Secretary of State for Work and Pensions
Inquiry into the underlying causes of construction fatal accidents

Phase 2 Report:

Underlying causes of construction fatal accidents –

Review and sample analysis of recent construction fatal accidents

Health and Safety Executive
Construction Division

July 2009

First published 2009

DOCUMENT STATUS

This report is a free standing document representing work undertaken by the Inquiry into the Underlying Causes of Construction Fatal Accidents. This Phase 2 review and analysis of fatal accidents has informed Rita Donaghy's Report* but the contents of this document are not necessarily endorsed by the Inquiry nor necessarily reflected in Rita Donaghy's recommendations. It represents useful background work, with sources clearly identified, to inform discussion.

This Phase 2 review and analysis of fatal accidents and companion background reports to the Inquiry are available for download from: http://www.hse.gov.uk/consruction/inquiry.htm

A peer review of this Phase 2 report of the review and analysis of fatal accidents is available for download from:
http://www.dwp.gov.uk/publications/policy-publications/fatal-accidents-inquiry.shtml

* **Rita Donaghy's report to the Secretary of State for Work and Pensions. 'One Death is too Many: Inquiry into the Underlying Causes of Construction Fatal Accidents', July 2009. http://www.dwp.gov.uk/publications/policy-publications/fatal-accidents-inquiry.shtml**

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EXECUTIVE SUMMARY

On the 4th December 2008, the Secretary of State for Work and Pensions commissioned an Inquiry into the underlying causes of construction fatal accidents. The Inquiry arose from concern over the number of construction fatalities, to examine what more could be done to tackle the underlying causes. The terms of reference from the Secretary of State set out three phases.

This report is one of the outputs from the second phase of the Inquiry and considers the evidence about underlying causes to be gleaned from a review of recent HSE investigations of construction fatal accidents. It complements work in Phase 1 which collated the findings from HSE's research work over the preceding decade and parallel work, also in Phase 2, to explore the evidence used by industry from other 'external' sources as a basis for preventing accidents occurring.

The work benefited from the expertise and willing cooperation of HSE inspectors linked to the investigation of 26 fatal accidents leading to 28 of the 211 deaths in the period 2005/06 to 2007/08. An interview method was adopted that traced the chain of events back from the final errors which precipitated the accidents. Grounded in theories of human and organisational behaviour it enabled the extent to which various pre-conditions and underlying influences played a part in the accidents to be considered systematically and consistently.

The cases were chosen by the Inquiry Chair and three academic peer reviewers appointed to provide independent oversight of the work. They participated in the case reviews and Professor Andrew Hale took an active role in the subsequent analysis of the findings. A new 'combined' model was devised, closely resembling the influence networks used extensively in HSE's prior construction research. It combined the sequential layers of 'underlying' causes with essential components for effective safety management confirmed in recent European Union research. The resultant model provided a basis for marshalling the findings from across the different cases.

The detailed case reviews gave a powerful illustration of the range of activity, business practices and personal circumstances associated with construction fatal accident numbers. However, that variety also underlined that the sample, necessarily influenced by the constraints of the Inquiry, was too small for any statistical treatment of the findings. Nevertheless underlying causes were highlighted successfully in each of the cases which together pointed at recurring themes warranting more detailed scrutiny in the search for effective safety improvements and risk controls.

Section 4.3.3 of the report provides a systematic analysis of dominant factors in the terms of the combined model. In general terms it is evident that despite a shift in focus to behavioural and cultural issues, the suitability of equipment and workplace conditions remain to be tackled as causes of fatal accidents. Underlying issues are associated with planning and risk assessments and the ability to adapt, re-plan and re-assess as circumstances change, or to account for the minor/one-off job. These issues can be linked, in turn, to examples of

weaknesses in the contracting chain, failing to ensure the suitability of contractors for the nature or scale of work. In addition leadership failings at the corporate level underpinned consequent failures to ensure a suitably qualified and competent workforce was in place together with suitable equipment and adequate arrangements for contractor control and workforce supervision. Examples of weak or ineffective action by principal contractors in the supply chain point at the critical role of site managers for which they need individually to be adequately trained and equipped. Inappropriate actions inevitably played a part exacerbated variously by underlying weaknesses listed above but manifested as a lack of compliance possibly linked to over-confidence, complacency, or a mis-perception of the risk – factors that can be impossible to disentangle in relation to fatal accident cases. Despite the wide range of cases examined, from minor works to multi-million pound infrastructure developments, failings in the basic principles of planning a job to be done safely and carrying this through with appropriate equipment and workers adequate controls through the supply chain are evident across the spectrum.

A small number of the cases were exceptional or unusual. Many more were repeating failures replayed many times over the years as untied ladders slipped or workers on foot were killed by manoeuvring plant or vehicles. The cases provide salutary examples and specific insight to the nature of these repeated failings.

What a methodology based on the output from individual incident investigations cannot provide is definitive evidence of association with what might be termed deeper underlying causes associated with socio-political dimensions of employment structures or business practices more generally, which in turn have shaped the structure of the industry. That perspective relies on complementary research considering the extent to which different arrangements might affect individual and organisational actions.

Some initial work was done in this way to consider the extent to which change in relation to the Inquiry recommendations, for example linked to the scope of building control or director's duties, might have led to work being carried out differently such that the accidents might have been prevented. However, such speculation is tentative and of limited validity given the small number of cases examined.

Overall the case reviews were considered to make a valuable contribution to the understanding of underlying causes of accidents in construction, providing clear evidence of the failings that lead to catastrophic fatal outcomes.

ACADEMIC PEER REVIEW OF THE PHASE 2 CASE STUDY REPORT

Three independent academic peer reviewers were appointed to provide independent scrutiny and continuity throughout the work of the Inquiry:

- Professor Andrew Hale (Professor of Safety Science, Delft University of Technology)
- Dr Sonia McKay (Reader, Working Lives Research Institute, London Metropolitan University)
- Professor David Walters (Professor of Work Environment and Director of Cardiff Work Environment Research Centre, Cardiff University).

As described in the body of this report, they all played an active part in the Phase 2 case study work. In particular, Professor Andrew Hale contributed significantly to the methodology for analysing the cases and assimilating the findings.

In addition they individually peer reviewed the draft of this Phase 2 case study report and developed a joint peer review which is available for downloaded from: http://www.dwp.gov.uk/publications/policy-publications/fatal-accidents-inquiry.shtml

Many of the detailed comments from the individual reviews are addressed in this final version of the report.

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1. INTRODUCTION

1.1 PREAMBLE

On 4th December 2008, the Rt Hon James Purnell MP, Secretary of State (SoS) for Work and Pensions commissioned an inquiry into the underlying causes of construction fatal accidents. A phased approach was set out by the SoS in the formal notification of the inquiry sent to the Health and Safety Executive Chair. Phase 1[(1)] set the scene with a review of prior HSE research and this was complemented in Phase 2 by: (i) an external review and collation of industry knowledge[(2)]; and (ii) detailed scrutiny of a sample of more than 25 recent fatal accidents. This report presents the findings from that second activity and makes comparison with an earlier study of 25 foreign/migrant and 25 'control group' cases from a similar period. It forms one of the inputs to the Phase 3 deliberations of the Inquiry Chair[(3)], Rita Donaghy CBE FRSA, and the three academic peer reviewers who have provided independent oversight and scrutiny of the whole process.

1.2 AIMS

The aims of this Phase 2 review of recent cases were:

- To give preliminary insight to the reality of a construction fatal accident - the breadth of work that constitutes 'construction' and the activities involved
- To highlight underlying causes of construction fatal accidents - differentiating the immediate acts and conditions in the workplace from underlying management and wider environmental factors – characterising the factors and pointing at their relative significance
- To provide a basis for 'testing' the potential impact that emerging recommendations might have in reducing the number of future accidents
- To consider the potential benefits of extending this type of analysis in the ongoing work of HSE.

1.3 SCOPE

The Inquiry remit stated that the review of the underlying causes of recent construction fatal accidents should examine 25 cases. In the event, 26 accidents were studied in total, relating to 28 fatalities. The sample was constrained by the time available and, although not providing findings of statistical significance, the review has provided insight and richness demonstrating how deficiencies, sometimes seemingly unconnected, determine the chain of events leading to fatalities. Importantly the work provides specific evidence of underlying causes to combine with the views and experiences contributed by consultees in other parts of the Inquiry.

This detailed review also augments an earlier HSE study which examined the vulnerability of the 25 foreign/migrant workers who died in construction in the three years 2005/06 to 2007/08 in comparison with a 'control' group of 25 non-foreign/migrant construction fatalities in the same period. That work is covered in the Phase 1 report[(1)]. Although the objective and therefore research methodology was different (as discussed in Section 2, Step j), relevant findings in relation to the causes of the accidents are compared here, where appropriate.

1.4 REPORT COVERAGE

This report describes in Section 2 the methodology adopted so that the nature of the information gleaned can be understood in the context of the elicitation method (see Annex A). Information about the cases is set out in Section 3 with further detail in Annexes B and C illustrating the breadth of activity covered by construction fatal accidents. The 'combined' model for accident causation is outlined in Section 4, before the immediate and underlying causes are collated and mapped onto the model. A similar approach is taken mapping the findings from other studies to see whether there is any commonality despite different evidence sources and elicitation methods. Some of the recurring themes are then discussed in more detail.

2. METHODOLOGY

2.1 PRINCIPLES

A number of important principles underpinned the approach to this Phase 2 review of recent cases:

- The Inquiry Chair and peer reviewers should themselves select the cases to be examined and have open access to all aspects of the work
- Nothing in the conduct or reporting of the work should jeopardise the legal processes for securing justice
- The methodology should be pragmatic and balance the need for rigorous insight into underlying causes with the time available.

2.2 KEY STEPS

On this basis the steps in undertaking the review were as follows:

a) The Chair and peer reviewers were provided with the full list of 211 construction fatalities in the period 2005/06 to 2007/08. The listing included:
   - Synopsis of the accident
   - Age of the deceased person (DP)
   - Kind of accident (e.g. fall)
   - Occupation
   - Employment status
   - Employer size (small being 15 or fewer workers)
   - Nature of the project (e.g. housebuilding, new build or refurb etc)
   - Public or private sector client
   - Site size (small being 15 or fewer on site)
   - CDM notifiable or not
   - Geographical region
   - Status of the investigation
   - Current role of the investigating inspector.

   Although some of these categories of information are reportable under RIDDOR[4], others came from the HSE inspector's initial notification of details to the Construction Sector after their first visit to the scene (Phase 1 report, Section 1.3 refers[1]).

b) The Chair and peer reviewers selected a range of cases for review. Where possible they chose closed cases to avoid sensitivities but for the sample to cover both 'recent' and complex cases, five 'live' or ongoing cases were included. They also chose to repeat a small number of cases from the foreign/migrant and control group studies, again to ensure the Inquiry review sample covered as wide a range of accident types and circumstances as possible, at suitable depth.

c) The Chair and peer reviewers, who include Professor Andrew Hale, Professor of Safety Science at Delft University, an expert in safety management and accident investigation, were provided with a short briefing discussing alternative methods for examining the underlying causes of the construction fatal accidents. The method adopted was developed from the HFACS-C (Human Factors Analysis and Classification system) approach[5], reviewed in the Phase 1 report[1]. Preparatory case

study trials had been based on the more comprehensive Events and Conditional Factors Analysis (ECFA+) approach that forms part of HSE core training but the time constraints and retrospective approach for the Inquiry cases meant HFACS-C offered a more pragmatic solution in the circumstances. Information was elicited through a structured interview with the Inspector. This had the advantage of being time efficient and totally open to the peer reviewers' scrutiny. It also gave the opportunity to delve into the wider issues inspectors may have become aware of through their detailed investigations but which may not have formed part of the formal documentation of investigation and enforcement.

d) At the behest of the peer reviewers, the original HFACS-C template was expanded to encompass all the factors adopted in prior HSE research, including the Influence Network[6] (see Phase 1 report). The purpose was to ensure findings could be compared between past and current research. The final template is reproduced in Annex A. Further information about the application of the tool is provided in Step h) below.

e) Before work commenced in earnest, the Chair nominated two contrasting cases from the sample set to trial the approach. HSE made arrangements for the investigating inspectors to attend a plenary session with the Chair and all three peer reviewers. Damian Walker, a member of HSE's Human Factors Corporate Topic Group (himself a former Construction Inspector) led the structured interviews. The Chair and peer reviewers were able to interject with questions as appropriate as the interviews progressed. Some minor adjustments to terminology were made to the template but the trial was deemed successful in eliciting comprehensive information about the underlying circumstances and chain of events leading to the construction deaths.

f) HSE then set in place a timetable for up to four interviews to be undertaken per day involving investigating inspectors from the regions of England, Scotland and Wales. The commitment from the Inspectorate should be recognised as the interviews had to be set up at short notice through a period of intensive refurbishment inspections and alongside other ongoing operational work and enforcement case loads. Some inspectors took part even though they no longer work in Construction Division, others broke leave to attend and in some cases Principal Inspectors stood in for an Inspector on maternity leave or who had left HSE. Damian Walker travelled the length and breadth of the country to provide consistency in the interviewing and to minimise the travel burden for the construction inspectors. Occasionally interviews were conducted over a video-link and in one case by telephone, as the inspector was on leave. At the planning stage there was concern that this might affect the interview dynamics but in all cases it worked quite successfully despite difficulties in communicating physical layouts or configurations.

g) The schedule was offered to the peer reviewers with an invitation to attend any or all of the interviews. In the event each peer reviewer selected a different date/set of cases to attend. Nearly half the interviews were therefore scrutinised directly.

h) A representative from the Construction Sector attended each interview to keep a contemporaneous record of all deficiencies (and good points) identified, and the basis / degree of certainty. A narrative record of the circumstances and events was also set down. The process involved the inspector describing the base facts in terms of conditions and actions and the sequence of events. The inspector was asked to identify one or more distinct errors which led to the accident about which they were then asked questions following the HFACS-C template (see Annex A). These looked first at the nature of the **unsafe act** (accidental or deliberate etc), any **preconditions** for the unsafe act (related to environmental, personal or task factors), any underpinning **organisational** influences (where relevant in terms of policy, resource management, organisational culture, safety management and organisational competence), and finally wider **environmental** influences from society, the market, the regulator or political factors. Each session concluded with the opportunity for other relevant factors to be raised but always the structured interview had been comprehensive. Peer reviewers attending the individual case discussions were able themselves to question the inspector in relation to the fatality.

i) Following a review of the raw narratives from each case by the Chair and peer reviewers and the granting of a time extension to the Inquiry by the SoS, it was agreed to develop the analysis of the cases further as they clearly provided a rich source against which to consider the wider inquiry findings. To this end Professor Andrew Hale made time available to work alongside the HSE team providing direct input as well as guiding and verifying the analysis.

j) That joint work involved a number of elements:
    - Based on the completed HFACS-C templates (Annex A) and interview records, detailed analysis of the factors identified relating to each error in each accident case. Specifically this linked the factor to the relevant party or role under CDM and distinguished whether the factor was:
        1. Poor/Causal with evidence
        2. Poor/Possibly causal/contributory
        3. Poor/Circumstantial
        4. Poor but not considered relevant
        5. Don't know - not explored / only known to DP / no cooperation from parties with knowledge
        6. OK/Neutral
        7. Good
        8. N/A – not applicable / not relevant

      The analysis was performed by Construction Sector participants in the interviews based on their contemporaneous records. For a sample of cases this coding was independently checked by Professor Hale confirming a high degree of reliability.
    - For each case it was then possible to re-draw the events chain clearly identifying where failures (e.g. in appointing a competent contractor, or hiring in appropriate capacity equipment) had successively removed those safety management barriers which should prevent an accident / fatality occurring.

- o It was also possible to look across all the errors, for each accident scenario and for each death, to identify which factors were repeatedly deficient and particularly where the failures were causal in leading to the fatality (i.e. graded 1. or 2. per the above). In addition, repeated combinations of direct and underlying causes could also be identified (for example linking use of inappropriate equipment to the absence of planning rather than financial constraint). These analyses of recurring themes, illustrated by evidence from the recent cases, form the basis of the findings in this report.

k) The Inquiry extension also enabled a more thorough mapping than had been possible to that point of the Inquiry between a classical safety management system model (ARAMIS)[7], HSG65 – the HSE treatise on safety management[8], the requirements under the Construction (Design and Management) regulations (CDM 2007)[9], the Influence Network[6] and other models from previous research, and the modified HFACS-C[5] used in the case reviews. The mapping is described in more detail in References 1 and 10. The preferred solution was a 'combined' model as shown schematically in Figure 1 below representing the underlying **environmental**, **corporate** and organisational influences (or **delivery systems**) through to the proximal factors, **output from the delivery systems**, impacting directly on accident causation. It also illustrates the core principles of successful safety management required at different levels such as competence, coordination and cooperation, risk assessment, monitoring and audit etc.

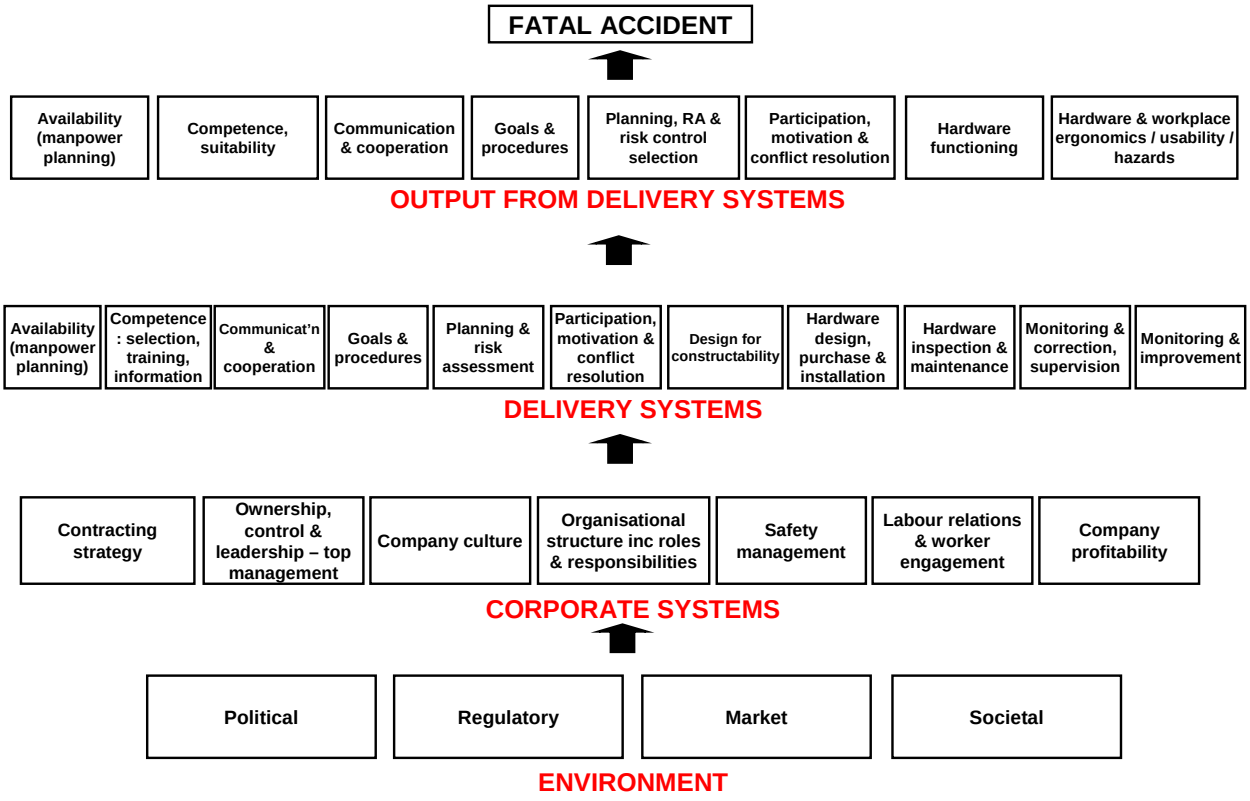

Figure 1 – The 'combined' model for analysing underlying causes in construction fatal accidents

l) The themes emerging from the activity at Step j) were structured within the comprehensive safety management model from Step k). The output summarised in this report has been subject to review and scrutiny by the Inquiry Chair, peer reviewers and representatives from the Construction Division involved in different aspects of the work.

m) A further step, subsidiary to the main work, was to draw in corresponding information from the earlier study of 25 foreign/migrant worker deaths and 25 control group cases (see Section 1.3). That earlier work[1] formed part of a cross-cutting project within the Construction Programme on vulnerable workers and set out to determine whether there was anything about the employment of foreign / migrant workers in the industry that meant they are more vulnerable than other workers in terms of their safety. The key tests drew on a definition of vulnerability related to an individual's inability to protect themselves (e.g. because of a lack of training or experience) and their likelihood of being exploited by an unscrupulous employer (e.g. as an undocumented migrant, working casually for cash). The key facts gathered for each case in this earlier study were based on a short (generally telephone) interview with the investigating inspector during which the inspector also itemised what he / she considered to be the principal causes of the fatal accident (up to four in number). These causes map readily onto the elements of the combined model. A further study had been undertaken as a comparison (or 'control') group to consider the extent to which the emerging themes associated with the foreign / migrant worker deaths applied to other cases. Again, with a specific pro-forma and based on telephone interviews, the principal causes additionally identified by the inspector provide some basis for comparison with those identified through this Inquiry case study work. Whilst it is not appropriate to amalgamate the datasets given the different structures for eliciting information, it is reasonable to compare the dominant themes from the detailed case reviews and earlier vulnerability studies.

n) Finally the combined safety management model devised in this Phase 2 activity was used for assimilating the findings from other parts of the Inquiry. The prior research reviewed in Phase 1 was mapped onto the model to test for consistency in the themes emerging. Similarly Professor Hale, as part of his peer review of the Phase 2 external research undertaken by Loughborough University[11], mapped the themes from their surveys and focus groups and consequent suggested prevention strategies to this same combined model.

2.3 INTERPRETATION OF THE COMBINED MODEL OF ACCIDENT CAUSATION

Before proceeding to the findings from the analysis of 28 construction fatalities, a qualitative interpretation of the combined model generated in Step k) and shown in Figure 1 is presented. The structuring of the factors in the model, under the peer reviewers' direction, has reflected the essential components of safe practices in the way work is managed and executed.

With reference to Figure 1 (and subsequently Figures 2 to 4) and taking the factors across each row, left to right and then top to bottom, safe practices require:

- Availability of sufficient human resources with adequate capacity
- Competent and suitable personnel
- Communication and cooperation between those on site
- Clear information about what is required and how it should be done
- Planning to include ongoing recognition of risks and implementation of control measures
- Engagement in the work processes
- Appropriate tools and equipment to perform the work
- Conducive conditions in which inherent hazards are controlled and to which equipment is suitable matched.

These '**outputs'** are each provided by '**delivery systems**' with corresponding functions in each of the above areas, together with:

- A system of monitoring, correction and supervision to ensure the elements are implemented together
- A mechanism for monitoring and improvement based on lesson learned from experience.

The direction and resourcing of these delivery systems, whether within a company or in a more complex construction supply chain, emanates from the **'corporate'** or governing management systems in terms of:

- The contractual basis for drawing competent parties together and attention to safety requirements
- The ownership and leadership and consequent emphasis placed on safety
- The wider culture in terms of values, communication and approach to cooperation
- The clarity with which roles and responsibilities (for safety) are defined
- The recognition of safety as an integral part of management practice
- The respect for workers, and the attention to their viewpoints and needs
- The financial capacity and commitment to ensure safety.

Whilst project execution frequently looks inward, the model also recognises that the way businesses operate and construction projects may be constrained are influenced by a combination of political practices, the effects of health and safety regulations and regulatory function, the market and societal status and priorities (the '**environment'**).

The mapping of the causal factors from the inspector interviews to the model (as in Section 4.3) enables two interpretations. In the first the combination and inter-relation of the deficiencies in the specific construction context are considered to identify scenario based solutions – this is the typical opportunity within an individual / company investigation. Alternatively, the nature of the deficiencies in each generic area of safety management is described demonstrating common and contrasting issues across the breadth of 'the construction industry' to the extent represented by the cases – this is the focus here as the opportunity to look across a range of scenarios is relatively unusual.

3. THE CASES

3.1 CASE DESCRIPTIONS

Annex B contains a fact based narrative for the closed cases reviewed within the study. A narrative for all work-related fatalities is published by HSE and the Construction intelligence report[13] collates the narratives for all construction fatalities in the 2005/06 to 2007/08 period. The descriptions are brief (e.g. Migrant worker fell through roof-light of adjoining premises used for access as he was carrying out repairs to roof on industrial premises) and the material presented here provides substantially more description of the circumstances as they were understood from the HFACS-C interviews. The Inquiry Chair and peer reviewers have, under strict confidentiality terms, been provided with access to some additional ongoing cases which they had also selected as part of the study. These have helped illuminate the processes, complexities and sensitivities involved. However, it is with their full agreement that any basis for identifying issues relating to live cases is excluded from this report so that the integrity of legal processes is preserved.

The case descriptions have been divided in Annex B between public and private sector work, and then in the private sector between large and small commercial projects and work for domestic clients. This division is somewhat arbitrary, and one of many groupings that could have been selected, but it reflects some of the issues raised in other parts of the Inquiry. In summary the cases comprise:

- 6 public sector clients
    - 1 high speed roadworks incident (2 workers killed by an errant motorist)
    - 1 civil engineering site – short duration repair work
    - 3 major new building developments
    - 1 industrial building demolition for an LA client
- 8 jobs for domestic clients
    - 3 small scale maintenance and repair jobs
        - 2 roof repairs (spot repairs)
        - 1 external painting job - soffit/barge boards – 2 deaths
    - 4 extensions
        - 1 associated external works – large retaining wall
        - 1 electrician descending ladder
        - 1 removal of structural wall
        - 1 delivery/collection of materials
- 12 jobs for other private sector clients
    - 3 refurb/extension of industrial premises
    - 3 new housing developments
    - 1 office refurbishment (including passenger lifts)
    - 1 utilities project
    - 1 church external painting job
    - 1 restaurant refurbishment (including roofing)
    - 1 ad hoc industrial plant extension – small scale
    - 1 industrial building demolition and relocation – informal/favours

Together the narratives illustrate the very wide range of 'construction' activity reflected in the fatal accident statistics. The nature of the work, the way the parties are organised etc underline the lack of homogeneity. However, there are aspects of commonality – for example, people fall from a height to their death in all the sectors. There are instances where the link to construction might appear tenuous (e.g. when modifying manufacturing plant), but where activities like crane hire or roadways development form part of the 'project' the designation comes under the definition of construction. The cases range from multi-million pound developments to the proverbial 'five-minute job' or are so informal that there is no money changing hands between the businesses. They encompass firms with safety management practices which in some respects would be deemed exemplary as well as others where there has simply been no regard for safety. Some cases relate to established 'framework' contracts and others involve casual terms of engagement and even illegal practices. Some failings are human or organisational, others reflect deficiencies in equipment. Although many scenarios are arguably routine with extensive guidance and established safe practices, others are obscure relating to an unusual combination of circumstances. The many contrasts serve to illustrate the challenge and complexity in identifying improvement measures with sufficiently wide impact.

The 28 fatalities are but a small (13%) sample of the 211 work-related deaths in construction in the three year period but the variety of circumstances they represent is salutary when considering the need for recommendations to reduce the overall toll.

3.2 CASE CHARACTERISTICS

Annex C shows how the case characteristics compared with the overall profile for the period. Many of the categories are based on the initial notifications database maintained in the Construction Sector and described in detail in Section 1.3 of Reference 1. Although such a small sample cannot be described as representative, Annex C shows the sample actually to provide good coverage across the different parameters pertaining to fatal accidents in the period. The cases point at specific issues that could be investigated with a more targeted selection.

For example, in 6 of the 26 cases, close family members were working together and witnessed the fatality. In one case the men had been friends since childhood and in at least 5 other cases close friends or extended family were working together. This underlines the impact of construction fatalities and demonstrates the close working arrangements that often prevail. Whilst expected on small domestic works, the family links also appear in gangs supplied by subcontractors (sometimes large firms)[a].

3.3 CASE OUTCOMES

The prosecution status for the cases in the sample provides a further perspective on the profile of the cases in the sample although this information was not available to the peer reviewers at the time the selection of cases was made and

[a] Although fatal accidents do not provide a basis for such research, the extent to which close relationships afford a feeling of protection and safety potentially affecting risk perception is noted.

so had no bearing on the choice. However, at the stage the work was undertaken not all cases were determined. A number had already been prosecuted with successful charges related to:

- Manslaughter (1 case)
- Health and Safety at Work etc. Act 1974 (HSWA), Section 2 (3 cases) and Section 3 (2 cases) prosecutions relating respectively to employees (one employed via an agency) and self employed or others affected by the company's construction work
- Additional charge under the Work at Height Regulations 2005
- Additional conviction under HSWA Section 37, director's duties.

Other cases were still ongoing at different stages of investigation but for the majority there was no prosecution. This was principally because the potentially liable party had died (typically truly self-employed working on a small scale job or the boss of a small firm). Other factors included a case where consideration of terminal illness had led to a caution rather than prosecution.

Some caution is necessary as the focus on 'recent' cases and selection criteria may have biased the profile as relatively straightforward cases may be concluded more rapidly than complex cases that potentially lead to prosecution.

4. IDENTIFYING THE CHAIN OF ACCIDENT CAUSATION

4.1 INTRODUCTION

As described in Section 2.2 Step h), the errors involved in each accident were drawn out through the interview process and each of these was tracked back through the HFACS-C model in Annex A to identify underlying causes. In this section the categorisation of errors is presented describing the immediate causes of the accidents and is followed by consideration of the underlying causes.

4.2 IMMEDIATE CAUSES OF THE ACCIDENTS

These **direct or immediate causes of each accident** were initially characterised under the HFACS-C scheme as either deliberate or accidental. The categorisation draws on the work by Professor James Reason[14] which further subdivides these violations or errors as shown in Table 1. Another distinction drawn by Reason, which bears consideration through the remainder of this review, is the differentiation between 'latent' failures which have left an unsafe condition and 'immediate' failures which are unsafe acts or omissions.

Table 1 – The categorisation of the immediate human failures according to Reason[14]

Violation (deliberate deviation)	**Routine**	Regularly done this way
	Situational	Done this way under pressure of circumstance
	Exceptional	Done in reaction to something having gone wrong – benefits judged to outweigh risks
Error (accidental deviation from safe course)	**Skill based** (associated with routine activity)	**Slip** – action not as planned
		Lapse – memory failing, action forgotten
	Rule based (associated with familiar activity)	'if-then-do' remembered rules and check that action appropriate
	Knowledge based (dealing with the unexpected)	Misdiagnosis leads to devising wrong solution

A notable difficulty when considering fatalities, explored in some detail in the interviews with the investigating inspectors, is that the degree to which an individual recognised a 'rule' is not always known, especially when the person concerned is the victim. Nevertheless the following table categorises each of the errors underlying the 28 deaths based on the inspectors' judgements and subsequent analysis:

Violation			**Error**			
23			21			
Routine	Situational	Exceptional	Skill/Slip	Skill/Lapse	Rule	Knowledge
10	12	1 (2 deaths)	6	3 (4 deaths)	3	9

There is an even split between violations and errors and the former further divide almost equally between routine deviations and actions reflecting pressure of circumstance. Within the errors, the largest group also reflects the need to deal with the unexpected circumstances or situations where the person was forced to

improvise and an incorrect solution was adopted. It is notable that less than a quarter of the errors constitute routine and deliberate violations.

Examples of the different error types are given below

Violation – Routine
- Ladder for temporary access untied
- Built wall poorly without design, despite Building Control advice
- Driver of hiab (lorry mounted crane with Hydraulic Articulated Boom) performed lift in unsafe manner
- Employer left apprentice unsupervised and exposed to risk
- Heavy goods vehicle reversed without banksman
- Didn't use company supplied crane access equipment
- Not wearing lap belt on dumper
- Covered and hid unprotected roof voids and allowed workers access
- Walked the purlins to remove roofsheets

Violation – Situational
- Removed end wall at householder's behest
- Proceeded with crane hire lift despite absence of competent plan
- Attempted to swap lift car support straps under load
- 5-minute repair in unsafe manner at height
- Inappropriate access to remove asbestos sheeting
- Inappropriate access for high level painting and decorating
- Used inappropriate (convenient) support for equipment lift
- Failed to select and construct safe working platform
- Drove dumper on spoil heap and without lap belt

Violation – Exceptional - No (worker) error
- 2 roadworkers in a 'safe' zone hit by an errant motorist

Error – Skill based slip
- Heavy goods vehicle reversed too far
- Telehandler reversed into pedestrian
- Dumper driven over spoil heap edge
- Failed to operate mobile elevated work platform (MEWP) correctly
- Slipped for unknown reason

Error – Skill based lapse
- Pedestrian walked into path of telehandler
- Stepped into hole in walkway
- Contacted aluminium ladder with11kV overhead cable

Error – Rule based
- Unsafe access for roofwork
- Followed instruction to go under collapsing load to insert a support

Error – Knowledge based
- Window replacement without attention to fall protection (unaware)
- No safe tipping area established (latent)
- Unsafe access for roofwork (attempted fixing but inadequate)
- Went under unsupported conveyor to free prop

- Crane driver didn't move as vehicle approached (unaware)
- Walked on tarpaulin with hidden voids under (unaware)
- Stood on toolbox to free window reducing edge protection.

4.3 SIGNIFICANT UNDERLYING CAUSES

4.3.1 Identification and Grouping

HSE's accident investigation processes[15] encompass:

- Gathering and establishing facts
- Identifying immediate and underlying causes and the lessons to be learned
- Identifying breaches of legislation for which HSE is the enforcing authority
- Taking appropriate action, including formal enforcement
- Consider what action might be appropriate to prevent recurrence and ensure that those who have duties under health and safety law may be held accountable for failures to safeguard health, safety and welfare, such as by taking formal enforcement.

Examining the underlying causes is therefore a key step in Inspectors' investigations between establishing the direct or immediate causes of each accident and taking enforcement action. It is on these insights that this Phase 2 work has drawn through the structured interview process described in Section 2.2 Step h). In order to interpret the emerging lessons, the study has categorised these underlying causes across the 28 accidents and the focus of the remainder of this report is on the resulting insights into causation and potential prevention. This is approached in two ways: semi-quantitatively to indicate the weight of evidence and qualitatively to illustrate the nature of deficiencies leading to construction fatal accidents.

As described in Section 2.2 Step j), the role or otherwise of every HFACS-C causal factors was considered for each error within each case based on the information from the interviews. In addition, the exercise described in Step k) had generated an initial mapping between the modified HFACS-C categories (see Annex A) and the elements of the combined systems model from Figure 1 as shown in Figure 2.

The diagrams are rather complex but reference should be made to the description in Section 2.3 which describes the four principal '**layers**' of (underlying) causes and the recognised elements of effective safety management within each layer (boxes). The HFACS-C model considered the component parts of each element in more specific detail so that '**Competence and suitability**' (to the top left of the diagram in Figure 2) is shown to reflect training, experience, health, aptitude, etc etc. and the references to C231 etc ties in with the coding in Annex A. Deficiencies in any one or a number of the areas may compromise competence or suitability but the greater detailed elicited through the HFACS-C interviews provides a basis for devising specific improvement measures.

The same principles apply to the breakdown given for other elements at the different system levels within the model. In effect the HFACS-C model provides a

bottom up definition for each of the elements of the combined model. However, the combined model development process actually began from a definition of the recognised elements of safety management and considered the appropriate assignment of the HFACS-C categories on that basis. Work is expected to continue beyond this Phase 2 work to develop further the definitions and classifications within the combined model to facilitate its further use.

Within the representation in Figure 2 the HFACS-C factors have been colour coded to give an indicative scale of the frequency with which they were identified individually as causal in the chain of events leading to the fatal accidents. The colour coding is the same in Figure 3 but in place of the HFACS-C reference, the count for each of the individual factors is given. The scale to the top left of both figures defines the colour coding on a quasi traffic light scheme from green (never identified as causal) to black (rarely), amber (sometimes) and red (relatively frequently identified as a causal factor).

An immediate observation is that the extent to which factors were considered causes varies significantly. Some have never been identified as causes (but note concerns in Section 4.5), whereas others have been identified in many of the 28 fatal accidents. Under an individual element of the combined model there are instances where all the factors seem to feature (e.g. Planning, risk assessment and risk control selection at the top level) but for other elements (e.g. Competence and suitability) some but not all factors appear. This suggests that although considerable caution over any quantitative interpretation is needed (see Section 4.3.2), it is reasonable to identify dominant factors or recurring themes at the extremes.

A representation of this is shown in Figure 4. This diagram takes the same elements of the combined model as represented in Figures 1 to 3 and presents a tally of the extent to which some aspect is considered causal in the fatal accident cases. Two rows are associated with each element, the first relates to the 28 fatal accidents reviewed in the Phase Inquiry work. The second row introduces conclusions from an earlier study on 25 foreign/migrant fatal accidents and a comparative control group of a further 25 cases (see Sections 1.3). These additional results are considered separately in Section 4.3.2.

Considering the findings from the 28 fatal accident cases in this study, it is important to recognise how the detailed findings relating to the individual aspects from Figure 3 have been consolidated in Figure 4. In summary, an element in the combined model is counted once if one or more of its constituent factors from the HFACS-C review was considered causal in one or more of the errors leading to the accident. The maximum count in the first row of Figure 4 is therefore 28. This potentially over- or underplays the significance of some elements but the complexities, outlined below, particularly in light of the small number of cases elude more ‘accurate’ consideration. The representation in Figure 4 considers the prevalence as a proportion of all cases. The deep red in the first row applies where the cause of more than half the cases was from the particular element and the lighter colour when the proportion exceeded 25%.

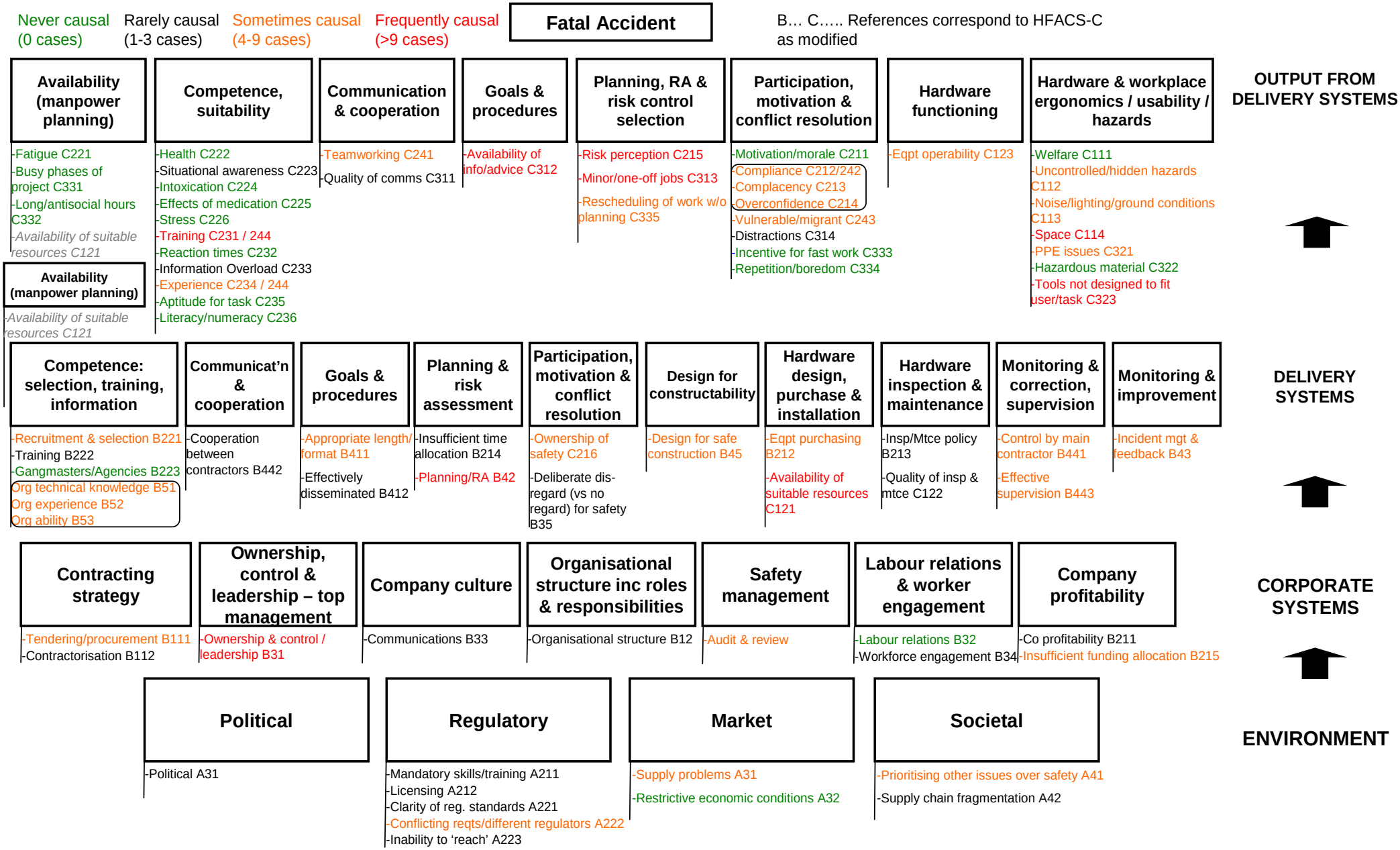

Figure 2 – Mapping of the modified HFACS-C categories onto the elements of the combined safety management model

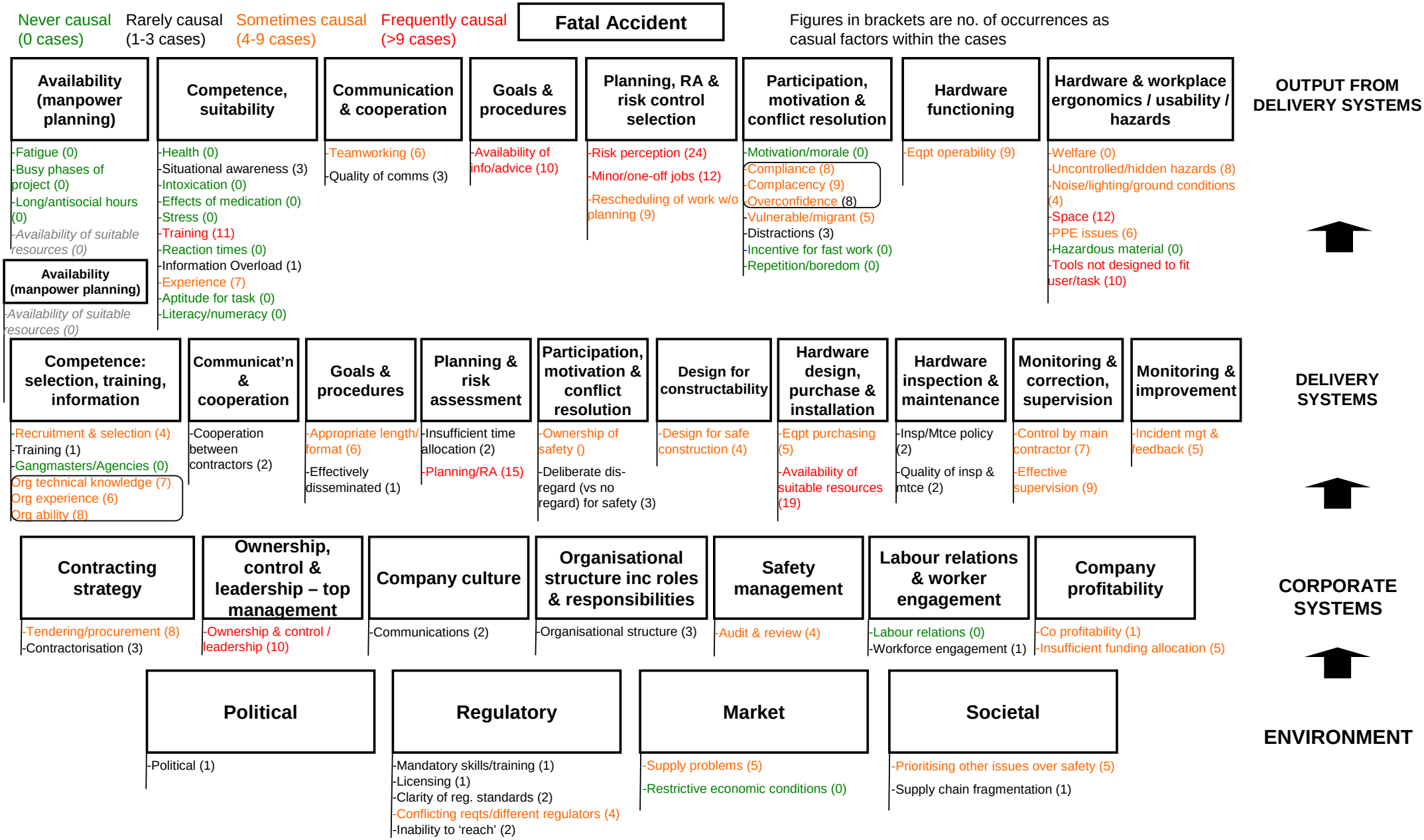

Figure 3 - Indication of the frequency with which the factors contributed to the causation of the 28 fatalities examined

No of cases where 1 or more elements of this factor were deemed causal

N
n

- TOP: Detailed study of 28 fatalities
- BTM: Vulnerability study of 25 migrant & 25 control group fatalities

Fatal Accident

N	>1/2 of detailed, >1/3 of migrant/control
n	>1/4 of detailed, >1/6 of migrant/control

OUTPUT FROM DELIVERY SYSTEMS

Availability (manpower planning)	Competence, suitability	Communication & cooperation	Goals & procedures	Planning, RA & risk control selection	Participation, motivation & conflict resolution	Hardware functioning	Hardware & workplace ergonomics / usability / hazards
0	15	12	0	25	16	9	24
-	24	6	6	6	29	5	24

DELIVERY SYSTEMS

Availability (manpower planning)	Competence: selection, training, information	Communicat'n & cooperation	Goals & procedures	Planning & risk assessment	Participation, motivation & conflict resolution	Design for constructability	Hardware design, purchase & installation	Hardware inspection & maintenance	Monitoring & correction, supervision	Monitoring & improvement
0	9	2	6	15	3	4	20	2	10	5
0	6	-	1	20	1	4	18	1	13	-

CORPORATE SYSTEMS

Contracting strategy	Ownership, control & leadership – top management	Company culture	Organisational structure inc roles & responsibilities	Safety management	Labour relations & worker engagement	Company profitability
10	11	2	3	-	1	5
-	1	-	-	3	-	-

ENVIRONMENT

Political	Regulatory	Market	Societal
1	7	4	5

Figure 4 – Comparison between the detailed review of recent fatal accident cases in Phase 2 and prior foreign/migrant and control group studies

4.3.2 Caution and Complexity of Semi-quantitative Interpretation

Before considering the implications from Figure 4 a number of points need to be made about the validity and complexity:

- This detailed review has examined 26 construction accidents leading to 28 deaths in the three year period 2005/06 to 2007/08 during which 211 men died in the industry in total. The sample is **too small for statistically robust conclusions** to be drawn and the focus is on the qualitative insights. However, those factors which emerge repeatedly clearly warrant further attention.

- Fatal accident statistics are published in relation to the number of deaths. As in the 28 fatalities examined, these result from a slightly smaller number of accident scenarios (26) although review of the detailed circumstances reveals that in some cases the number of deaths could in fact have been even higher. To reduce the number of fatalities actually requires the accident scenarios to be prevented and in some cases these scenarios result from a series of errors which need to be eradicated to prevent this and possibly other scenarios unfolding (44 errors were examined here). These considerations illustrate the difficulty in determining the appropriate measure for weighting the significance of underlying causes. Put another way, if the absence of planning a specific construction sequence led to three further errors which came together in one accident scenario in which two people were killed, does the planning failure count once, twice or three times? This Inquiry is prompted by serious concern about the number of deaths in construction and therefore the academic semantics are set aside and the weighting is linked to the numbers killed. It is however acknowledged that alternative interpretations could be made.

- The count in Figures 2 and 3 relates only to factors which clearly contributed to the accident causation; in other cases standards in relation to the given factor may have been poor but are not included in the count because they were not seen as an underlying cause of the fatality. Secondly the count relates to the occurrence of causal factors – some cases may have just two or three clear causal factors and other cases have multiple direct and underlying failings. Looking at Figure 2, there can therefore be more than one cause under the same 'boxed' heading that applies in a specific accident (e.g. Space and Hidden hazards in relation to Hardware & the Workplace). However, where the same generic factor is causal for different errors in the same accident (e.g. the absence of training meant a plant operator misused the equipment and an untrained operative gave an incorrect instruction) the causal contribution of the training deficiency is counted only once.[b]

[b] Consideration might alternatively have been given to a relative weighting of the causal factors but this implies deeper analysis and a mathematical precision that is not warranted. Furthermore some factors may be a matter of degree, others are either present or not. On this basis a coarse assessment is considered to be appropriate.

- In many of the fatal accidents it is simply impossible to determine the contribution of individual attitudes or other factors known only to the deceased person (DP). For example, whether complacency, over-confidence or non-compliance played a part could be speculated based on statements from witnesses in relation to other circumstances but which and to what extent cannot be determined with certainty. In addition, although a clear judgement about inadequate competence can be made, distinguishing specifically whether it was failings in the technical knowledge, experience, or ability of an organisation to undertake the work can be difficult, yet this more detailed information would help in directing future risk controls or improvement measures. For these reasons the diagrams (in Figures 2 and 3) brigade these uncertain and/or linked factors together. Issues around fatigue, stress etc may be similarly obscured yet potentially have some work management association. Similarly in almost every case there can be concluded to have been some failing in risk perception, usually by the victim, but whether the risk was not recognised at all or whether the scale was underestimated will never be known[c]. Such considerations affect the extent to which casual evidence is, or is not, available for inclusion in the 'analysis'.

4.3.3 Significant Underlying Causes revealed by the Case Studies

The above reservations notwithstanding, Figure 4 suggests the causes of the construction fatal accidents studied are dominated by a small number of elements represented in the combined safety management model:

The deficiencies at the site activity level (the **delivery systems output**) which, in a sense, underlie the immediate causes or errors relate to:

- Hardware and workplace ergonomics / usability / hazards (including issues with constraints of the physical work environment, suitability of equipment for the task etc – see Figure 3)
- Competence and suitability (linked principally to an individual's inadequate training or experience)
- Participation, motivation and conflict resolution (manifested in terms of lack of compliance, over-confidence or complacency or pertaining to a vulnerable worker)

Although planning, risk assessment and risk control selection at the workface emerged frequently this is founded on assumptions about an inevitable absence or miscalculation in risk perception and the consequent actions of individuals the details of which can never be known with certainty.

Less dominant but still repeated across the cases were causes related to

- Goals and procedures (the absence of sufficient or appropriate information or advice)
- Hardware functioning (equipment operability)

[c] Understanding the nature of risk perception (and/or hazard recognition) is an important area of research but is better informed by near-hit or injury cases than fatal accidents directly.

- Communication and cooperation (whether in terms of team working or basic communication

Underlying those deficiencies are organisational (or **delivery system)** failings which nevertheless can be identified as casual in the accident chain relating to:

- Hardware design, purchase and installation; and
- Planning and risk assessment

with, to a lesser extent,:

- Monitoring, correction and supervision; and
- Competence covering selection, training and information (but also organisation competence and experience for the construction jobs).

Despite the express focus on underlying causes, the extent to which factors remote from the worksite could be confirmed to be causative was relatively limited, entirely consistent with prior studies[(1)]. However, despite the uncertainty it is notable that two factors dominated by comparison with others at the **corporate systems** level, namely:

- Contracting strategy (particularly the tendering or procurement route and lack of attention to safety); and
- Ownership, control and leadership (in relation to responsibility, accountability and the safe conduct of projects)

Tracking back from an individual accident to determine the extent to which wider **environmental factors** contributed to the causation of specific fatal accidents, is challenging (and more challenging than reverse studies to consider the extent to which environmental factors might influence business behaviours for a range of outcomes). A small number of factors were identified, those particularly associated with regulation variously concerned conflicting regulatory requirements, lack of clarity of standards and the inability to reach particularly small business resistant to influence and deserving of enforcement.

More detailed consideration to the qualitative insight from the case studies in these areas in presented in Section 5.

4.4 COMPARISON WITH OTHER STUDIES

4.4.1 The Foreign / Migrant and Control Group Cases

As described in Section 2.2 Step m), the earlier foreign / migrant and control group studies elicited information on the causes of the accidents but in the context of a different methodology than adopted for the Phase 2 cases. In place of the systematic review of factors relating to the chain of actions leading to some form of error and accident (using HFACS-C), attention was paid to the prevalence of certain conditions surrounding the employment, construction activity and accident. The interviews were shorter but the investigating inspector was asked specifically to list what they considered to be the principal accident causes. An independent review of the source material from the foreign / migrant and control group studies mapped that information about the causes of the accidents on to the factors within the combined model (Figure 1).

The results of this exercise are shown in Figure 4 with the upper figures relating to the detailed Phase 2 study and the lower to these foreign / migrant and control group cases. The most frequently occurring factors are highlighted and the correspondence is striking. It should be noted that the scale for the colour coding differs between the two datasets (but so too does the methodology), as the purpose is to highlight the most frequently occurring rather than to compare proportions.

Planning / risk factors at the output level are highlighted separately as the different elicitation methodologies significantly influence the comparison. Planning and risk control issues have a high count for the detailed case reviews. In almost all cases when asked specifically about the risk perception of those involved there was, by definition, some failure. In the foreign / migrant and control group studies, inspectors nominated the causes of the accident without prompt and they generally pointed at more specific failures. However, from a re-review of the migrant/control group cases, it is possible in almost all instances to identify risk perception issues comparable to the recent cases. It can therefore be concluded that some failure in risk perception is an inherent feature for parties in the vast majority of construction fatal accidents (Footnote c refers).

Overall the comparison with nearly 50 additional fatal accidents in the 2005/06 to 2007/08 period adds weight to the focus emerging from the findings from the detailed review of 28 cases in Phase 2.

4.4.2 Comparison with Phase 1 research

The Phase 1 review of prior research prepared by HSE for the Inquiry[1] includes reference to a number of studies including one which in total reviewed 90 earlier construction fatalities based on evidence in the documentation within HSE's accident investigation files[12]. Figure 5 is reproduced from the Phase 1 report and the red bars provide the relevant profile across all 90 cases (the blue bars are specific to a subset of Scottish cases). Full comparison requires detailed scrutiny across the corresponding definitions but, with reference to the mapping in Figure 2, it is evident that the relative significance of the factors correlates remarkably closely to the profile revealed in the more recent work in Figure 4.

For example the top factor in Figure 5 is situational awareness (risk perception) identified across the recent cases as a prevailing factor. Next in significance are competence and the direct work environment followed by planning (at the organisational level) and issues with tools equipment and PPE. Management and supervision, and issues with compliance also appear frequently as causal factors mirroring the importance revealed within the Phase 2 case studies (see Figure 4 for example)

Subsequent to the work in Phase 2, the Phase 1 draft report was reworked to include an analysis from across all the previous studies reviewed. That exercise collated factors from a range of research methodologies and purposes, but nevertheless broadly endorsed the significant issues –see also Reference 1. Importantly the nature of these issues is discussed in further detail in Section 5.

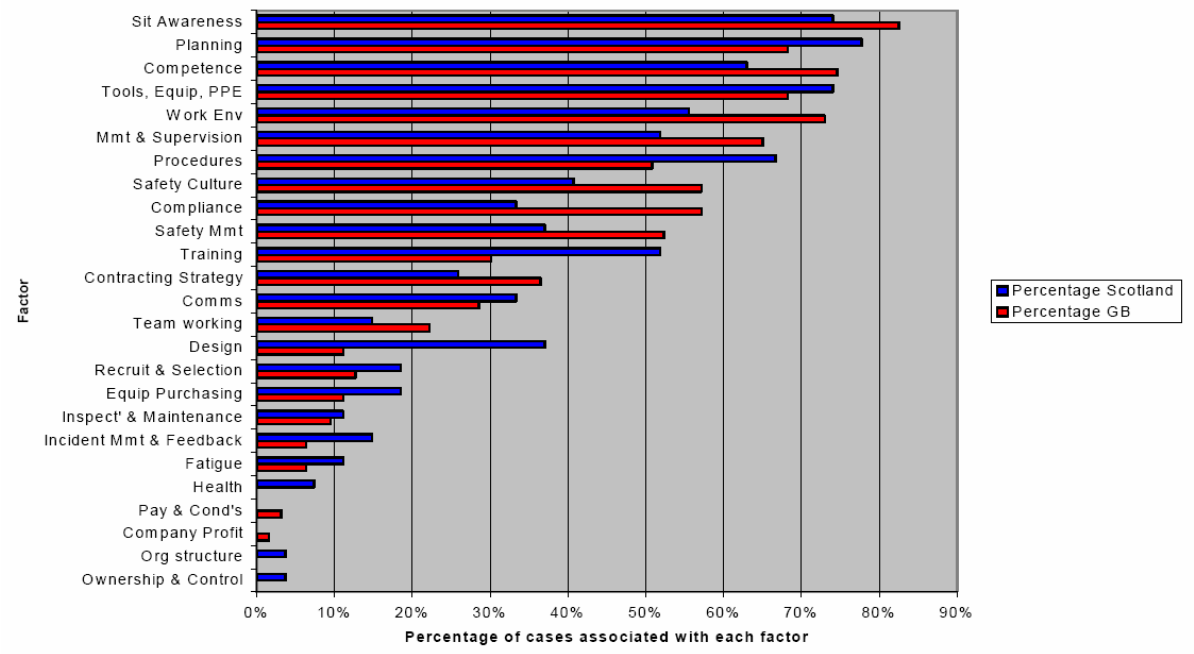

Figure 5 – Analysis of casual factors from 90 construction cases (divided between Scotland and the rest of GB[12])

4.5 LIMITATIONS

Although the foregoing sections have brought useful insight to the causes of a range of recent fatal accidents in construction, it is important to acknowledge that the approach has some limitations. In addition to the small number of cases encompassed by the work, other limitations relate specifically to the elicitation method, the selection of cases for study, the reliance on fatal accident evidence from a single (HSE) source, and the perspective on underlying causes. For example:

- The HFACS-C interview method offered a pragmatic solution for eliciting information from the inspectors efficiently and consistently within a tight time frame but it did not accommodate more detailed or wider exploration of specific factors, their inter-relation or indirect influences.

- The selection of cases for such a small sample is crucial and different criteria might generate information better suited to specific purposes or study of specific aspects. In this Phase 2 of the Inquiry, the cases were selected to reflect a broad range of parameters (Annex C) and were tested to ensure sufficient coverage across issues of interest or concern such as employment status, technical complexity, work from different sectors etc. Whilst this provides for objective study, insight to poor organisational practices could perhaps have been examined more thoroughly by considering only cases subject to prosecution. This point was raised by way of observation rather than recommendation but serves to highlight the dependence of the findings on the selection criteria.

- Reliance on evidence from fatal accidents alone means evidence from the contribution of a number of the factors cannot be determined with certainty, particularly where the victim's actions or omissions were

instrumental. Principally these issues affect immediate causal factors more than underlying organisational issues but the influence remains uncertain. In many instances testimonies from family or co-workers give some clues but definitive conclusions cannot be drawn. Such factors include fatigue, boredom, stress, risk perception, over-confidence etc which may in certain circumstances be significant but for which alternative research methods may be needed.

- The purpose of the Phase 2 case study activity was to complement prior research (forming Phase 1[(1)]) and knowledge volunteered by stakeholders about the underlying causes of fatal accidents (in the course of the Inquiry via the Chair's consultation and the Phase 2 external research[(2)]), with insights from the evidence available to HSE through its investigations. The immense sensitivities around fatalities, taken together with the Inquiry time constraints, resource implications and practicalities of reaching and securing the cooperation of other parties, obviated other approaches for example gathering independent 'evidence' to explore underlying causes for specific recent accidents[d]. However, the HSE investigations gather evidence from many triangulated sources with different individual and corporate perspectives so, whilst some details within the current model may not have been examined to the same degree before, the principal issues have had robust coverage. Furthermore, the approach represents a significant advance on prior desk-based studies which relied only on formal documents associated with enforcement records[(12)].

- The information gathering has been based on discussions with the Inspector who investigated the case as enforcer of health and safety law (not in the guise of research projects into human and organisational factors). In many cases the deep insight across wide ranging underlying issues has been remarkable. Nevertheless, the information available varied with the nature of the accident, the police/Crown Prosecution Service (and Scottish equivalent) roles, continuity in the involvement of the individual Inspector, the existence and/or cooperation of other parties etc. As a consequence, the source data were not exactly comparable across all categories for all cases, particularly at the corporate and environmental levels.

- The Inquiry focus is on underlying casus of construction fatal accidents. As discussed in Section 2.1.4 of the Phase 1 report[(1)], safety management practices generally link underlying causes to the organisational systems as distinct from the immediate actions precipitating the accidents[(8)]. However there is a series of nested perspectives and for others the 'underlying causes' are in the wider industry structures which cascade to the organisational system adopted within individual businesses or specific construction projects. To others, underlying the industry structures are the fiscal and employment regimes

[d] Other such approaches could, for example, have included information gathering directly from organisations involved in the construction project where the accident happened and/or with the specific circumstances of the accident.

linked in turn to Government policy. For all perspectives there is a case for research to consider how specific examples relate to the underlying issues and conversely, for the underlying topics to be examined to consider how they might lead to specific accident-related consequences. This work has taken the specific details of fatal accident cases and looked back from proximal issues to distal underlying issues. The nature and focus of HSE accident investigations inevitably focus on the workplace, the people and business practices affecting the circumstances - the links to more remote underlying influences therefore becomes more tenuous.

These limitations notwithstanding, the collation of insight from inspectors in a consistent manner from across a number of construction fatal accident investigations has generated new information about the causes and the influences that may have brought them about. The work therefore makes a new contribution, complementary to other research.

5. QUALITATIVE INSIGHTS TO THE UNDERLYING CAUSES OF CONSTRUCTION FATAL ACCIDENTS

5.1 FINDINGS

Having demonstrated the reality of construction fatalities and the recurring themes, this section illustrates some of the causes drawing on the evidence from the cases examined. This section is structured around consideration of the most prevalent deficiencies from the scrutiny of 28 cases as illustrated in Figure 4. Those factors at the 'output' level closest to the accident are described first followed by the underlying delivery, corporate or wider environmental factors. To give a comprehensive picture, factors which have not contributed to the accidents were also recorded to help differentiate fact from fiction insofar as the sample of cases reveals in future work. It is important to emphasise that most accidents reflected a sequence or combination of factors. Whilst individually the factor may not be 'the' cause of the accident, rectified it could have provided an effective barrier or defence, preventing the full accident sequence unfolding.

5.1.1 Hardware & workplace ergonomics / usability / hazards

Despite increased interest in human and organisational factors as the potential key to preventing accidents, the case reviews demonstrate the clear need for continued attention to the workplace environment and equipment. **Physical 'space'** issues were causal when combined with the work methods adopted in 12 cases and can be characterised by:

Physical constraints affecting operations:
- Narrow space for manoeuvring
- A low window sill
- Limited access for plant
- No ready fixing for a ladder
- Overgrown hedges
- Roof/mezzanine geometry

Constraints introduced due to:
- Build sequence
- Design
- Site layout
- Temporary works
- Wrong choice of plant for the space

Perversely the feeling of excess space possibly
- contributed to banksman controls not being adopted
- enabled disposal activities to be carried out on site (with the associated hazards) rather than being offloaded

The **lack of suitable equipment or equipment incompatible** with the physical conditions had direct impact on a number of cases with, for example:

Ladder inappropriate selection for access/work
Inappropriate extension for work at height – ladder on balcony / ladder on scaffold tower
Equipment not fixed to prevent tampering
Materials too weak / poor quality kit at required location

Circumstances make inherent problems worse – tight space, absence of banksman controls, ladder untied / fixed / footed
Equipment design requires access from hazardous zone

Given failures in potential underlying controls to eliminate risks, a number of cases throw attention on **PPE** as the final but missing defence in preventing accidents occurring (in particular fall protection) or in minimising the consequences (lap belts / hard hats etc). However, for more than half the cases PPE was not relevant (e.g. PPE would not have afforded any protection in the circumstances) which in itself underlines the importance of more fundamental risk controls. Where PPE issues did arise issues included:

Inappropriate selection of equipment or reliance on protection too low in hierarchy
Road vehicles without audible reversing aid
Failure of PPE to provide intended protection
Use of PPE with tower scaffold
No restraint or collective measure for work at height
Not using dumper lap belts
Not wearing hard hat

Hazards in the work environment were **'hidden' and/or uncontrolled** due to an array of failings including:

Visual: Speeding vehicle, unseen co-workers
Technical: instability of structural elements (including modified scaffolds), forces within ground
Identification: concealed voids under tarpaulin, no tip edge barriers
Forgotten: component configuration

Although noise, lighting and ground conditions were generally not detrimental, **poor conditions** in relation to each were found in certain cases:

Lighting: Walkway grating and ground below similar colour so no visual clue to missing panel, sun potentially obscuring visibility of overhead power lines
Noise: Background noise of plant obscuring sound of approaching vehicle
Ground conditions: Wet and slippery conditions on temporary roof covering
Absence of defined vehicle routes left bumpy terrain – leaving dumper drivers disinclined to wear lap belts

It is clear that taken together all these aspects of hardware and the work environment have been significant contributors to the circumstances of the construction fatalities.

5.1.2 Hardware functioning

Allied issues associated with hardware functioning included:

Visibility of dumpers / telehandlers / large HGVs reversing
Inadequately constructed scaffold towers
Movement fouled by structure
CE complaint kit failing in terms of function or ergonomics
Incompatible components in supplied lifting kit
In some cases ladders were found to be damaged but this is likely to have been caused in the accidents

5.1.3 Competence / Suitability

As Figure 3 illustrates, competence and suitability at the output level comprise a number of factors. In no case was there evidence of intoxication or the effects

of medication affecting the workers' performance nor that literacy or numeracy deficiencies had played a direct part.

Situational awareness was generally unknown in terms of the individual's perception although an unfamiliar site work environment or other hidden hazards could all have contributed to poor situational awareness in some cases. However in only 3 cases could it be concluded that the lack or loss of awareness or a false feeling of security may have contributed to the outcome. The contrasting examples include:

> Working within a room to replace a window may have felt 'safe' divorced from the fall risk.
>
> In another case, having worked on the completed walkway structure without harnesses for many months this would have been felt as a safe area even when a gratin was temporarily removed
>
> Manoeuvring plant in an 'open' area possibly removed a sense that pedestrians might be in the vicinity.

There was an association with **training** deficiencies in 11 cases (some with more than one deficiency). In other cases training deficiencies could not necessarily be linked directly to the accident. In some circumstances it is not clear that normal training would have prepared the individual. Equally some highly trained individuals were actors and/or the victim of accidents. Deficiencies range from no training, to skill-based training without a health and safety component, or being trained but not in relation to the task undertaken. The distribution whether across the 39 actors (first column) or 28 deaths (second column), is as follows:

Trained – skill + H&S	13	9
Trained but not for activity	8	6
Trained – skill but not H&S	4	2
No training	10	9
Unknown	4	2

While it is clear training is a critical component, the cases also demonstrate the complexity of ensuring training is effective and appropriate.

It was concluded in 7 cases that **inadequate experience** also contributed to poor competence or suitability. Examples included:

> Apprentice and novice untrained plant operator.
>
> Newly qualified crane driver.
>
> Two workers taking on an improvised / do-it-yourself approach to demolition and plant construction jobs.
>
> Site manager moving from a small to larger site than previously experienced with traffic management issues not normally encountered.
>
> Workers faced with a complex problem to resolve beyond their skills and capacity.

The work also identified examples where experience was limited but from which it was not possible to be certain of a causative link. Examples included:

> Specific deficiencies for otherwise experienced workers given unusual circumstances (hillside cut) or role e.g. as supervisor of apprentice, or lead role in fitting job.
>
> Limited experience of a lorry drivers.
>
> Lack of construction experience/familiarity could apply to a maintenance worker traversing a site.

Although generally training and experience are strongly correlated, in 3 cases workers were trained but lacked experience and in another 3 they were experienced but had training deficiencies.

5.1.4 Participation, motivation & conflict resolution

As noted in Section 4, personal factors related to attitude are very difficult to judge. In many cases there is some combination of non-compliance, complacency, over-confidence or deficiencies in risk perception but the degree of each is uncertain – not only is the state of mind not known but the prior knowledge and information against which the individual was making decisions in their actions is also uncertain. The effects of distraction (unrelated to work) or boredom similarly cannot be discerned. Despite these uncertainties evidence on non compliance, complacency and overconfidence emerged in a number of cases.

In 8 cases **non-compliance** is considered causal

> 6 errors at the working level involve violations of known rules (reversing without a banksman, not wearing lap belt on dumper, driving on spoil heap etc)
>
> Non compliance at the business level included 2 business owners who had previously been stuck off for financial irregularities, one of whom repeatedly employed undocumented workers and the other failed to comply with prior warnings about H&S standards.

Conversely in a couple of cases compliance with unsound instructions led to the individual's death.

Where **complacency** played a part, evidence was drawn from the warnings of co-workers and, at site management level, in failing to plan for one-off circumstances at the end of an otherwise routine build. **Over-confidence** has a strong correlation with other personal factors with examples linked to young inexperienced workers driving dumpers and technically challenging or out of the norm activities where individuals may have over-estimated their abilities.

Conditions in which workers are **vulnerable** give rise to concerns in this element of safety management and within the cases this was deemed causal in 5 cases **-** 2 young, 2 migrant, 1 low-skilled worker. The cases involved:

> An undocumented migrant worker paid and provided with accommodation by the principal contractor
>
> A migrant worker engaged in the informal economy for some period – although as a migrant he was possibly more likely to be in informal economy the vulnerability links to work in that sector more than migrant status
>
> Two young workers were put into vulnerable positions – in one case as an apprentice having struggled to find a placement in another driving plant without training
>
> One example of low-skilled workers put into position beyond their capacity requiring problem solving skills or the ability to speak up beyond things for which they were technically or characteristically equipped.

It is notable that not all the foreign / migrant workers involved in the cases were judged to be vulnerable. One was an English speaker, highly trained with no issues of vulnerability, another had his own business, was not exploited and with capacity to protect himself, and another was a qualified plant operator.

5.1.5 Hardware design, purchase & installation

At the delivery 'system' level the underlying causes could be traced particularly to **suitable equipment or resources not being made available** in 18 cases. Furthermore in all cases except the one where two workers were killed by an errant motorist, some inadequacy (even if not clearly causal) was identified in this area. Issues within the causal chain included:

No banksman to compensate for inherent visibility problems (3 cases)
3 borrowed ladders – examples of poor fixing / footing, too short, wrong type
2 tower scaffolds built incorrectly
Tamper proof kit being preferable
Available kit not used / obtained
Unforeseen ergonomics issues despite kit otherwise being appropriate
9 inappropriate methods in hierarchy for work at height
Failure to supply PPE
Insufficient crane capacity / competent contract lift not obtained.

Other issues considered the poor quality of materials for the build (leading to failure) and inappropriate/unsafe working areas for plant fro example.

In 5 cases links could be made to the **equipment purchasing** policy with evidence of cost saving in 2 cases with a further 2 linked to a failure to plan what was needed. The final case was from the informal domestic economy where a number of allied examples demonstrated an approach to make do, borrow, use what's available rather than hire or purchase the ideal equipment. However, the links to causation were not always clear.

5.1.6 Planning & risk assessment

Planning failures at the system level were causal in 15 cases. The effects were planning failing to identify risks leading to inappropriate methods being adopted or work proceeding without the right kit. Failures also related to specific activities (lifts, traffic management). Changes in site management personnel or failures to involve relevant parties in the planning were also highlighted. The issues associated with planning (including poor as well as causal factors) were characterised by

7 cases jobs were well planned but failed in execution.
9 were planned but not to be done safely
6 were not planned from the outset
4 were not re-planned when things changed

Insufficient time allocation was also significant in a couple of domestic jobs where short cuts were taken possibly to please or appease the domestic client.

5.1.7 Monitoring & correction, supervision

Deficiencies in the **control by the main or principal contractor** (PC) were considered causal in 7 cases with 6 examples on large sites where the PC seemingly failed to ensure standards were being met or to sort out emerging problems. In one of the cases there were particular issues associated with specialist subcontractors in discrete work areas. On one site the issues were associated particularly with supervising delivery and collection activities

The absence of effective supervision was causal in 9 cases with the following occurring in one or more instances:

Failings with crane hire not having appointed person to supervise lift
Plant incidents where supervisors had not spotted or stopped activity
Teams unsupervised made fatal errors in problem solving
Failure to supervise an apprentice
Small site where the manager visited each day but otherwise left team of undocumented migrant workers unsupervised.
Additional cases where supervisor/boss of small teams was himself killed leading 'one-off' or exceptional activity.

In a number of cases it was noted that supervision would not necessarily have been expected given small 'competent' teams of specialists doing their 'routine' work.

5.1.8 Competence, selection, training, information

Figure 3 illustrates the spread of factors at the delivery system level related to competence. **Recruitment & selection** was generally suitable with 5 exceptions related to

Undocumented workers
Informal demolition, calling in a favour to get co-worker
Site manager unqualified – using unqualified workers on plant
Struggling to recruit and accepting young team, including site manger & supervisors – too young to be carded

In terms of **gangmasters and agencies** there were no specific causal links in the cases examined. Where agency workers were involved they were effectively integrated from a safety perspective. In the case of undocumented workers being provided with accommodation there was no link to a gangmaster regime.

The lack of **organisational competence** to undertake the specific construction work was considered causal in 7 cases. Examples include:

Employer employing undocumented migrants also had supply chain/advisor lacking technical competence
Improvised self build / demolition jobs for business purposes
No competence/experience of large site with traffic management requirement
No competence to deal with major retaining wall in domestic job
No competence to be responsible for apprentice working safely
No competence to ensure adequate ladder support (fixing inadequate and failed)

Closely allied are issues with **organisational experience or ability** which additionally revealed underlying causes linked to

Organisation with no managerial expertise
Organisation not able to manage safely on the scale of the project

These organisational deficiencies point back to the contracting / appointment process ensuring suitability and capacity.

5.1.9 Contracting strategy – client appointments and contractors sub selection

At the corporate systems level, evidence for causation could not always be discerned but strong examples related to the **tendering and procurement processes**, with failings deemed to be contributory causes in 8 cases, including

1 poor contracting process using prequalification list without adequate checks on suitability or competent review of adequacy of proposed methods.

2 PC appointing subs (one from prior experience) BUT taking them beyond bounds of capabilities – adequacy of checks
1 contractor with experience of safer option tenders being kicked out on price
Late changes to appointments based on availability were additional factors in 2 of the above
1 case client took on work themselves – informal and poor methods – failure to contract (or be required to contract) competent team
1 commercial job appointment was based on recommendation without proper competence checks

In the domestic secotr – in all the cases where the situation was known it appeared the worker/contractor was identified and appointed by word of mouth / prior contact. In 2 cases pressure from the domestic client in terms of time or change in scope contributed to the subsequent unsafe actions.

Contractorisation was judged to be Causal in 3 cases

1 late change on site led to a more fragmented role than previously planned the implications of which were not thought through
1 householder made individual trade appointments with no one centrally coordinating
1 inappropriate choice of crane hire over contract lift

It was observed in cases with a complex supply chain that often the PC and specialist appointments appeared to be appropriate but failures arose in the subsequent planning, coordination and control.

5.1.10 Ownership & control – top management

Ownership & control / leadership seemed to be causal in 11 cases with 13 issues highlighted. Specific examples related to:

PC failing to monitor sub/sub contractor compliance and/or take action or adequately track back on effects of delay / change in a number of cases
Specific failures in recognising appointed person responsibilities with crane hire
Poor recognition of responsibility:
Domestic clients –didn't recognise any responsibility or influence

In some cases there was explicit evidence of management assuming someone else was responsible. However, there were also a number of cases where some good leadership and high standards were noted.

5.1.11 Deeper Underlying Causes

The examples drawn from the analysis of the cases in this section relate to those elements of the management system which have been found to recur frequently as causes in the accidents studied. Some are identified in the immediate workplace context others can be seen to be underlying causes in the organisational and corporate systems. Individually the cases also reveal specific insight to the underlying causes but the focus here has been on areas in which concerted action could be expected to have helped in preventing a number of the accidents.

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ANNEX A: MODIFIED HFACS-C FAILURE CATEGORISATION TEMPLATE FOR STRUCTURING THE UNDERLYING CAUSES OF FATAL ACCIDENT CASES

1st Order	2nd Order	3rd Order	4th Order
(A) Environmental Influences	(A.1) Political Influence		
	(A.2) Regulatory Influence	(A.2.2) Sufficiency of regulations	(A.2.2.1) Mandatory skills/training
			(A.2.2.2) Licensing
		(A.2.3) Effectiveness of regulator	(A.2.3.1) Clarity of regulatory standards
			(A.2.3.2) Conflicting requirements- different regulators
			(A.2.3.3) Inability of regulator to 'reach' duty-holders
	(A.3) Market Influence	(A.3.1) Supply problems – services/materials/ labour	
		(A.3.2) Restrictive economic conditions	
	(A.4) Social Influence	(A.4.1) Society prioritising other issues over safety	
		(A.4.2) Social change – supply chain disintegration	
(B) Organisational Influences	(B.1) Policy	(B.1.1) Contracting strategy	(B.1.1.1) Competitive Tendering
			(B.1.1.2) Contractorisation
		(B.1.2) Organisational Structure	
	(B.2) Resource Management	(B.2.1) Capital resources	(B.2.1.1) Company Profitability
			(B.2.1.2) Equipment Purchasing
			(B.2.1.3) Inspection/maintenance policy
			(B.2.1.4) Insufficient time allocation
			(B.2.1.5) Insufficient funding allocation
		(B.2.2) Human resources	(B.2.2.1) Recruitment and selection
			(B.2.2.2) Training
			(B.2.2.3) Gangmasters/Agencies
	(B.3) Organisational Culture	(B.3.1) Ownership and control	
		(B.3.2) Labour relations	
		(B.3.3) Communications	
		(B.3.4) Worker representation	
		(B.3.5) Deliberate disregard for safety	
	(B.4) Safety Management	(B.4.1) Procedures	(B.4.1.1) Appropriate length/format/language
			(B.4.1.2) Effectively disseminated
		(B.4.2) Planning	
		(B.4.3) Information management / feedback	
		(B.4.4) Management/ Supervision	(B.4.4.1) Supervision of all by main contractor
			(B.4.4.2) Cooperation between different contractors
			(B.4.4.3) Effective supervision
		(B.4.5) Design for safe	

1st Order	2nd Order	3rd Order	4th Order
		construction	
	(B.5) Organisational Competence	(B.5.1) Technical knowledge	
		(B.5.2) Experience	
		(B.5.3) Ability	
(C) Preconditions for Unsafe Acts	(C.1) Environmental Factors	(C.1.1) Physical Operating conditions	(C.1.1.1) Welfare facilities
			(C.1.1.2) Uncontrolled/hidden hazards
			(C.1.1.3) Noise/Lighting/ground conditions
			(C.1.1.4) Space
		(C.1.2) Technological Environment	(C.1.2.1) Availability of suitable resources
			(C.1.2.2) Quality of inspection & maintenance
			(C.1.2.3) Equipment operability
	(C.2) Personal Factors	(C.2.1) Attitude	(C.2.1.1) Motivation/Morale
			(C.2.1.2) Compliance
			(C.2.1.3) Complacency
			(C.2.1.4) Overconfidence
			(C.2.1.5) Risk perception
			(C.2.1.6) 'Ownership' of safety issues
		(C.2.2) Adverse Physiological States	(C.2.2.1) Fatigue
			(C.2.2.2) Health
			(C.2.2.3) Situational awareness
			(C.2.2.4) Intoxication
			(C.2.2.5) Effects of medications
			(C.2.2.6) Stress
		(C.2.3) Training/Experience/ Ability	(C.2.3.1) Competence
			(C.2.3.2) Reaction times
			(C.2.3.3) Information overload
			(C.2.3.4) Inadequate experience
			(C.2.3.5) Aptitude for task
			(C.2.3.6) Literacy/numeracy
		(C.2.4) Personal Readiness	(C.2.4.1) Teamworking
			(C.2.4.2) Compliance
			(C.2.4.3) Vulnerable/migrant workers
			(C.2.4.4) Training/experience
	(C.3) Task Factors	(C.3.1) Task type	(C.3.1.1) Quality of comms
			(C.3.1.2) Availability of info/advice
			(C.3.1.3) Minor/one-off jobs
			(C.3.1.4) Distractions
		(C.3.2) Equipment	(C.3.2.1) Poorly designed PPE
			(C.3.2.2) Hazardous materials
			(C.3.2.3) Tools not designed to 'fit' user
		(C.3.3) Task Tempo	(C.3.3.1) Busy phases of project
			(C.3.3.2) Long/antisocial hours
			(C.3.3.3) Incentives for fast work
			(C.3.3.4) Repetition/boredom
			(C.3.3.5) Rescheduling of work without planning
(D) Unsafe Acts	(D.1) Accidental	(D.1.1) Skill-based Errors	
		(D.1.2) Decision Errors	
		(D.1.3) Perceptual Errors	
	(D.2) Deliberate	(D.2.1) Routine	
		(D.2.2) Exceptional	

ANNEX B: SUMMARY OF EXAMPLE CASES

This annex contains a narrative of the conditions and actions leading up to each accident as understood by the research team from the interviews. The cases are grouped in terms of public sector works, smaller domestic activity and commercial contracts of differing scale. Not all the cases examined are covered as in a number of cases investigations or legal proceedings were ongoing.

PUBLIC SECTOR

1. Short term work was taking place over three nights to concrete in new central reservation sections by a long established term contractor – a standard activity. On the second night the two-man TTM team had coned off Lane 3 to create a safe working area, the contractors had drawn in behind the TTM vehicle to undertake the work, and the TTM team was about to leave. One TTM worker was on the nearside of the vehicle checking the ratchet straps, the other was to the front of the vehicle. Everything about the company's systems and execution of the task was compliant with good practice. Meanwhile a member of the public, suffering depression and on prescribed medication, was seen driving erratically down the motorway (over a 40-50 mile stretch) swerving between lanes to the extent the police had been notified. Approaching the roadworks she under-took a car, came up behind a lorry and swerved out entering the 'safe' roadworks zone at speed from the side killing the two TTM workers and then herself.

One of the men was thrown into Lane 2 – there could have been a third worker fatality as a colleague instinctively ran out from the coned are to help him.

There was no basis for prosecution.

In general the circumstances arise because of societal pressures to keep the motorways open, with some conflicts between H&S regulatory requirements for work to be as safe as reasonably practicable and HA constraints for that to be 'whilst keeping the motorways open'. A wider political issue affecting motorway maintenance work more generally is different police force practices in terms of willingness or otherwise to provide rolling road blocks, and/or imposing different charging strategies for such services along a stretch of motorway.

A lesson learned concerns the location of ratchets on fixing straps – the nearside location is based on the more frequent risk for work on the hard shoulder before any coning or 'safe zone' is established. Ratchets to both sides would reduce risk when working to the off-side of moving traffic. This recommendation arises with hindsight and there is no criticism of the contractor – although safer for Lane 3 working, it is unlikely to have saved either worker in this extreme impact scenario.

2. A fender pile at the docks was being replaced – a complex operation needing heavy plant. A major specialist company was engaged by the harbour authority. The company had a strong safety management system with procedures being clear and translated for different audiences, method statements, safety advisors at each base etc etc. All site movements require a banksman, even forward movement of cranes. The team was specifically resourced with sufficient personnel to allow for banking.

The crane had been offloaded and was on the jetty being prepared for the operation. A further ton of ballast was required and the lorry had arrived on site with the ballast. All the men involved were long standing employees of the firm, although the crane and lorry drivers worked from different bases. A briefing was held at the start of the day – although often briefings are held in sequence as different plant arrives, on this occasion the plant and HGV driver were on site and shared the same briefing.

The crane driver had said he was ready for the ballast and would get the HGV driver to come down. Records show mobile phone contact had been made between them. Meanwhile the lift coordinator and others in the team were reconfiguring a spreader beam.

The HGV driver turned his vehicle and reversed slowly down the jetty. No people could access the jetty from the side and unbanked vehicle manoeuvres are necessarily undertaken by road going vehicles in highway settings. Nevertheless this was contrary to site rules and astonishment is expressed that banking help was not sought, particularly once orientated and reversing towards the crane. As the HGV reversed the crane driver was rigging the crane front boom – a special safe ladder system was supplied which would require separate access to both sides. Mounting from the front of the crane as the driver had chosen to do contrary to company procedures made it one operation. It seems the crane driver did not see or hear the approaching HGV. The HGV driver failed to stop before reaching the crane and the crane driver was crushed to his death against the crane boom.

The crane engine was running. The HGV, consistent with requirements for road going vehicles, did not have a reversing alarm or rear-view CCTV. However concerns about switching between cameras and mirrors mean the latter would not necessarily have been appropriate.

No grounds were found for prosecuting the contractor or harbour board. A charge was to be laid with the HGV driver but it was found he had advanced cancer. He was given a formal caution which he accepted – he always acknowledged he should have had someone act as banksman. The CCA were involved and the family was intent on prosecution. However they all accepted the final position once the medical condition emerged.

A wider consideration raised by the case is inconsistent requirements for road and ‘site’ vehicles so the bleepers which are normal for plant are not necessarily a feature for predominantly road vehicles sometimes moving on site. Societal concerns about noise nuisance affect the balance with safety.

3. Under a PFI contract for a new school the PC engaged a specialist roofing firm who in turn engaged gangs of 2-3 self employed roofers. The school was designed with a curved façade which made MEWP access difficult. The roofing subcontractor hired in the MEWP which was a US import and CE marked. The MEWP control is a single joy stick for movement with a toggle switch determining whether movement is in the up/down or forward/back axis. It has a 'hare' mode for major moves and 'tortoise' mode for positioning.

The roofer was installing guttering with only around 500mm clearance between the roof and the MEWP. The roofer was IPAF trained, held a CSCS card, had been on a course specific to the type of roof and had been on site for some 4 weeks. He had had a familiarisation session from the MEWP hirer for which he had signed. A labourer (friend of a friend) was with him in the MEWP – he was untrained and had no experience so, although not material to the subsequent events, he should not have been on such a site.

The bricklayers asked for the MEWP to be moved forward. To do so the roofer leant over the edge of the rail to watch the wheels. He moved the joy stick but the toggle was positioned such that the MEWP went up (not forward as intended) and it seems was in the more rapid movement mode. In seconds he was trapped between the soffit and the MEWP with his hand stuck, still driving the MEWP up. The co-worker had no familiarity with the control and so did not operate the emergency cut out. The worker died of his injuries.

Although the complexity of duty holders with different management structures and scattered witnesses through the supply chain complicated the investigation, no enforcement action could be taken as the fundamental problems were with the design of the MEWP controls on this CE compliant product. The investigation revealed the lack of understanding about ergonomics factors amongst equipment designers and hire companies. The complexity of CE compliance applicable to certain aspects of products coupled with the range of standards applicable to products like MEWPs, further underlines the difficulties for sale/hire companies and contractors.

4. The job was a two storey demolition for an LA client beginning with the removal of an asbestos cement roof. The contractor was engaged directly by the public sector client from a preferred tender list – they had employed the contractor previously.

The paperwork supplied was poor and generic, for tender purposes not managing safety on site but this was not commented on in the procurement process. The contractor had no management expertise, no training for supervision, etc. The method statement required PPE to be attached to a tower scaffold if used – the (lack of) safety protection afforded was not questioned.

Although the contractor had used a cherry picker on previous jobs, the configuration of the sloping roof obviated edge protection so, exceptionally, a tower scaffold was erected. The men working on the job were direct employees of the demolition contractor: a very experienced man in his 50s plus a university student labourer with whom he did not get on well. They had no training in scaffold erection but the kit they had was in good order.

The first man fell from the scaffold whilst climbing – deduced because the trap door was still closed and the body was found within the footprint of the scaffold. Little information was forthcoming from his co-worker.

Charges were laid successfully in relation to HSWA Section 2 duties and Work at Height Regulations, Section 6.

Around the same time other incidents associated with the same LA client and asbestos work were identified and were also prosecuted by HSE.

WORK FOR DOMESTIC CLIENTS

5. A sole trader specialising in window replacement had regular work at a particular block of flats replacing windows for individual flat owners. He had inspected and priced this job and agreed to undertake the work.

For the designated day he called on a self-employed co-worker whom he regularly brought in for 2-man jobs and a fitter's mate (also self-employed) who had worked for him previously but had just returned from eight months travelling - this was his first day back on the team. The sole trader himself left site to go and replace his tools which had been stolen in the preceding days. Meanwhile the men carried on replacing one window and were on to the second window of the day.

Work was done from the inside and having removed the old window the new fitment was manhandled to the outside then pulled in fast against the jamb before being fixed in. For the first window of the day they had stood on a desk fixed in front of the window but the window had been successfully fitted. For the second window they stood on the floor but the sill height was low (810mm) failing to give adequate edge protection. As the men tried to get the window into position it jammed and it seems the regular co-worker stood on his toolbox to increase his purchase but overbalanced and fell out through the window to his death.

The sole trader drove up just before the accident happened. He was a lay preacher and a fireman. It was judged that failure to implement a safe system for work at height was explained (but not excused) by ignorance of what was required rather than a flouting of known rules. Since the accident has put in place safe working methods and procedures including use of mansafe harnesses.

He was prosecuted and fined under S3.

6. A domestic householder wanted external work done including clearing gutters, painting barge boards etc on his house. A local builder was taken on by recommendation. The builder was self employed and brought along a colleague he employed directly albeit not full-time. The employee did not work for anyone else and was content to work the hours on offer and have time to himself. The builder however was under some pressure to take on work – he generally did bigger extension jobs but was in a lean patch and bills were mounting.

Painting work was underway, and unbeknown to the householder the builder and his mate had borrowed his relatively new aluminium ladder. The house backed on to a field with a footpath and used recreationally by local residents. The hedge to the house side was however very overgrown to the extent that it impeded access at one corner. It seems that they decided to try to access the barge boards from the field which could be accessed over a stile. Exposed electrical 11kV overhead lines ran over the field (6.3m above the ground compared with the 5.2m minimum statutory spec.) and 9m from the house (compared with a statutory requirement for cables to be insulated if within 3m of a property). The sequence of events is unknown but the two men were found dead in the field having been electrocuted with the aluminium ladder extended to 8.15m.

The ladder would not have been of sufficient length to reach the barge boards from the field. It is reasonable to assume that an experienced builder (more generally involved in extensions) would recognise power cables. It was a hot sunny day and this could have hampered visibility. The hedges adjacent to the lines had been cut back within the required timescales and the support pole was labelled to warn of the risk of electric shock (albeit primarily to deter people from climbing the pole). As an 11kV level there would have been no trip when the ladder contacted.

There was no basis for prosecution. Had the employee but not the employer been killed, Section 2 charges would have been in prospect.

One family wrote to Government Ministers, the Engineering Inspectorate (subsequently part of HSE), the HSE Chief Executive etc concerned at the proximity of the cables but thorough investigations showed all aspects of electricity supply were within required limits. The searches also revealed a rolling programme the supply company had initiated to extend the insulation programme but 9m is some way beyond current scope.

7. A householder was having a small single storey extension built on his house. He assembled a group of self-employed tradespeople through his contacts (as a former police officer) paying each directly. No one on site was in charge and each was responsible for their own trade task. The DP, himself a former policeman, was now a qualified electrician, a trade he had been involved in for 10 years or so. Having been working in the roof space he was seen towards the end of the day taking his toolbox, work light and some back boxes to the roof hatch. It seems he descended the untied ladder carrying his

equipment and the ladder slid backwards. Seriously injured, he subsequently died in hospital from pneumonia 2-3 weeks later.

The ladder was aluminium and in good condition and appropriate to use for short-term access. It was owned by the general builder tradesman but used by the others on site where needed. Whoever put it up and whoever used it should have ensured it was adequately tied although the coroner apparently commented that it was not reasonable to expect this of small scale builders.

HSE wrote formally to the owner of the ladder to advise him that he should ensure any equipment he loaned was used safely but responsibility in the circumstances lay with the experienced electrician who seems to have descended an unsafe ladder in an unsafe manner.

There was no basis for prosecution.

8. The owner of a Victorian property (1st floor flat over a shop) employed a Polish odd job man he'd used previously, to replace some roof tiles that had slipped and do some internal decorating. They went to the builder's merchant together and the property owner purchased the replacement tiles. The workman was known to do small construction jobs but this was informal economy work with no tax or NI records. He had been in the country for some 6 years and had a permanent address. His car was parked outside the property but there was little evidence of tools or equipment. He brought his brother to work with him on this job but he had only recently come to the UK and had very limited English. The brother got on with internal painting in the house and did not witness the incident.

In order to get to the roof the lead worker borrowed a ladder from a restaurant in the parade of shops. He placed the ladder inside a small balcony on the first floor rested against the ornamental railings. He climbed the ladder and the railings gave way and he fell to his death on the pavement below. With a long enough ladder this short duration task could have been done safely with the ladder footed from the pavement.

Although a migrant worker, the concerns are more strongly related to the informal economy and vulnerable workers in that sector rather than his country of origin. Relevant HSE construction guidance is produced in Polish but is unlikely to have impacted someone so hard to reach.

There was no basis for prosecution.

9. A self-employed builder (Polish) known locally for competitive pricing built an extension for a domestic householder. In his usual way he brought relatives to help on site as and when required. No formal training or qualifications were identified for him or any of his team. The quality of build was presumably satisfactory as he had a history of work on nearby properties and was recommended on.

The site was set into a steeply sloping hillside which meant a 1.85m high retaining wall was to be built to bound the new back yard. The builder used a building regs designer to get the plans passed. These simply showed a line in plan where the wall was to go. The householders run a taxi firm and decided to have the back yard extended to enable them to park their many cars off the street. In cutting back further into the hillside the required wall became 3.4m high and was 24m long in a straight run.

Building control visited site on three occasions. Although the wall, being at the back of the property and away from the public, fell outside their jurisdiction, the BCO repeatedly advised the builder he should contact the designer to get proper calcs done for the retaining wall. The BCO recorded this and was in fact reprimanded internally for stepping beyond his remit. The BS designer was alerted and also contacted the builder directly to encourage him to get the wall designed.

The builder repeatedly ignored the advice – there is no basis for knowing whether this was due to lack of understanding, misplaced confidence, cost saving etc. The build method involved the insertion of unlapped short lengths of reinforcement bars, hand mixed concrete and no buttresses – all aspects undermining the structural strength. Nevertheless the wall was completed and work moved on to the yard and driveway. In the process someone driving a small digger accidentally hit the wall. A large crack opened up which the builder went up to inspect. The wall, with the pressure of the groundwater behind, collapsed on him and he died. The strike, in a way, was incidental – the wall would have collapsed at any stage engulfing anyone beneath.

There was no basis for prosecution.

The fatality counted as construction work fatality because the incident occurred during the course of ongoing construction work. Had the collapse occurred once work was complete and say the homeowner triggered the collapse by hitting the wall when parking a car, the classification would have been different.

The design of such a retaining wall requires chartered engineering level input, possibly involving geotechnical input from a specialist with post-graduate qualifications. It is surprising that a builder would not have some recognition of the forces involved but even if trained in general building, any course is unlikely to address this situation specifically.

There is an apparent gap in the coverage of such a safety critical component between building regs and CDM in the domestic client context with reliance on the main contractor.

Although a migrant worker, it is unclear that this had any bearing – he had established links with designers and building control had no doubt he understood their advice, he just failed to act on it.

10. A householder saw evidence of a leak in his roof, subsequently found to be coming from round a roof vent. He called a general odd jobbing builder he had used previously and asked him to come round urgently as heavy rain was forecast. The builder was himself keen to get on as it was his son's birthday and he wanted to be home early. He was a very well respected builder and recognised for good work in the area.

The builder set about accessing the roof but did not have a roof ladder. Instead he placed a regular ladder up the side of the house and attempted to 'fix' it, drilling into the mortar, inserting an ordinary rawl plug and a simple 3/4in. cup hook, and putting a strap between the ladder and the hook. Climbing the ladder he placed a sheet of ply in the gutter and placed another short ladder on the roof rested back against the ply. He was seen by a neighbour half way up the roof but at some point the set up gave way, the lateral forces ripping the rawl plug from the wall.

The builder was taken to hospital who subsequently called HSE when it appeared he was not going to survive. When HSE visited the householder his principal concern was how he was going to get his roof fixed before it rained.

There was no basis for prosecution.

Despite evidence of a thought process to address the risks, the solution was wholly inadequate and it seems pressure somehow drove him to abandon safety. The situation also reflects householders' expectations of 'their' builder being able to turn their hand to anything.

11. A small domestic roofing/extension job was carried out by a small contractor. He had been persuaded to take on a 19 year-old apprentice (his only employee) as the young man had been struggling to find a placement. Although the college audits employers and the mentor visits sites with a remit including health and safety, the checks are relatively superficial and failed to detect the contractor did not have the capacity or capability to train or protect an apprentice in specific relation to health and safety.

As work progresses, the contractor wanted to return 3 pallets of unused bricks to the builder's merchant for a refund. The hiab driver had been trained in safe lifting methods for routine lifts of this type which included designating a safe lift area and preventing access. The builder's merchants also had in place a system whereby the local manager had to complete risk assessments for lift activities but these local managers were not trained for this. Furthermore there was no system for auditing the work of drivers and mechanisms for disseminating lessons learnt from accidents were not effective. Although lorries had carried cones to mark out the lift area, this practice had stopped locally some two years before.

The palletised bricks were enclosed in polywrap but the packaging is only designed to withstand a single lift. Additional wrapping was available on site but was not used. The driver lifted the pallets without bothering to lower the side flaps on the lorry. During the first lift the wrapping failed and the

contractor instructed his apprentice to gather the bricks up. At that point he left site to attend a doctor's appointment leaving the apprentice working with the driver. The 2nd lift went OK. In the third lift the driver left the load suspended and instructed the apprentice to go beneath the load to insert a timber baton to strengthen the pallet. In so doing the apprentice, without any head protection as was customary on the site, was beneath the load – when the pallet collapsed he was killed by the falling load.

His employer had failed to understand the risks with lifting operations or ensure a safe area. He also didn't understand his role and responsibility for supervision. The builder's merchant had failed to develop suitable and sufficient risk assessments for the job or have any effective audit system for how their drivers worked on sites.

The case was successfully prosecuted. The driver from the builder's merchant was prosecuted under Section 7 (fined £3.5k), the contractor who employed the apprentice was fined £4.5k under Section 2 and the Builder's merchant was prosecuted under Section 3, although not linked directly to the fatality, and fined £1.5k.

12. A two-man company, small domestic builders, was modifying a single storey extension. A structural engineer was engaged for another part of the job which involved building a second storey on an already much modified bungalow. The domestic client, as was their wont, asked for a late change which necessitated the removal of an end wall instead of just putting in a doorway as planned. Without professional consultation or structural investigation, the work was done that day probably without recognising the stability issues although it is surprising that an experienced builder would not have recognised issues with a 9" block wall being structural. However the form of roof construction reflected the post-war build of the extension – corrugated sheeting formed the underside with unreinforced, poor quality concrete above. A suspended ceiling inside the building further masked the structural form.

As a consequence the roof was unsupported and collapsed trapping one of the builders – quite why he entered the building is unknown but possibly because the structure creaked. He was taken to hospital and life support was switched off a couple of days later.

There was no prosecution – the widow asked that the partner not be prosecuted. In any case, the DP was the lead partner responsible for getting work, pricing etc. The two men, then in their mid-thirties, had been friends from childhood and had worked and socialised together ever since.

PRIVATE COMMERCIAL

Large scale

13. Work running over two years was nearing completion on a major extension at a concrete batching plant which included construction of high level walkways. The PC, a specialist engineering contractor was under close scrutiny of the client, themselves a major construction industry player, and had been observed to have maintained high standards including extensive fall protection measures when erecting the walkways. The PC's auditing function was somewhat compromised by the Supervisor knowing when senior management were expected to visit. When work reached the snagging phase a series of tasks was planned at different levels and locations following a walkdown with the client.

This included final placement of control cabinet panels. For some reason the experienced team of mechanical fitter slung a panel into place with the strops going through one of the walkway gratings – presumably this was a short cut, rather than obtain the right kit from the stores. However the operation was completed successfully, save for a small bow in the grating.

Within the next couple of days the supervisor who was particularly fastidious and had not been present at the time, decided the walkway grating should also be straightened although it hadn't been picked up formally by the client or snagging. Obtaining a replacement grating would have been straightforward and have had no budget implication in this multi-million pound contract. In addition, the experienced workforce doubted it could be straightened with cold working and were not keen to be involved. The supervisor had the most junior of the team remove the grating and resting it alongside had him bang it straight. This was a 'five-minute job' and procedures for protecting the void and wearing PPE in the face of a fall from height risk were not followed.

As this was in train, one of the other team members called up for the supervisor to assist them further along the walkway. The supervisor set off, ducked under a beam as the walkway configuration required, and fell through the hole left by the grating falling to his death (5m) below. The silvery grating and cement dust on the ground below meant the hole was not obvious. Potentially the walkway had also become established as a 'safe' working area. When gratings were missing during the construction process strict requirements for wearing harnesses would have been adhered to.

No prosecution action was taken, the actions being an unforeseeable violation by an otherwise competent individual with authority.

14. A refurbishment of industrial premises was being carried out by a contractor who had worked for the client previously albeit generally on smaller projects. This site was also different as it included a large open area with spoil being distributed on the site involving construction plant operations; on smaller sites it would, by necessity, be loaded directly and taken away.

Planning supervision services had been bought in but documentation was found to be poor and non-specific to the site. The company had no SMS or apparent ownership of safety. The QS was also providing some notional 'safety advisor' services. The company subscribed to an H&S/employment advice service but had never accessed H&S information. Specifically no traffic management plans were in place and poor practice was subsequently identified in several areas. The site manager, a qualified plant operative, had no site management training but should have recognised deficiencies in the plant-related operations. He was the brother in law of the company's controlling director.

Spoil was being taken to a 'rubble compound' using a dumper truck which comprised an embankment mound and tipping area. Poor forward visibility from a dumper truck and stability issues for a wheeled vehicle mean that use of a tracked vehicle to spread spoil is a safer method. A tracked vehicle was on site. The embankment edge was not blocked to prevent a vehicle approach although a regulatory requirement. The plant on site was hired in and in good order.

The dumper truck was being driven by a young labourer (22) who was untrained but had been shown how to drive the dumper on site by a plant operator. Once shown he had never sought further guidance. In recent days he had tipped a smaller piece of plant into a trench – as a consequence the director had said he should not be allowed to drive other plant on site. The untrained status and continued driving activity by the young labourer were known to the site manager.

The labourer drove up the embankment with a load of spoil but went over the embankment edge and was thrown from the seat as he was not wearing a lap belt. He landed on rubble causing fatal injuries.

The site manager successfully defended a manslaughter charge laid by the CPS on the basis that he was untrained by the company. Charges under Section 2 in relation to Section 37 duties on the company and the director specifically as the controlling mind were successful – he had been to site, knew there were unsafe practices but failed to take effective action. Fines were imposed.

The prosecution took the line the labourer was an employee although the company had initially claimed he was self employed. He had however been working continually and exclusively for the firm over many months, confirming a clear mast/servant (employer/employee) relationship.

The CPS decision to place manslaughter charges curtailed aspects of the HSE investigation into the apparent inadequacies in relation to other parties in the supply chain. Unusually barristers ran the manslaughter and H&S cases simultaneously given the inter-related arguments.

Even in the aftermath of the incident there had been limited awareness by the director and site manager about standards required and/or recognition of their

responsibilities. A PN was issued to prevent continued tipping and an IN when the company could not produce their traffic management plan and further did not recognise what one was. They appeared out of their depth and the set up was described by the legal team as the partially sighted leading the blind with it being said the site manager 'thought he knew better' and the director 'couldn't be bothered'.

Following a previous IN some 18 months before the firm had been directed to HSE guidance which they had reviewed but thought it showed them nothing new.

15. This was a house-building site where this 23 year old had been directly employed for 6-8 weeks by the groundworks subcontractor, a reputable firm the workers said was one of the best they had ever worked for. Standards were good with, for example, a ban on wheeled vehicles on spoil heaps. This policy was generally well known but appears not to have been communicated to the latest recruits to the site. The firm needed additional plant drivers and, given the shortage in the industry, set about putting workers through a CITB course to get a CPCS qualification. The young man put himself forward, encouraged by a ganger on site with whom he'd worked on a SE basis previously. Although having no more than a week's prior experience on plant, he told the company he had more than five years' experience and signed a document to that effect. He was therefore put through the refresher course with 5 others on the site and passed. The ganger had given him the opportunity to drive plant on site in the week before the course although this was against site rules which allowed only ticketed workers to drive plant.

During the training, manoeuvring on slopes was carried out on the spoil heap, as this was the only gradient on site. The trainer was not made aware of the company policy and did not make any of the 'trainees' aware that this was a controlled exception. They were trained about the risks and need for bunding and protection of spoil heaps. Subsequent to training, the newly (re)qualified groundworker was seen on the spoil heap and being bawled out by the site foreman.

On the day of the incident the groundworks supervisor was off sick so, in accordance with normal practice, the experienced excavator driver assumed charge. The excavator driver had been working on the spoil heap but moved to another location for a short term job – the heap was not battered back but the site rules would not allow access anyway. Meanwhile the newly (re)qualified groundworker was collecting spoil from one location in a dumper truck for use in another. He was rebuked for not wearing his lap belt in accordance with site rules earlier in the day. He took a load to the required location but it was not needed; rather than take it to the area where excess spoil was being off-loaded from the site, he went to the spoil heap. He was a keen worker and the assumption is that as spoil was no longer needed and he had yet to have specific instructions for his next job, he took the opportunity to practise. He drove onto the spoil heap, failed to see the edge which he approached unimpeded. The dumper overturned and he was killed. He was not wearing his seatbelt; had he been it is believed the outcome would have

been different. The spoil heap was u-shaped in plan; the dumper has very poor forward visibility but to the sides the spurs of the spoil heap would still have been visible. There was apparently no attempt to stop at the edge.

No prosecution was taken – the actions the individual took were contrary to known site rules and there was evidence of them having been enforced with him previously.

Subsequent to the accident the company has implemented best practice (beyond the industry norm) including seat belts interlocked with plant movement and signage at the base of spoil heaps.

16. A refurbishment of offices owned by a large pension company with a managing agent was notified under CDM. That work involved refurbishment of the lifts hence it came under 'construction'.

The selected principal contractor was a lift specialist but tended to engage a grouping of four specialist subcontractors for refurbishment. All four were genuinely self employed, experienced and qualified lift engineers. Each procured work in their own right but also teamed up with each other depending on the scale of the jobs, an arrangement they had had for some 20 years. The guy who procured this job brought in one of his four colleagues who was more 'senior' and the latter took the lead in the practical work

The lift refurbishment had been designed by a lift consultant and the specification included a safe method of work, ensuring that the back up fall arrest system remained in place as the main ropes were being replaced. As the date for the work approach the PC contacted the subcontractor to see what kit they needed. Having no response the put together a 'starter pack' of strops and hooks and said if the sub-contractors needed anything further they should ask. A copy of the consultant's specification was given to the subcontractors but they did not look at it and chose their own method of work. One of two lifts had been refurbished satisfactorily. Work was underway on the second.

The strip out activity included removal of the gear for the back up lift arrest system. When replacing the main ropes the lift car was suspended at the 8th floor level and the lead man was working on top of the lift car. The lift was suspended with a temporary lifting arrangement comprising a 3ton capacity strop with the ends in a hook suspended from the chain block. The 1ton rated hook had a safety catch but the thickness of the strop eyes meant they could not lie within the hook thus preventing the catch from closing. Although lift shaft arrangements differ, the set up in these installations was quite unusual with only a small aperture through which the ropes pass up to the control room. This meant the large strop could not pass through the aperture and the slinging operation needed to be altered part way through the operation.

Some manipulation of the strop eyes around the hook was taking place when one end fell, the lift sliding down the length of the strop unchecked, plummeting to the floor below killing the lead worker.

The actions were described as ‘reckless’ and met with general incredulity amongst co-workers in the partnership and PC. The late change, midway through the job, pointed to an absence of planning, the early removal of the back up system was unsound practice and the use and manipulation of kit in such a vulnerable position by experienced people was incomprehensible.

The PC was engaged and had provided safety information but it is notable that the location of the work means that lift contractors’ activity is often isolated from wider scrutiny.

Prosecution was not taken. The risk gap in the actions of the PC were considered insufficient under EMM although they were sent a formal letter pointing to deficiency with respect to CDM and control of contractors. The company has since done more to devise safe methods for this specialist activity. The surviving partner had procured the job but the practical control was taken by the DP.

This specialist sector has limited central / trade coordination. However, HSE prepared and issued a safety alert concerning the temporary support of lift cars during maintenance distributing it directly to lift owners, those who control premises where lifts are installed and refurbished and those managing or undertaking refurbishment work.

Small

17. The gable end of a church was being painted but the job was too small to be notifiable under CDM. The micro company engaged had undertaken the job some years previously. The apex at the gable end was 10m high above a small courtyard which could only be accessed through the building via a tight set of doors obviating the use of a scissor lift. A tower scaffold was erected and preparatory worked carried out by the company owner and his two employees one of whom he’d employed when needed over a period of some 6 years, the other was a new recruit. It seems from the post-incident inspection that the tower scaffold as erected was missing bracing and had no outriggers. The scaffold had been bought some years previously second-hand from a hire company. None of the workers is known to have been trained in the tower scaffold erection but one warned that the scaffold was unsafe. The boss assured him it was OK.

The company had been seen by the investigating Inspector some time previously on a more typical large exterior painting job – use of MEWPS was in evidence suggesting the conditions drove access selection in these circumstances.

The tower scaffold was not high enough to access the apex and a ladder was placed on top which the company owner himself went up, footed on the tower scaffold platform by one of the employees. The scaffold toppled propelling

the worker who was injured into the neighbouring ground; the owner landed in the footprint of the tower scaffold and died.

There was no one to prosecute. Had the employee been killed and the boss survived the charge could have been manslaughter.

18. In a remote rural area in Scotland a blacksmith was in the process of selling some land to a housebuilder – transfer of title was dependent on vacant possession etc and at the time of the accident seems still to have been with the blacksmith. The land included a number of redundant steel frame / asbestos cement sheet roofed buildings which the housebuilder was to demolish. The MD of the housebuilding firm agreed with a friend, the self-employed mechanical engineer who maintained their plant, that he could have one of the steel frame structures if he were to dismantle it. The SE mechanic planned to re-erect it as a storage shed/workshop in land around his home from where he worked. The housebuilder's expectation was that he would still be required to dispose of the asbestos cement sheeting once removed – it was not the mechanic's plan to re-use it.

The housebuilder had the mechanic sign an undertaking that he was responsible for his own safety during the demolition / removal and leant him a telehandler together with a man-riding basket.

In the week before the accident the housebuilder erected heras fencing around the site. On the Sunday the mechanic, his father and another man went to the site to consider the work involved in de-constructing the building although they did not have access to the interior. The third man was a small farmer in his 60s who had previous involvement in demolishing and erecting farm buildings including roofwork etc. He was going to assist the mechanic with the demolition – no money was exchanging hands but it seems there was some debt outstanding to the mechanic that this would settle. This man was known to HSE (in fact the same inspector) as he had been injured some months previously – he had hit his head and claimed he couldn't remember anything so he was given advice on work at height but no action could be taken.

Work got underway and by Wednesday much of the roof had been removed although the mechanic had his father coming out to help maintain progress that afternoon as he had some other work still to do and was planning to go on holiday himself the following weekend. The interior of the building was largely empty but the telehandler was really too big to be useful although it was used when removing the exterior flashing – according to HSE a scissor lift would have been more appropriate.

The farmer/roofer, a slight man probably weighing no more than 7 stone, argued it was safe to 'walk the purlins', although they were seen to be walking in all directions across the roof. As the bolts were cut, the sheets were released and lowered down to be transported by FLT and stacked for later removal by the housebuilder. One bolt was not released sufficiently so the mechanic went back along the roof. Having cut the bolt, he stepped back and

fell through a fragile rooflight within the asbestos cement roof sheet falling to his death below.

In the course of the subsequent investigation the farmer/roofer would never accept that the method was unsafe and simply regretted not having cut the bolt adequately at the first attempt. He also blamed HSE for not allowing them to have simply smashed up the asbestos cement roof sheets rather than requiring then to be removed intact for subsequent controlled disposal.

It was a very difficult investigation, not just because of the interrelation of the parties but also because the DP's father had arrived on site shortly before he fell. It was not entirely clear whether the death was work-related but it was considered that because the DP was taking the shed to use it for his mechanical fitting/engineering business it was. The DP had controlled many aspects of the demolition and despite the clear influence of the farmer/roofer it was concluded a prosecution could not be taken. The Sherriff concurred with this view.

The inspector commented that this was not atypical of remote rural practices – the difference is that in many instances the person walks away unscathed or with survivable injuries.

19. A small company, encouraged by the green agenda and market opportunities, was set up recycling rubble and aggregate. The MD, previously disqualified as a director for tax evasion and generally described as 'a bull at a gate' in approach, was building a grading plant as and when he had time and money – the plant had no planning permission and was an ad-hoc, site-welded, construction without any proprietary components.

A sloping conveyor (weighing around 1 tonne) was not operating satisfactorily and needed to be repositioned to reduce the inclination so the MD hired in a mobile crane and driver to work under his instruction (a lower cost alternative to arranging a more complete contract lift under the lifting regs). He had no training or experience in construction lifts although his approach when building the structure had been to use mobile plant for the recycling activity, hiring in a carne as a last resort, something he had done in a handful of cases through the build. The crane driver was qualified and experienced but left the MD control the lift as this was a hire job not a contract lift. Communication was based on informal hand signals – they could not hear each other and the MD had no knowledge of lifting signals. An employee of the MD (his best mate and the welder involved in building the plant) was also on site.

There was no evident planning for the lift.

The bolts at the base of the conveyor were released and the top rested on a prop comprising a channel section on a box section support, held with a G-clamp to the structure. As the conveyor was lifted, the top end became jammed in the channel so the lower end was let back down and the chains fell slack. The MD went under the conveyor to free the conveyor using an iron

bar but as he did so the unsupported conveyor fell sideways crushing him against railings, killing him.

Control was with the DP so there was no basis for prosecution.

The crane hire company was issued with an IN to make better checks for crane hires in terms of method statements, lift plans etc and to decline hire if standards are not reached. The company is now described as an exemplar but acknowledges it loses business on account of the strictness. The crane driers are apparently much more comfortable with the conditions they now meet on site.

20. Two individuals wanted a bakery converted into a bistro. They appointed an architect who gave no advice on CDM and an LA Building Control officer as project manager who took no responsibility for health and safety. The project, set to run for 10-12 weeks and therefore notifiable was not notified in accordance with CDM and no CDMC/PS was appointed. The PC was not appointed in writing and was chosen based on recommendation by a friend. The small contractor (essentially one active director employing undocumented migrant workers he paid cash and accommodated in a closed hotel) had no capital following collapse of a previous company so the clients paid up front. The director was a convicted criminal for tax and mortgage fraud and had previously been reported for illegal gas work (unregistered under CORGI).

Work was being undertaken on the roof to fix edge protection – although unplanned this was required by a roofing sub-contractor before they were prepared to start work. It was wet and slippery on the roof which was covered by a tarpaulin. This concealed three voids in the roof although there was no barrier or marking to this effect. One of the workers, an undocumented Chinese migrant, known as a good worker albeit with no UK qualifications, walked on the tarpaulin and fell through one of the roof lights. The director drove him to hospital without calling 999 where the worker died.

The workers on site were Chinese but with different dialects. Communication with the director who visited site daily was with hand signals. After the incident there was little cooperation with the investigation and most workers ‘disappeared’. Just one worker (who returned to China) cooperated with the investigation.

After the accident it was found that the director was still employing undocumented workers at another site in the area – HSE visited and took enforcement action. In relation to the accident, the director was convicted of manslaughter.

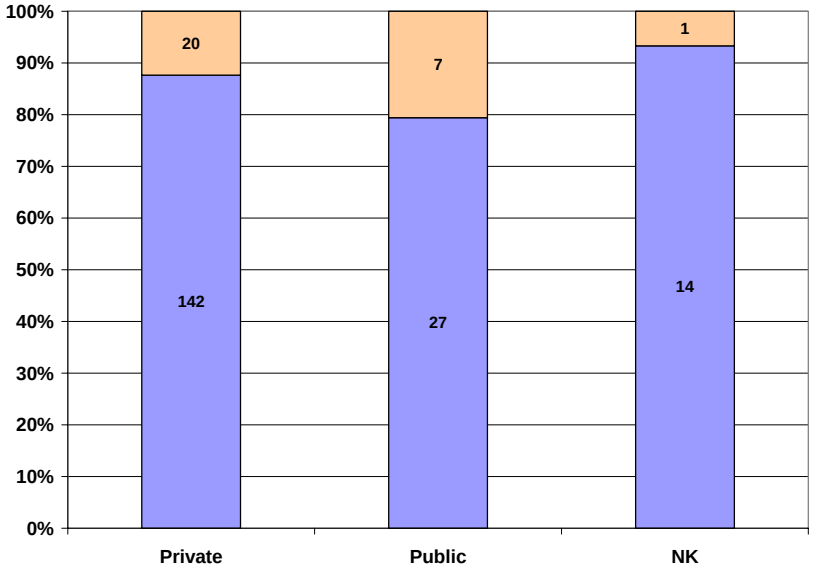
ANNEX C: PROFILE OF 26 CASES AND 28 FATAL ACCIDENTS BASED ON PEER REVIEWERS' SELECTION

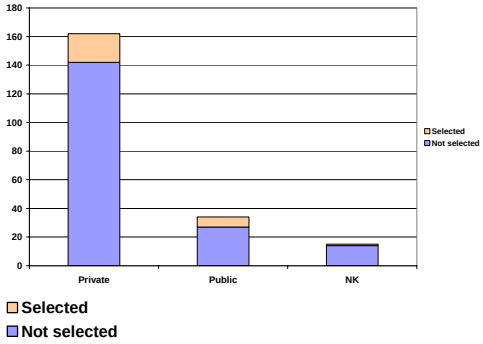
The following charts are based on the information available at the time of the initial notification of the 211 construction fatal accidents 2005/06 to 2007/08 inclusive. In some cases the information is incomplete (NK) and/or may have been subject to change in the course of investigation.

Charts show the proportion of cases in each category which are 'Not selected' or have been 'Selected' as part of the Phase 2 study. The selection covers 28 fatalities. The figures within each bar indicate the number of cases in each category. Caution is necessary as some of the absolute numbers are small as a basis for statistical comparison.

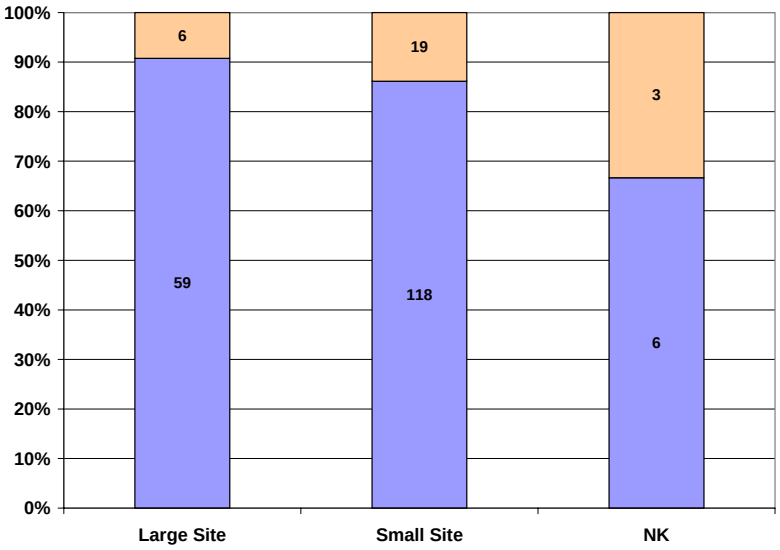
The purpose of the charts is to demonstrate that the selection reflects the key characteristics within the dataset. However, as only around 13% of cases were studied in the time available, the findings, whilst illustrative, cannot be used to draw any statistically based conclusions.

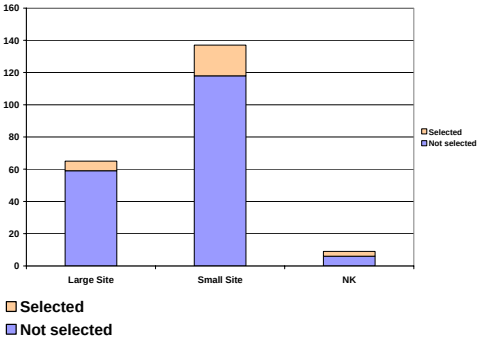
Public / Private sector work



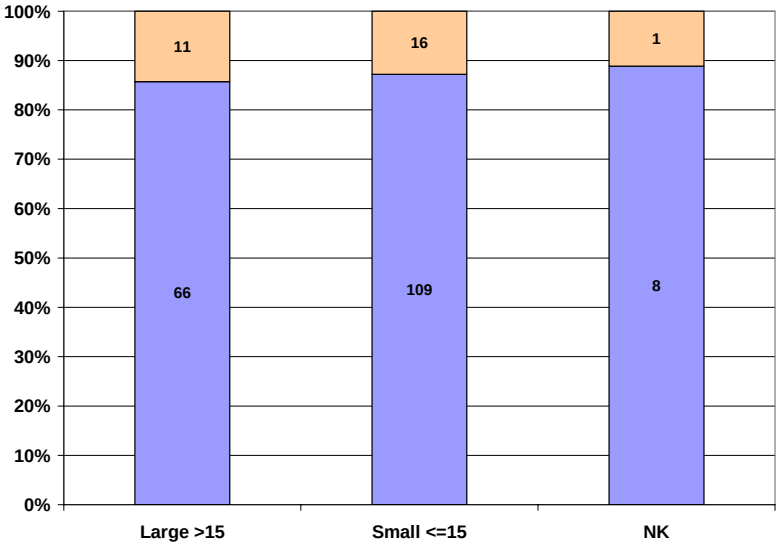


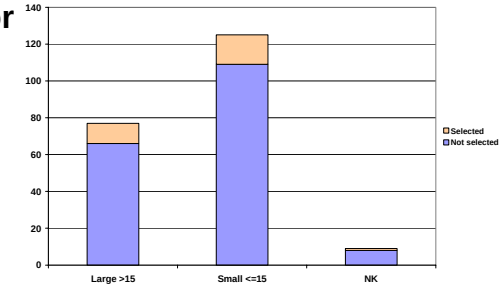
Large (>15 workers) / Small (=< 15 workers) site



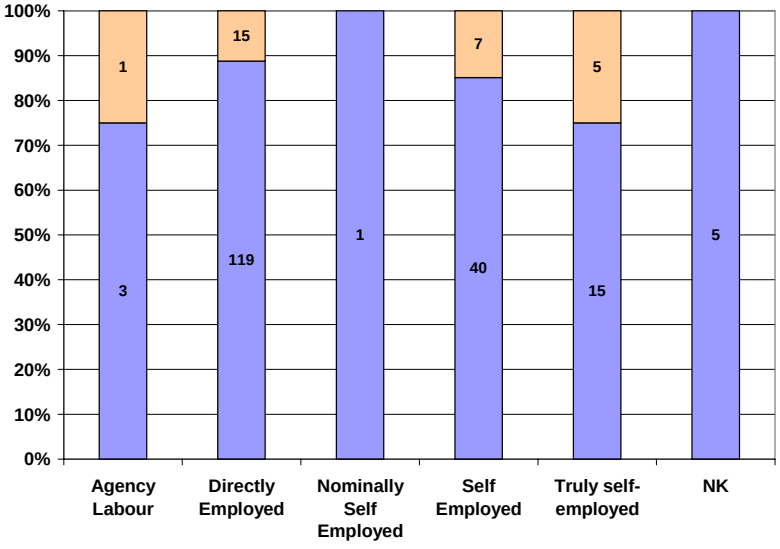


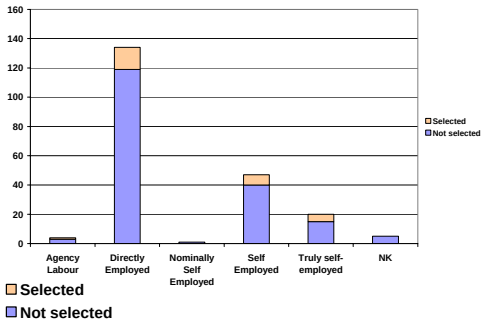
Large (>15 workers) / Small (=< 15 workers) contractor



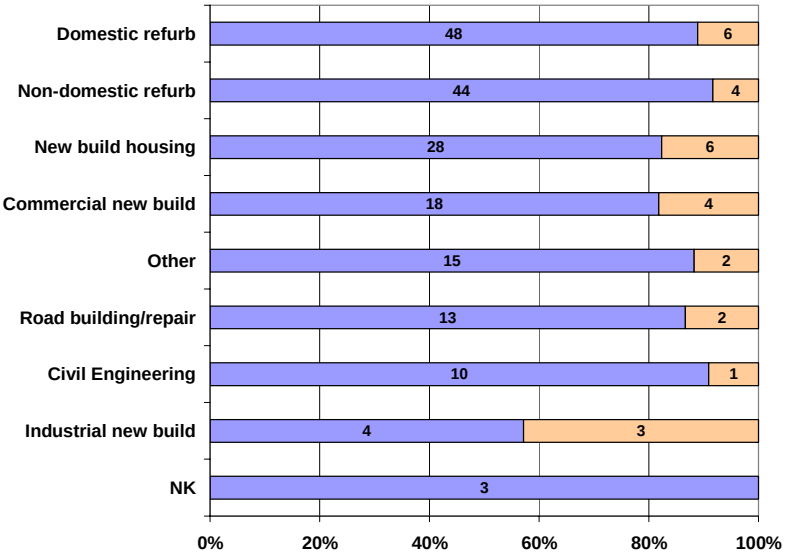


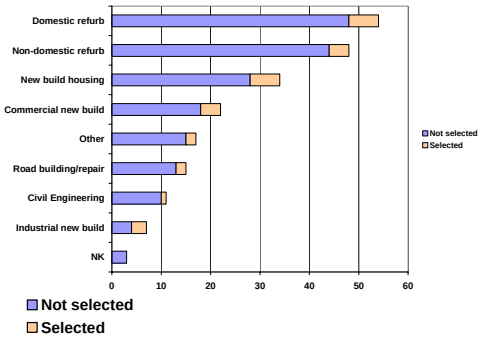
Employment status (NB small nos in some categories)





Project Type





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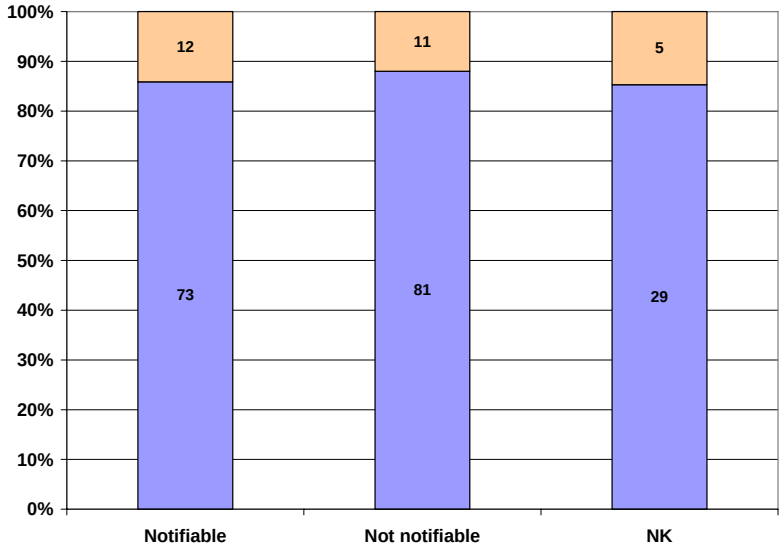
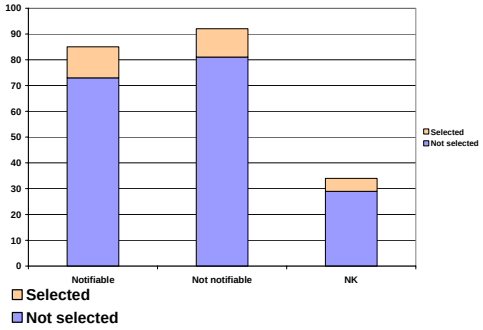
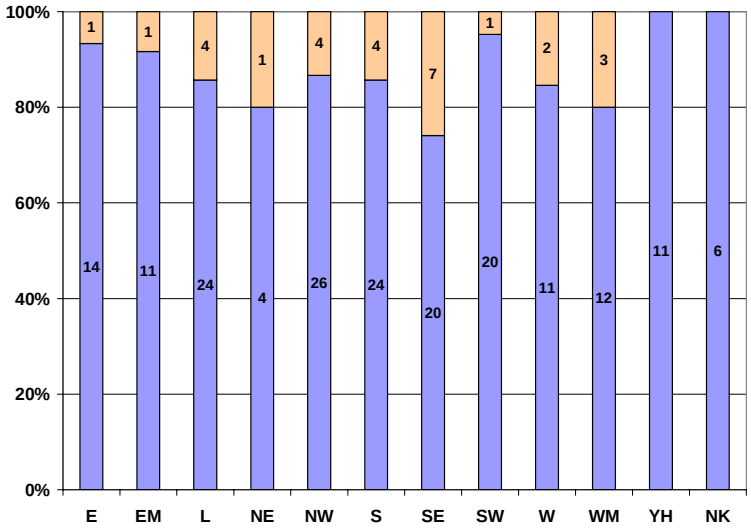
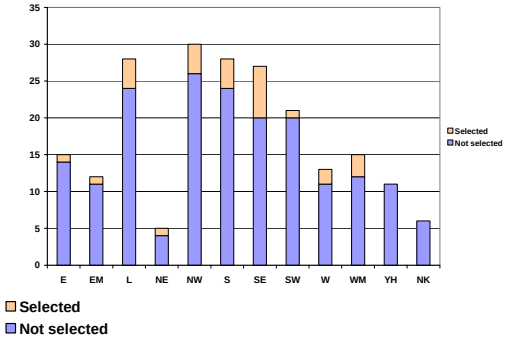


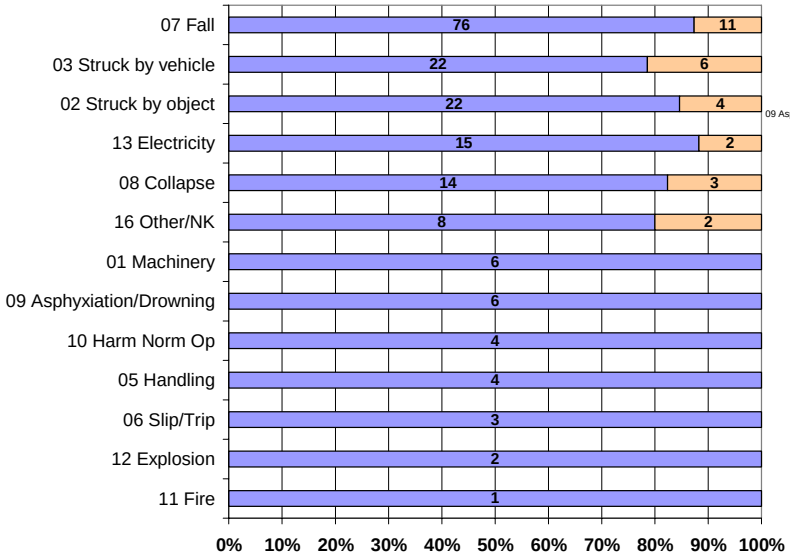


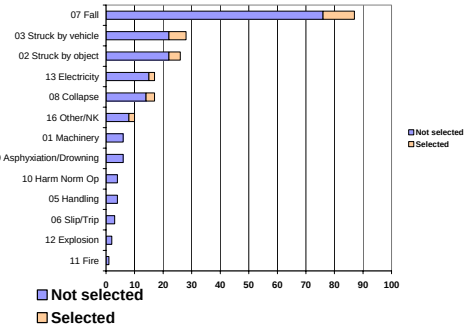
HSE regions





Accident Types (NB some small nos)





DP Age (NB some small categories at extremes)