Two inspectors are resident in Cork and One in Galway. In addition, further site inspections are "borrowed from" or carried out by inspectors drawn from outside the construction group but within the HSA organisation.

Targets are quantified by setting the number of site inspections per year. For the year 2001 the number of site inspections is set at 7000. This converts to 28 man years and an additional "borrowed" 7- man-years per year. In 2000 the number of site inspections was set at 4500 with 5000 being achieved. Individual inspectors have their targets set by senior management.

Site Selection Procedures

Sites are selected to be visited on the basis of

- Accidents
- Notifications
- Complaints
- Closeness to other scheduled site visits

Sites are selected to be visited based on a number of information sources. These are, accident notifications (IR1 Forms) notification of construction sites (CR1 Forms) complaints from the general public and from construction site personnel. In addition sites are visited pragmatically when other visits enable sites in close proximity to be accessed or geographical areas to be covered.

All complaints and accident notifications are visited as a priority.

Due to resource constraints there has been little accident or complaints analysis carried out. This may be remedied by the recent recruitment of a statistician.

Notifications and visits close to scheduled visits represent pro-active site selection by the HSA. However not all sites will notify. The inspectors were of the opinion that between 20 and 50% of sites notify with the bigger sites having high compliance in this regard.

The number of active construction sites in the Republic of Ireland is not known. A figure of 20,000 was quoted by one inspector but is based on anecdotal evidence only.

The system of site selection is seen by inspectors as being pragmatically fair. The majority of inspectors expressed the view that they knew that the smaller sites and rural sites were not being inspected to any where near the extent of the bigger sites. It was generally expressed that it would be difficult to change site selection policy given current notification rates and resources available to the HSA.

There are some proactive visits to construction designers professionals being scheduled for this year. 100 visits to architects and Engineering practices are planned for 2001.

However, due to set priorities and resource constraints site selection is in the main reactive with the smaller sites and smaller rural sites not being visited to any significant extent.

Site Inspection Practices

There are no standardised methods for inspecting sites and inspectors will survey the sites according to received training and experience. There is variation in assessing site documentation and auditing in not a regular occurrence. The definition of auditing used here is as per BS8800 (1996), as follows, "A systematic and wherever possible independent examination, to determine whether activities and related results conform to planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve the organisations policy and objectives.

Inspectors will have a high profile on site by wearing the HSA logo at all times. They will meet with and be accompanied by site management or safety officials as far as possible.

All findings from visits are recorded for site management and safety officials either by advice notes or letters. Formal enforcement action ranges from improvement, improvement direction, prohibition notices or high court injunctions. Voluntary site closure is also an option offered by the HSA on advice from the state solicitor.

The most common reasons for issuing prohibition notices was the presence of imminent risks or the lack of a safety management system. The majority of imminent risks on site were reported as falls from heights issues or overhead lines.

All complaints and formal enforcement activities are followed up. Follow up visits on all other sites depends on the situation with the emphasis on ensuring the rectification of problems discovered by earlier visits.

For the vast majority of sites access is always provided with hostility towards the HSA being rare.

Site Safety Standards Summary

All inspectors reported they encountered falls from heights and unguarded openings as common site problems. Other issues reported were lack of wearing PPE, overhead lines, plant movement and poor welfare standards. All inspectors cited a lack of planning as a principal cause of these issues.

Whilst site safety could be variable across all sites, all inspectors drew a general difference in safety standards between Dublin and rural and or smaller sites. All reported that in overall terms the Dublin region had the best standards overall and the rural and or smaller sites which tended to be worse. The boundary constraints operating on the Dublin region sites was also noted.

All inspectors drew a general difference between house builders and the rest of construction. The developer / housebuilder sites were constantly reported as being markedly poorer in safety terms relative to general contractors.

Other reasons cited for poor safety standards included weak safety management systems, lack of planning at the pre construction stage and lack of co-ordination between contractors on site.

In the opinion of the inspectors the presence of a site safety officer was taken as showing an increased commitment to safety by management. However all inspectors noted that the presence of a safety officer did not necessarily equate to better site safety standards.

Improvement of Site Safety

In terms of improving site safety all HSA inspectors agreed on the need to;

- generally improve training levels
- increase the amount of planning before and during construction
- increase client and designer influence over safety issues.
- Introducing more “tool box” talks
- Introducing more qualified scaffolders
- Improving management commitment to safety
- The safe pass scheme to be made compulsory
- Slowing down construction project timescales
- Decreasing the level of resistance from clients architects and engineers at the design stage to becoming more involved in planning site safety
- Reviewing inspection methods to include more auditing
- Strengthening the regulations to ensure co-ordination among contractors
- Increasing the number of safety representatives
- Increasing site safety meetings
- Increasing fines for non compliance with the construction regulations
- Introducing tribunals to speed up lengthy court procedures for non compliance

Predicting Compliance

One of the main objectives of this study was to investigate which factors are associated with compliance with safety procedures and requirements. Can the sites be differentiated by how well the ratings of the management system correlate with safety compliance? What association do safety behaviours and attitudes have with either management factors or compliance? The first step in this analysis was to establish how the many variables that were measured in the observation of compliance and in the safety management interviews related to each other. Once these main factors were established, it was then possible to investigate the correlations between the different types of variables. Only the main significant relationships are reported here. Many statistical analyses were carried out to explore a wide range of possible relationships between variables. The vast majority of these were not statistically significant and are not reported here, primarily for reasons of space.

The first step taken was to check for any pattern of relationships among the different variables of the observational study. A factor analysis technique is useful here, as it will allow us to discover if some variables tend to correlate better with themselves than with some others, so that they form identifiable groups. Three groups of related variables were found in the study when considering the compliance items (see table 20 below).

Factor 1 of non-compliance
ladders not tied
unguarded openings
unsafe storage of materials
missing boards on scaffolds (not toeboards)
trapped boards on scaffolds
missing toeboards on scaffolds
missing guardrails on scaffolds

Factor 2 of non-compliance
not external use of head PPE
not internal use of head PPE
not safe use of ladders
not wearing of viz vest
rubbish on scaffolds (lifts)

Factor 3 of non-compliance
rubbish on access routes
no defined plant routes
unsafe storage of materials

Table 20: Factors obtained when using 14 out of the 18 variables of compliance. 4 variables were rejected because of some missing values in them.

The first factor includes a range of items mostly related to working at height (ladders not tied, unguarded openings, and the condition of scaffolds) but also includes storage of materials. The second factor is mainly concerned with safe behaviour (use of personal protective equipment, use of ladders, and visibility vests). The third factor concerns access routes and interference by rubbish and unsafe storage.

Of the three factors, only the first one shows significant relationships with other variables in the research. In order to reduce the size of the report, only relationships for this factor will be described below.

Correlation indexes were calculated between *Compliance-Factor 1*, the *fall prevention measure* in the observational research (table 13 page 32) and the *overall safety performance* when all observed items are averaged together. Correlations between the three groups are all significant, with R= .86 for the overall safety performance, and R= .98 for the measure of falls prevention [see table 21 below]. These high levels of correlations are indicative that this factor of compliance can be used as a representative one for evaluating compliance with safety on site. Consequently it will be named as "Factor of non-compliance with safety."

Correlation Coefficients between factors

	Non-compliance	Overall	Fall
Non-compliance	1.0000 P= .	.8602 P= .000	.9780 P= .000
Overall Safety Performance	.8602 P= .000	1.0000 P= .	.8169 P= .000
Fall Prevention Performance	.9780 P= .000	.8169 P= .000	1.0000 P= .

Table 21: Correlation between statistically found Factor Non-compliance and previous factors in the observational research.

A similar procedure of factor analysis was used for the management survey. It was found that two factors accounted for the main findings at the managerial level. The factors and their variables can be seen in table 22 below. Although these factors have a non-significant correlation with each other, the level of correlation obtained (R= .36, p= .146) is not negligible. The small number of sites makes it more difficult to reach a significant result.

Factor 1: Management System
Quality of the communication
Philosophy of the company
Training of operatives
Training of managers
Commitment with co-operation
Plan of action
Quality of co-operation
Frequency of audits

Factor 2: Effectiveness of the management system
Effectiveness of audits to redirect organisational action
Effectiveness of hazard reporting to redirect organisational action

R= .3572 (p= .146)

Table 22: Factors related to the management system

The first factor is a general factor including diverse aspects of the safety management system (communication, training, co-operation, planning, audits, safety philosophy). Factor 2 contains two items both reflecting how effective was the response to either audits or reports of hazards.

Outliers, extreme cases and highly untypical results in management and compliance factors were examined. Two sites had to be removed from further analysis due to these anomalous data. Removal of site 8 was based on previous observation of a particular management system that could be guaranteeing compliance but could not be explained by the management variables used in our research. Site number 9 was removed because of its extreme values, but also because some of those values were related to single items (1 ladder

= 100% non-compliance; 1 opening = 100% non-compliance) seen on site. Site 9 was not believed to give a reliable indication of compliance.

Correlation indexes for each management factor against the non-compliance factor for the 16 sites were calculated (see columns 2, 3 and 4 in table 23). *Effectiveness of the management system* (Management-Factor 2) correlates significantly with the level of non-compliance found on site (r = -.66; p= .005). *Management system* (Management-Factor 1) reached a moderately low correlation which was not significant but had a positive tendency in the predicted direction (r = -.27; p= .31).

Another significant relationship found in the study concerns the presence of a Safety representative on site (see column 5 in table 23). In comparison to other safety related roles, those sites with safety representatives show significant lower levels of non-compliance (r = -.78; p= .000). That relationship is even bigger than the one found between *Effectiveness of the management system* and *Non-compliance*. There is a modest relationship between the general management system factor and the presence of a safety representative on site but this is just short of statistically significance (r = .49; p= .054).

	Factor Non-compliance	Management Factor 1 (scale 1-5)	Management Factor 2 (scale 1-5)	Safety Rep. on site?	Reporting	Fixing	Stop working	Follow working
Site 3	**2.28**	4.12	4.00	2 (Yes)	37.38	22.43	26.80	13.40
Site 2	**2.71**	2.50	4.00	2	76.61	5.85	6.76	10.78
Site 7	**7.14**	3.50	3.00	2	59.98	18.31	17.61	4.08
Site 15	**7.14**	4.37	3.00	2	42.95	25.76	12.70	18.60
Site 11	**7.85**	3.62	2.50	2	75.90	15.26	.88	7.96
Site 12	**5.00**	4.12	2.50	2	70.48	17.06	5.56	6.88
Site 5	**14.00**	2.50	3.00	1 (No)	58.91	5.18	19.25	16.65
Site 18	**12.85**	4.00	2.50	1	31.25	34.16	3.33	31.25
Site 13	**10.00**	1.37	2.00	1	45.55	26.46	5.55	22.40
Site 6	**11.71**	2.85	2.00	1	37.30	6.38	23.86	32.48
Site 14	**12.14**	2.87	2.00	1	47.26	27.28	4.85	20.61
Site 4	**12.85**	1.12	1.50	1	32.26	17.41	36.55	13.81
Site 17	**15.00**	2.87	2.50	1	50.36	26.58	13.11	9.93
Site 1	**15.71**	3.50	1.00	1	68.38	25.31	.00	6.31
Site 16	**20.71**	4.12	2.00	1	28.60	57.58	3.03	10.80
Site 10	**24.85**	2.00	2.00	1	47.63	16.66	7.15	28.60
	Factor Non-compliance	R= -.2709 (p= .310)	R= -.6604 (p= .005)	R= -.7870 (p= .000)	R= -.3623 (p= .168)	R= .3785 (p= .148)	R= -.1898 (p= .481)	R= .3305 (p= .211)
		Management Factor 1	R= .3572 (p=.146)	R= .4901 (p= .054)	R= .0535 (p= .844)	R= .3779 (p= .149)	R= -.3203 (p= .226)	R= -.2553 (p= .340)
			Management Factor 2	R= .6931 (p= .003)	R= .2031 (p= .451)	R= -.2904 (p= .275)	R= .1748 (p= .517)	R= -.1545 (p= .568)
				Safety Rep. on site?	R= .5074 (p= .032)	R= -.2698 (p= .279)	R= .0006 (p= .998)	R= -.4868 (p= .040)

Table 23: Visual and statistical correlations. Table ordered to show visual correlations between Non-compliance and Management-Factor 2. Other correlations shown are presence of Safety Representative on site and Preferred behaviour of operatives in the face of danger.

Furthermore, workers' preferred behaviour when facing risky situations was also correlated with safety compliance and the management system factors (see columns 6 to 9 in table 23). It was found that no behaviour relates significantly with either the management system or with compliance levels. On the other hand, the presence of the safety representative correlates significantly with the behaviours of reporting and continuing work. When a safety representative is present on site, behaviours of reporting are enhanced (r = .50), while behaviours of continuing working are minimised (r = -.48).

Figure 19 provides a graphical summary of these significant findings (and includes the near significant relationship between the general safety management factor and the presence of a safety representative). It should be noted that these are bivariate relationships –i.e. correlations between each pair of variables assesses independently of each other. However, in the real world, these relationships are not independent. For example, the correlation of 0.79 between the presence or absence of a *Safety representative* on site and *Non-compliance with safety* is probably not independent of the relationship between the *Safety representative* variable and *Effectiveness of the management system* (Factor 2) and *Non-compliance* with safety (r = -.66).

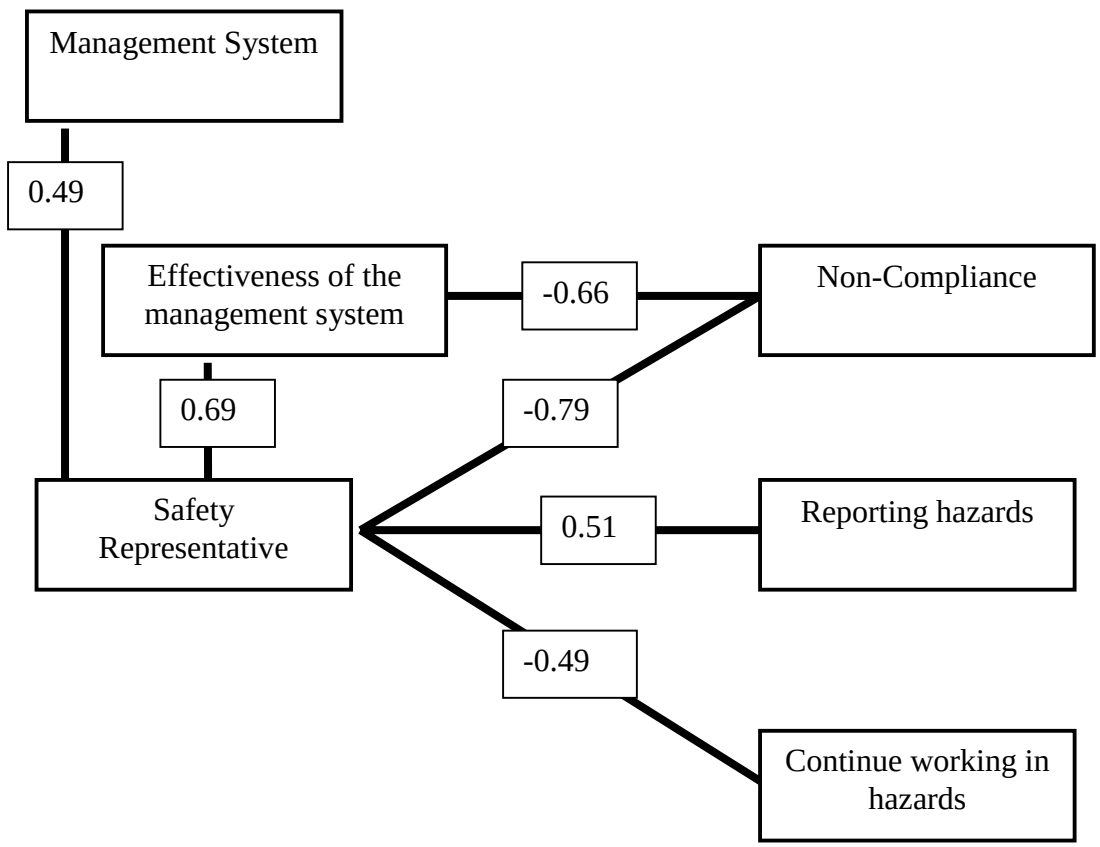

Figure 19: A model of bivariate significant relationships in this research

In order to examine the underlying structure of these relationships these variables were entered into a multiple regression equation. This parcels out the correlations between each pair of variables taking into account the relationships between the other variables within the other variables within the equation which may overlap. In this equation the only two significant variables, *Effectiveness of the management system* and *Safety representative on site*, were entered into the equation with *Non-compliance with safety* being the dependent variable. In other words, this was the strongest test of hypothesis concerning which variables predict or are associated with non-compliance with safety. The outcome of this demonstrated that only one variable –the presence or absence of a safety representative- was significantly related to compliance with safety. The presence of a safety representative is strongly associated with better safety compliance.

Summary

Factor analysis identified a general factor of safety compliance with two smaller factors (the latter two had no significant associations with any other variables). The management interviews generated a general factor relating to the safety management system and a more specific factor related to the effectiveness of the system in responding to audits and hazards. Figure 19 illustrates the significant relationships, which have been found following the removal of two untypical sites from the analysis. The strongest relationship with the main safety compliance factor is with the presence or absence of a safety representative. A safety representative on site is associated with better compliance. The only other factor that is associated with compliance is the second safety management factor - *Effectiveness of response to audits and hazard reports*. The general *Safety management* factor is not significantly associated with safety compliance, but does have a modest relationship with the presence of a safety representative (this is just short of statistical significance). The presence of a safety representative is the only factor which is significantly related to safety behaviours - safety representatives are associated with a greater likelihood of reporting risky situations and a lower likelihood of simply continuing working in such situations. The presence of a safety representative is also strongly related to the effectiveness of response to audits and reported hazards. This pattern of relationships suggests that safety representatives are the most important influence on the association between effectiveness of response to audits and hazards and safety compliance. To otherwise conclude that the influence of the safety representative is masked by the management system would be an erroneous one. When a regression analysis is carried out using management variables and safety representation, only the presence of the safety representative remains as predictive variable. This result will favour the conclusion that the relationship between *Effectiveness of response to audits and hazard reports* (management-Factor 2) and safety compliance is modulated by the presence of the safety representative in site.

Discussion and Conclusions

This section draws together the evidence of this report addressing five questions:

- How well does the sample represent the safety aspects of construction activity in Ireland?
- What can be concluded about the state of construction safety in Ireland?
- What factors are associated with better safety compliance?
- What implications can be drawn from the evidence?
- What recommendations should be made?

How well does the sample represent the safety aspects of construction activity in Ireland?

The sample was selected to represent both Northern Ireland and the Republic of Ireland and major dimensions of construction activity, which have been associated with fatal accidents. Thus it included both housing construction and general contracting, and construction in and around both the major metropolitan areas, Dublin and Belfast, and in regional towns in the Republic of Ireland. Both large and smaller sites were included, the former being categorised as IR£5 million or over, the latter, IR£1 million or over and under IR£5 million. While small companies are very highly represented in fatal accident statistics, these are often subcontractors working on larger sites. Thus it was anticipated that we would get a reasonable representation of those employed by these firms on the sites chosen. While labourers are the most highly represented occupational category in the fatality statistics, a wide range of occupations are involved in fatalities, and our sample of occupations was based on availability on the sites chosen. The high involvement of falling from heights in construction accident statistics led to a focus, in the site observations and operatives' questionnaire, on factors associated with falling from heights. This while the survey did not include very small sites or sites in purely rural areas, it has effectively included a wide range of construction activity, which includes the major dimensions associated with fatalities.

How representative is the sample of the construction industry in Ireland? There are two pieces of evidence that suggest that the sample may have a higher representation of "better" sites from the point of view of safety. First, the questionnaire results consistently showed that construction workers rated the prevalence of risky situations as being lower in the site on which they were interviewed that in other sites in which they worked. Secondly, it is possible to compare several dimensions recorded in this survey with the results of the surveys carried out by the HSA. These statistics show that less than five percent of sites inspected had safety representatives compared to forty percent of the sites in the Republic in this sample and one third overall (only one out of six in NI). Only fifty percent of the HSA inspected sites had safety statements whereas only one site (in NI) in this sample (of those whose documentation was inspected) did not have one.

While it is impossible to directly compare the criteria used in inspections with those used in this sample, it is interesting to note the relative level of compliance with safety requirements. The HSA inspections documented that 69 percent of sites had inadequate scaffolding, whereas, in this sample, 61 percent of all 18 sites had more than 15 percent of missing guardrails or edge protection. 24 percent of the HSA inspections found edges, openings or fencing to be inadequate, compared to 39 percent of sites in this sample having more than 15 percent of openings found unguarded. In the HSA sample, in eleven percent there was a recommendation for an improvement notice, and in sixteen percent a prohibition notice, compared to two sites (seven percent) in this sample reporting having received improvement notices. It is not clear from the HSA data how many notices were in fact issued.

Perhaps a reasonable conclusion from this would be as follows. Selection for inspection by the HSA is partly driven by internal and external complaints and so is likely to be biased towards sites that have a poor compliance record. The sites in this sample, mostly being drawn from the CIS database, may have a bias towards companies which are better established or better organised. However, the extent of this relative bias may not be very great. It is worth noting that sixty percent of the sites in this sample reported having had a recent inspection by the HSA or HSE. Thus it may be that the level of safety compliance in this sample will provide a modest overestimate of the level of compliance to safety among those working in construction in Ireland.

Nevertheless, even if there is a slight bias in this sample towards sites which may appear better on some indices of safety, the fundamental objective of this study is to investigate factors which are associated with compliance. For that it is necessary to have a good range of sites, which vary both on indices which may predict compliance and on the level of compliance itself. This sample fulfils these criteria quite satisfactorily.

What can be concluded about the state of construction safety in Ireland?

Bearing in mind the above comments, the following broad observations can be made about the state of the art of safety in the Irish construction industry

Compliance with safety requirements

The level of safety compliance across the sites was quite variable. In relation to the items concerning prevention of falls from heights, compliance ranged from good to poor. Thus, only two sites had full compliance on edge protections and handrails, five sites on unguarded openings. There were ladders which were not tied in eight sites. Thus it can be concluded that there was much that could be improved in the majority of sites. Factor analysis of the fourteen items which had sufficient variability between sites indicated three factors - the first, indicating general non-compliance with safety, included ladders not tied, unguarded openings, unsafe storage, and deficiencies in scaffold boards, toe boards and guardrails. This factor was highly correlated with a smaller factor concerning specific fall prevention measures but rather less so with a factor concerning general housekeeping.

Perception of risk

How well are the risks associated with falling from heights perceived? In general the nine situations concerning working with ladders, scaffold and on roofs were perceived as high risk (the major exception being short ladders, which were perceived as medium risk). However a small minority of workers in each site saw many of these situations as low risk. The frequency of these situations was generally seen to be fairly low in the construction industry, though constructions sites are generally perceived to be dangerous places. Workers do not generally see difficulty in being aware of hazards, or their familiarity with work, or the demands of their work as significantly contributing to safety. Thus, for most workers, developing and maintaining awareness of risk is not perceived to be a significant problem.

The great majority of workers report that they would respond constructively to risky situations, either reporting the defect, fixing it, or stopping work (depending on the situation). However, a sizeable minority (between ten and twenty percent) would just continue working (and this was between twenty and thirty percent for ladders being too short and working on roofs in bad weather). Thus there is a small minority who may not perceive risks accurately and a larger minority who say they are prepared to continue working in risky situations.

Training

Almost forty percent of operatives report that they have received no safety training from the main contractor. For a further fifty percent their safety training comprised the induction course (lasting between ten minutes and one and a half-hours). While managers consider this safety training to be necessary and indeed should be supplemented by further refresher courses, many believe the way it is currently carried out is primarily to "cover themselves" in case something goes wrong. Eleven percent of the sample has received safety training lasting more than one day. Very few sites claimed to have a systematic safety training schedule for their employees, and safety training was not usually a consideration in recruiting operatives, apart from the certificates required for scaffolders, crane and digger drivers, etc. In Northern Ireland there was much reliance on the mobile CITB unit, and in the Republic interest was expressed in the potential benefits of the Safe Pass Scheme. Thus it seems clear that for the majority of operatives the main way in which they achieve knowledge of the risks of their work is through their experience of work itself. Even where the main contractor provides induction training, this is often perceived as a formality, to protect the company, with little expectation that it would influence the knowledge and behaviour of workers. The low level of provision of safety training is particularly worrying considering that twenty five percent of the sample report that they have worked in the industry for less than one year and fifty percent less than two years. Thus their level of experience of the risks associated with the job and of how to manage them may not be that great. Direct and vicarious experience of hazards may be the main way of gaining knowledge of the risks of construction and how to manage them. This is a reactive and potentially dangerous way of learning.

Safety management

Both the management interviews and analysis of safety documentation indicated that whereas virtually all the sites had a safety plan, these were mostly generic documents that could be applied to any construction site. Thus, few contained a management structure with clear delegation of responsibilities. Few contained safety statements from sub-contractors. Although half the sites had risk assessments which were site specific, in some of these not all the relevant site activities were addressed. These documents played little or no role in ongoing management activities and their function appeared solely to meet legislative requirements.

All sites conducted safety audits, mostly following a checklist method with a written audit report. However few sites documented improvement measures or actions taken to remedy audit deficiencies. Hazard reporting was rarely documented and the same was true of incidents and near misses. Communication about safety was most often informal and verbal. A quarter of the sites had regular dedicated safety meetings, though for others safety was a frequent item on site meetings.

In all but one site some or all of the management had undertaken CIF/CEF training courses. A small number of safety managers had also undertaken diploma courses in health and safety management. Six sites had a safety representative. Frequently these had been appointed by the management.

A factor analysis of the variables investigated in the safety management interviews indicated that a range of safety management activities, including those just discussed, were highly correlated in one general safety management factor. A second factor comprised two items, which concerned the effectiveness of audits and hazard reporting in redirecting organisational action to improve safety. These two factors were not significantly correlated indicating that commitment to a range of safety management activities does not necessarily imply an effective response to audits and hazard reports. In general the perception by workers of the commitment of management to safety was fairly positive.

Role of inspectors

While the majority of sites reported having had an inspection from the HSA or HSE, reactions to these inspections varied. Many reported no feedback or follow up from the inspectors to ensure implementation of recommendations. While many sites welcomed the inspections and would have wanted more in-depth coverage from them, inspectors do not see their role as doing a full site audit and their practice in conducting an examination of site documentation varies. From the inspectors' point of view, it is through their exercise of their legal function (improvement and prohibition notices) that they see themselves bringing pressure on the worst performing sites. Other comments were quite critical of the inspections. Negative comments did not seem to be systematically related to experience of inspection on that site. Some could reflect the fact that inspections of construction sites are sometimes done by inspectors with no specific qualifications in construction. The most common complaint was that smaller less safe sites were

overlooked. However inspectors report that a large proportion of inspections are reactive to complaints or accident reports (overall, it is probably fair to say that there was little evidence of direct positive influence on the sites surveyed from the inspections reported).

Conclusion

In conclusion, the evidence suggests great variability in compliance with safety requirements, with plenty of room for improvement. The great majority of workers on construction sites report good awareness of risks associated with working at height and the majority would respond constructively to risky situations, though a significant minority would just continue working. Training for construction workers is patchy and seen to be inadequate, relying to a large degree on site induction training. Certification of specific trades (scaffolders, crane drivers, etc.) is monitored. The high proportion of relatively inexperienced workers gives rise to concern about their effective appraisal of and response to risk.

Although workers are fairly positive about the commitment of managers to safety, the evidence from management interviews and documentation is less positive. Safety plans and safety assessments are most often paper exercises with little role in day-to-day management. Only a minority of sites have safety representatives. Audits based on checklists are used in most sites but it is difficult to find documentary evidence of corrective action. While a range of core safety management activities is closely associated together, these do not correlate highly with effective response to audits and hazard reports. While the majority of sites have had an inspection from the HSA or HSE, the priorities of the inspectorate are reported to focus on using improvement and prohibition notices to influence compliance (other than that, there seems to be little opportunity for inspections to influence what happens on site).

What factors are associated with better safety compliance?

Perhaps the core question in this study concerns the factors that may be associated with safety behaviour and compliance with safety requirements. Those factors that tend to be present in the sites with better safety outcomes may represent the most effective influences on safety, whereas factors, which do not discriminate between relatively safe and unsafe sites are unlikely to be critical in promoting safety. For the purposes of this analysis the critical outcome variables are the safety compliance factors, and the safety behaviours which workers report they would follow in risky situations - report it, fix it, stop working or just continue working.

The strongest relationship with the main safety compliance factor is with the presence or absence of a safety representative. A safety representative on site is associated with better compliance. The only other factor which is associated with compliance, is the second safety management factor - effectiveness of response to audits and hazard reports. The general safety management factor is not significantly associated with safety compliance, but does have a modest relationship with the presence of a safety representative (this is just short of statistical significance). The presence of a safety representative is the only factor which is significantly related to safety behaviours - safety representatives are associated with a greater likelihood of reporting risky situations and a lower likelihood of

simply continuing working in such situations. The presence of a safety representative is also strongly related to the effectiveness of response to audits and reported hazards. This pattern of relationships suggests that safety representatives are the most important influence on the association between effectiveness of response to audits and hazards and safety compliance.

The presence of a safety representative on site shows the strongest relationship with safety compliance (the bivariate correlation of almost 0.80 is very high). Although there is a tendency (almost significant) for safety representatives to be present in sites with better general safety management performance, it would be a mistake to conclude that this general safety management factor accounts for the relationship between safety representatives and compliance. There is no significant relationship between the general safety management factor and compliance. This factor, at best, has an indirect relationship with compliance through the appointment of a safety representative. It is the presence of the safety representative which influences compliance.

How does the safety representative influence compliance? The pattern of correlation and the multivariate analysis suggest that the presence of a safety representative accounts for the great part of the relationship between the effective response to audits and hazards (*Effectiveness of the management system* or Management-Factor 2) and compliance with safety. Safety representatives strongly influence the response to audits and hazards (bivariate r = .60) but their influence on compliance is even stronger (bivariate r = .79). This suggests that they influence safety compliance not only through their influence on the response to audits and hazards but also through other means.

The safety representative variable is also the only variable that shows a significant relationship with reported safety behaviours –specifically reporting hazards and not continuing to work in hazardous situations. Thus safety representatives encourage the reporting of hazards and play the major role in ensuring that these reports lead to better safety compliance on site. Their presence also makes it significantly more likely that workers will not continue to work in hazardous situations.

It should be pointed out that these are not actual measures of workers' behaviours but reports of what they would do in specific hazardous situations. Thus, it is more accurate to say that the influence demonstrated here is on the expressed intentions of workers on site rather on their observed and recorded behaviour. However, although we cannot assume that intentions will always be translated into actions, what has been demonstrated here is a strong and systematic relationship between the presence of a safety representative and intended behaviours in a range of specific safety situations which are generally perceived by workers as being risky.

Two aspects of the statistical analysis are worth a comment because of the, perhaps surprising, lack of statistically significant relationships. The first is the lack of association between de general *Safety management* factor and anything else except the appointment of safety representatives (almost significant). In particular, although the correlation between the general *Safety management* factor (Management-Factor 1) and *Effectiveness*

of the management system factor (Management-Factor 2) is 0.36, this falls short of statistical significance and thus we cannot be confident that this is not a chance result. Likewise there is no relationship is which we can have confidence between the general safety management factor and either safety compliance or the variables assessing safety behaviours. These results must pose a fundamental question: why does so much activity which is undertaken in the name of safety apparently have so little influence on safety compliance and safety behaviours?

Secondly, there is the lack of any significant relationship between the attitudinal variables (safety attitudes, perception or risk and safety climate) and any of the safety outcome variables (compliance, safety behaviours). General safety attitudes were fairly high, though general attitudes towards risk were more ambivalent. The climate measure shows a generally positive perception of the management commitment to safety, and the specific risk perception measures show, amongst the great majority, an accurate perception of risk. These attitudes and perceptions do not appear to have an influence on safety behaviours and compliance. Thus it is possible to have fairly strong pro-safety attitudes and perceptions but poor levels of site safety compliance. This suggests that the difficulty of getting more consistent and higher standards of safety compliance may be less to do with attitudes and perceptions of workers and managers, and more to do with systemic factors –having mechanisms for reporting hazards, following up on hazard reports and audits, and doing what it takes to ensure that hazard reports and audits are translated into effective compliance with safety requirements.

What is remarkable about the findings reported here is how little safety management activity has a measurable positive influence on safety outcomes –suggesting that safety management systems as they exist very often do not provide a systemic basis for effective safety action. It is equally surprising that safety representatives who have little or no formal power, and some rights to be consulted and informed, have the strongest and most pervasive influence on safety compliance and safety behaviours.

It is worth noting that most of these safety representatives are, in no formal sense, representatives –as they were appointed by management rather than elected by their fellow workers. This in turn suggests the strong and important role of informal mechanisms of influence and persuasion in developing effective safety management. The role of safety representatives in ensuring the job goes smoothly, in facilitating communication, hazard reporting, and playing a strong informal disciplinary role was repeatedly highlighted in the interviews. Their ability to inspire trust and confidence amongst fellow workers on site is illustrated in the following quotes: "If you approach them in the right manner they will listen to you", "You need to communicate the message to young inexperienced staff". Although in this sample it was safety representatives who played this role (wherever they had been appointed), there is no reason in principle why these informal mechanisms of influence should not be exerted by others as well as safety representatives. This is clearly not being done in the current situation.

As the majority of sites had at some time been subject to an inspection by national authority inspectors, it seems sensible to pose the question –do these inspections have any

direct influence on safety compliance on site? We are not here concerned with the possible influences of national activities of the authorities which are not quantifiable in this context. Setting aside, also, the role of improvement and prohibition notices, the effect of which could not be directly investigated in this study, the main sources of evidence which can be brought to bear on this question are:

- what site personnel say about inspections,
- what inspectors say about their role and objectives,
- whether there is any evidence that sites which have received inspections perform better than those that have not.

In relation to the third source of evidence, no clear pattern emerges with just one site reporting a strong positive influence of the inspection on improving safety –for others the impact was rated as neutral or weak. In the majority of sites positive comments were made about inspections, and some of these indicated willingness for a more in-depth active role of inspections. A lack of feedback or follow-up was a common comment. Negative comments about inspections were also expressed in a majority of sites. Some of these also suggest that an improvement in the inspection process would be welcomed. From the point of view of inspectors themselves, a number of issues arise. There is a tension between rolling out a planned programme of inspections which systematically covers the whole industry and responding to complaints and accidents. The latter reactive demands take priority over and often disrupt the former. The primary focus of inspections is on documenting compliance with safety requirements and the interviews with inspectors confirm many of the findings of this study in relation to compliance levels in the industry. While site documentation is often inspected, there is no systematic methodology for auditing or assessing the safety management system as a functioning management process which is designed to ensure safety on site. Indeed, inspectors do not see it as their role to conduct such an audit.

Thus, it could be concluded that while quite a lot of activity by inspectors was reported in relation to the sites in this survey, very little of this activity appears to have, or to be designed to have, a direct influence on the effective management of site safety. This may be a missed opportunity to create value (in terms of safety impact) out of a large scale national activity.

There was little evidence of any other direct influence on site safety management from other agencies external to the site, and the main and sub-contractors concerned. This includes architects, the client of the building contract, or trades unions. External safety consultants were engaged on some sites in providing an auditing service. After handing the conclusions to the main contractor, these external consultants appear not to have an influence in the measures employed by the main contractor in relation to safety. The lack of apparent direct an identifiable influence by these external agencies does not, of course, imply that they have no important role in site safety. Our conclusion is simply that, in terms of the dimensions and measures which were employed in this study there was no evidence of a direct and identifiable influence. It would take a very different study to systematically investigate the safety role and influence of such agencies.

What are the implications of the evidence?

At its broadest level the main implication is that the system is not working. The core principle of the European safety management framework is the identification of responsibility for safety at the level of the enterprise and the consequent outlining of a range of safety management actions through which this responsibility is to be exercised. These duties of management are complemented by duties of employees to co-operate and to behave safely. The Irish safety regulations, including those specific to construction, derive from this model, which is based on the premise that, if management and workers fulfil their duties and obligations, then safety will ensue. Most starkly, the evidence from this study suggests that this model is not working or, at best, is only working in a patchy and fragmented manner.

In particular,

- The formal documentation of the safety management system - the safety statement and risk assessments - are most often seen to be a paper exercise whose role is to satisfy the legal requirement, rather than being an effective guide to management action.
- The same can be said about much of the operatives' safety training, which is undertaken. There is a lack of serious effort to ensure that inexperienced workers (a high proportion of the workforce) receive a thorough basic training in safety. The study elicited less evidence about the quality of management safety training, but none of the evidence suggests that it is having any major impact on compliance.
- While nearly all sites can provide evidence of the safety audits that they have undertaken, few can show how and when the defects highlighted in the audits have been corrected. Many safety managers express frustration at their inability to ensure that recommendations are translated into corrective action. When it comes to executive authority it is often too easy to marginalize the advisory role of the safety officer.
- The primary role of inspectors from the regulatory authorities is to inspect the site itself. There is no systematic approach to auditing or holding accountable the safety management system of the main contractor and its sub-contractors. Other than through the formal channels of improvement and prohibition notices (which were not investigated in this study) there is little follow-up and little evidence of significant influence of the regulatory authorities on safety behaviour or compliance.
- Only a minority of sites have a safety representative.

On the other hand, there are some very positive findings, which come from the survey.

- The way in which safety representatives can exploit their very informal role to help to influence what both workers and management do.
- The positive attitudes towards safety exhibited across the sample
- The high awareness of the riskiness of situations associated with working at heights and the tendency of the majority to act in a pro-safety manner in these situations.
- The level of commitment and activity by many safety officers and management to take their safety responsibilities seriously and fulfil them wholeheartedly.

Thus, while it could be said that the organisational safety culture in the construction industry is not strong, the most acute problem may lie less with the commitment of individual workers or management, and more with the failure of the system for regulating and managing safety to provide effective channels to translate safety aspirations and initiatives into effective outcomes. Strengthening the safety culture requires a systems approach, which should include the following elements:

- Strengthening the safety management process
- Defining more clearly the measurable outputs of safety management
- Developing competence standards for training
- Ensuring that performance criteria & targets are auditable.

Recommendations

Finally it is appropriate to make some recommendations arising from the findings of this study.

Safety Representatives

This study has demonstrated the potentially strong role which safety representatives can play in influencing both behaviour and compliance with safety requirements, and ensuring that both audits and hazard reports are effectively dealt with. All sites should have safety representatives and their role and functions should be reinforced as part of the safety management system.

Training and certification

The most plausible interpretation of the findings in relation to safety representatives is that their effectiveness is largely due to their ability to exert influence and persuasion through informal interpersonal methods. The social and interpersonal skills which this requires should not be the prerogative of safety representatives alone. There is enormous scope for improving the ability of those who have management and safety responsibilities, and indeed all those who work in construction, to manage the human relations of safety more effectively. These skills are trainable and susceptible to systematic development. They need to be clearly and systematically addressed in all training related to safety in construction.

As far as possible, training should not only seek to foster awareness of hazard and risk, but it should strengthen knowledge and skills in managing risky situations effectively. This should include the communications and interpersonal skills, which are necessary at every level to ensure that the correct influences on behaviour are consistently reinforced. Transfer of these skills to the working environment needs to be carefully fostered and monitored. All levels of training should be addressed including

- Site induction and refresher training
- Initiation to the industry and specific crafts / trades training

- Management training. Particular attention should be paid to fostering participation in in-depth professional safety management training at diploma and masters level.

The safety management system

Clearly the requirements for safety management systems need to be radically reviewed and overhauled. It is too easy to comply with the law through having a paper system, which does not effectively operate in practice. This review should address:

- Developing stronger criteria for active and effective safety management systems. These should include design and planning, day-to-day management and monitoring and auditing practices.
- These criteria should be developed in new ways of auditing safety management systems, which can routinely and reliably assess the activity and effectiveness of the system.
- The role of safety officer should be strengthened to ensure that it is less easy to marginalize what is essentially an advisory role.
- The accountability of operational management needs to be made clearer and firmer, and this accountability needs to be tied to measurable outputs of the safety management system, including the demonstration of effective action to address identified defects and hazards.

The Construction Safety Partnership Plan

The regulatory authorities and the social partners who collaborate in rule making are responsible to ensure the effectiveness of policy. Perhaps the clearest conclusion from this study is that established policy is not working well. New initiatives are currently underway in the Construction Safety Partnership Plan (2000), and new codes of practice in scaffolding and other areas have recently been published. At the time that the field work for this study was collected (Nov. 2000 - Feb. 2001), the Construction Safety Partnership Plan was in the early stages of its implementation. Two measures in the CSPP were most apparent in the survey: the safety representatives' scheme which was evident in a number of sites in the Republic, and safety training for managers (involving the great majority of sites). The evidence suggests that the safety representatives' scheme is highly successful. On the other hand safety training for managers does not seem to be delivering a higher standard of safety compliance on many sites.

Other initiatives do not seem to have been implemented widely enough to have been apparent in the survey, including the recommendation for inspectors to leave a report on their inspections (the reported inspections were at a time earlier than the survey). The Safe Pass Scheme and Construction Skills Certification Scheme were known about but not widely implemented at that time.

In the light of the findings, critical issues for the CSPP include the following:

- Extending the safety representative scheme to all sites. There was a tendency for the sites with safety representatives to already have better general safety management and

many of the representatives were, in fact, appointed by the main contractor. Developing effective safety representation on all sites will need more effective support from the social partners to make this work where management commitment is lower.

- An effective methodology for routine site audits must be developed. Auditing will not be effective unless it includes an effective system for monitoring the implementation of safety measures and response to hazard reports. The CSPP only states that the current auditing arrangements will be reviewed by early 2001. This should be strengthened to require more stringent criteria for auditing.
- The recommendations for the introduction of a Safety Management System by the Construction Industry Federation should urgently be reviewed in the light of the evidence of this report. Will the proposals for an SMS effectively overcome the limitations in safety management indentified in this study? The evidence suggests that a lot of safety management activity is relatively ineffective from the point of view of safety performance. Recommendations for Safety Management Systems must address the problem of translating a paper demonstration that there is a management system into clear evidence that that system is delivering improvements in safety on the ground.
- The wide range of training recommendations in the CSPP are to be welcomed. However it is important to ensure and to demonstrate that this training is effective and that the safety messages are transferred to the site and result in safer behaviour and more effective safety management. The management training programme should be urgently reviewed in the light of the lack of evidence that it is having an impact. The other training initiatives should also be reviewed with respect to how well they address the social and interpersonal processes which are essential to ensuring that safety is effectively addressed on a day-to-day basis.
- The role and activities of Inspectors should be reviewed with a view to maximising their impact on site safety in a cost-effective manner. The advantages of developing additional methods of influence which do not require legal sanction should be explored. Attention should be given to strengthening the oversight of inspectors in relation to the safety management systems of the contractors concerned; to improving their communication and feedback to encourage better safety activity; and to arrangements for follow up activities to monitor improvements.
- The CSPP is a major social initiative with considerable resource implications for all the social partners. Yet there is no proposal to monitor whether or not this initiative will be effective in improving safety in the construction industry, beyond noting the implementation of the various measures. If it is partially successful, there will be no way to systematically evaluate the strengths and weakness of various measures and initiatives and adjust them with a reasonable expectation of improving the overall programme. A systematic evaluation strategy needs to be urgently developed. This current survey was conducted at an early stage of the implementation of the CSPP. It could form part of a baseline measure against which improvements could be judged. However evaluation should not be done piecemeal, but as part of a clearly thought out strategy in relation to the objectives of the programme. Good public policy would seem to require that such a strategy be developed as a matter of urgency.

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