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

Phase 1 Report:
Underlying causes of construction fatal accidents –
A comprehensive review of recent work to consolidate and summarise existing knowledge

Health and Safety Executive
Construction Division

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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 1 review 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 1 review and companion background reports to the Inquiry are available for download from: http://www.hse.gov.uk/construction/inquiry.htm

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GLOSSARY

3CA  Control Change Cause Analysis
ACOP  (HSE) Approved Code of Practice
AISIG  Accident Investigation Structured Information Gathering
AP  Affected Party
BCWE  Behavioural Change and Worker Engagement
CAA  Civil Aviation Authority
CBE  Commander of the British Empire
CC  Construction Confederation
CDM  Construction (Design and Management) Regulations
CFOA  Chief Fire Officers Association
CIS  Construction Industry (tax) Scheme
CITB  Construction Industry Training Board, ConstructionSkills, the Sector Skills Council for construction
CMS  Common Minimum Standards (for Procurement of the Built Environment) – from OGC
CO  Carbon Monoxide
COHME  Construction Occupational Health Management Essentials
COIN  Corporate Operational Information System
ConD  Construction Division (within HSE)
CONIAC  Construction Industry Advisory Committee (advises HSE)
ConP  Construction Programme (within HSE)
COPFS  Crown Office and Procurator Fiscal Service
CPA  Construction Plant-hire Association
CPS  Crown Prosecution Service
CPW  Construction (Division) Plan of Work
CSCS  Construction Skills Certification Scheme
CTG  Corporate Topic Group (within HSE)
DCFS  Department for Children, Schools and Families
DP  Deceased Person
DSO  Departmental Strategic Objective
DTI  Department of Trade and Industry which became BERR in 2007
DWP  Department for Work and Pensions
ECFA  Events and Conditional Factors Analysis
EMM  Enforcement Management Model
EPS  Enforcement Policy Statement
EU  European Union
FAI  Fatal Accident Investigation
FEEB  Fair Employment Enforcement Board
Fisca  Factors Influencing Scottish Construction Accidents (Project)
Fit3  Fit for Work, Fit for Life, Fit for Tomorrow (HSE strategic delivery programme)
FMB  Federation of Master Builders
FMU  Field Management Unit (within Construction Division)
FOCUS  Field Operational Computer System
FOD  Field Operations Directorate (within HSE)
GB  Great Britain
GDP  Gross Domestic Product
H&S  Health & safety
HFACS  Human Factors Analysis and Classification System (- Construction)
HII  High Impact Interventions (cross-cutting strategic project within Construction Programme)
HMRC Her Majesty's Revenue & Customs
HSAO Health and Safety Awareness Officer
HSC Health and Safety Commission (merged with HSE in April 2008)
HSE Health and Safety Executive
HSG Health and Safety Guidance publications from HSE
HSL Health and Safety Laboratory
HSWA Health and Safety at Work etc. Act 1974
IAC Industry Advisory Committee (to HSE)
ICE Institution of Civil Engineers
IER Institute of Employment Research
IES Institute for Employment Studies
IMO International Maritime Organisation
IN Influence Network
IoD Institute of Directors
LA Local Authority
LACE Local Authority Construction Engagement (cross-cutting strategic project within Construction Programme)
LFS Labour Force Survey, Labour Force Survey (conducted by ONS)
MAP Major Accident Potential (cross-cutting strategic project within Construction Programme)
MCA Maritime and Coastguard Agency
MCG Major Contractors Group (construction), replaced by the UKCG, UK Contractors Group, as of January 2009
MEWP Mobile Elevated Work Platform
MP Member of Parliament
NADOR Notification of Accidents and Dangerous Occurrences Regulations
OGC Office of Government Commerce
ONS Office for National Statistics
ORR Office of Rail Regulation
p Provisional (statistics designation)
PPE Personal Protective Equipment
PSA Public Service Agreement (performance agreements between Government and its departments and agencies)
PTSD Post-traumatic stress disorders
RA Risk Assessment
RCI Risk Control Indicator
RDA Regulatory Decision Audit
RHS Revitalising Health and Safety
RIDDOR Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
RP Reasonably practicable
Rt Right (Honourable)
SfFC Strategic Forum for Construction
SHAD Safety and Health Awareness Day
SIC Standard Industrial Classification
SME Small and Medium-sized Enterprises
SoS Secretary of State
TTM Temporary Traffic Management
UCATT Union of Construction, Allied Trades and Technicians
VW Vulnerable Workers (cross-cutting strategic project within Construction Programme)
WRDP Work-Related Death Protocol
WWT Working Well Together network/campaign
EXECUTIVE SUMMARY

Introduction
On the 4th December 2008, the Rt Hon James Purnell MP (then Secretary of State for Work and Pensions) commissioned an Inquiry into the underlying causes of construction fatal accidents. Rita Donaghy CBE FRSA was appointed as independent Chair of the Inquiry. 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 the principal output from the first phase of the Inquiry. The report aims to consolidate and summarise existing knowledge of underlying causal factors in construction fatal accidents based on Health and Safety Executive (HSE) internal and externally commissioned work over the last 10 years. It also covers a 2008 study examining the root causes of 25 migrant / foreign worker fatalities together with a control group.

The report is divided into two main sections. Part 1 provides background information on the nature of the construction industry, construction fatal accident statistics and HSE. Part 2 pulls together information about the work HSE has done (directly and in collaboration with industry stakeholders) in examining construction fatal accidents and their underlying causes.

Three independent academic peer reviewers were appointed to provide independent assurance and continuity throughout the Inquiry: Professor Andrew Hale (Professor of Safety Science, Delft University of Technology); Dr Sonia McKay (Reader, Working Lives Research Institute, London Metropolitan University); and Professor David Walters (Professor of Work Environment and Director of Cardiff Work Environment Research Centre, Cardiff University). A draft of this report was submitted to the Chair and peer reviewers in January 2009 and this final report addresses the points raised in their individual reviews.

Part 1: Background and Context
The purpose of Part 1 is to provide an introduction to health and safety within the construction industry and the work of HSE, in turn providing context for Part 2 of the report and the Inquiry more generally. It does not aim to encompass everything with regard to health and safety in the construction industry, nor list in detail every initiative or each element of the work of HSE.

It introduces the profile of the construction industry and the challenging environment it creates in which to influence and improve health and safety. It outlines a timeline of the significant work, including reviews of construction practices, which have been undertaken since the 1990s to modernise and improve the performance of the industry. In particular, it illustrates elements of work that have contributed, and continue to contribute, directly and indirectly to health and safety improvements within the industry.

The current economic environment of the construction industry is discussed, with acknowledgement of the uncertainty in conditions faced by the industry at the
time of writing this report. Construction accident data are summarised, with particular emphasis on fatal injury data and progress to date in improving safety.

An introduction is provided to HSE, the work of the Construction Division and the development and continued evolution of the Construction Programme. Finally, Part 1 sets out the role of an HM Inspector of Health and Safety and the fatal accident investigation process.

**Part 2: Insight to Underlying Causes of Fatal Accidents in Construction**

Part 2 focuses particularly on HSE’s internal work and externally commissioned research to understand the underlying causes of construction fatal accidents. It begins with work reviewing techniques for incident investigation and underlines that a structured approach using a causal system-based model is essential if meaningful lessons about direct and underlying causes are to be learnt. Examples are given where human, organisational and technical factors are considered alongside each other, with the distinct influences from parties at different layers in the construction supply chain represented. The work also puts emphasis not just on identifying poor standards or practices but also on the influences which have brought these about so that measures to control risk can be targeted with effect. For all investigations, the importance of establishing a clear and comprehensive causal chain is noted.

Examination of HSE’s prior work into the underlying causes of construction fatal accidents demonstrates a wide range of complementary studies have been undertaken. These encompass longer term progressive research and more immediate investigations responding to changing patterns revealed by intelligence gathering, for example. The techniques deployed include accident data and investigation report analysis, structured surveys of stakeholders, and focus groups with HSE and industry, variously considering causation and barriers to prevent accidents. Sometimes the work has taken a broad approach to identify which amongst the many possible factors have the greatest consequences; other studies explore the extent to which a particular factor can affect performance.

That work necessarily draws on the wider academic literature in relation to the individual factors in accident causation, as well as the underpinning social science research exploring the way structural issues affect business practices and safety performance. Although the fundamental research issues are acknowledged, the focus is on learning about which factors have been shown to have greatest impact in the constraints of the construction context.

The work reviewed here is used by HSE to understand specific issues, to identify appropriate risk controls and / or interventions to precipitate improvement, as well as to monitor progress or evaluate impact. Depending on the purpose, research is focused, for example, on high risk activities (e.g. site transport or work at height) or on sectors of the industry where specific engagement is planned (e.g. small sites / firms, house-building etc). It is sometimes linked to the role of specific duty holders (e.g. public sector procurement, designers); in other cases it has been to explore aspects of industry structures (e.g. regional variations) or the conditions that render workers vulnerable.
The knowledge gleaned over a decade or more of HSE activity is collated within the report with a particular focus on the insight into underlying causes relevant to fatal accidents. The ways in which intervention measures have been devised to tackle particular high risk elements are illustrated and, similarly, although not the principal focus, examples are given from evaluation demonstrating the beneficial impact these have had.

The significant body of research from across the last decade, and more, has formed an integral part of the Construction Programme development, prioritisation and delivery. A preliminary scan did not find comparable depth and breadth in the international literature but this aspect was carried forward for more thorough treatment in the Phase 2 external research.

As part of the subsequent fatal accident case study work within Phase 2 of the Inquiry, Professor Andrew Hale led a review of the Phase 1 research models alongside safety management system principles and the regulatory framework (particularly CDM, the Construction (Design and Management) Regulations 2007). A new ‘combined’ model emerged which builds on the strengths of the research to date. In concluding Phase 1, the findings from the various research studies have been mapped onto this combined model of accident causation confirming the following areas to be particularly significant at the different structural ‘levels’ characteristic of the way construction work is carried out:

- **At the Output (direct) level:**
  - Competence and suitability
  - Hardware, workplace ergonomics, usability and workplace hazards
  - Planning, risk assessment and risk control selection (on the job)
  - Participation, motivation and conflict resolution (managing competing demands).

- **At the Delivery system (site management) level:**
  - Competence, selection, training and information
  - Planning, risk assessment and risk control selection (pre-planning)
  - Hardware (equipment) design, selection, availability, and use
  - Monitoring, correction and supervision

- **At the Corporate level:**
  - Ownership of safety and leadership
  - Contracting strategy and controls.

There are some methodological reservations about any quantitative combination of the findings from such wide ranging studies each of which had been specifically designed to address particular issues. Nevertheless, qualitatively as well as quantitatively these factors, emerge as significant influences on fatal accidents. The detail included within the Phase 1 report provides the supporting evidence and explanation for the role of these factors in general and specific circumstances and the source reports provide further information about risk controls.

**Concluding Remarks**

The Phase 1 review demonstrates the continued attention HSE has paid through research and work with stakeholders to understanding the underlying causes of construction accidents and specifically fatal accidents. The work has provided the foundation for the wider conduct of the Inquiry and a basis for directing Phase 2.
ACADEMIC PEER REVIEW OF THE PHASE 1 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 the initial phase of work, a draft of this Phase 1 report was submitted by the Health and Safety Executive to the Inquiry Chair and peer reviewers in January 2009.

The peer reviewers subsequently submitted to the Chair detailed and wide ranging individual reviews of the draft Phase 1 report. Commentary within their reviews included points for clarification, and wider issues for discussion, broadly categorised as political environment, evaluation of HSE’s work and accident causation models.

Taking account of their reviews of the material in the Phase 1 draft report, the peer reviewers then provided direction to the scope and conduct of the second phase of the Inquiry.

HSE welcomed the stimulating and helpful comments and gave detailed consideration to each peer review. This final report addresses the points raised in their individual reviews, through amendment of the original text and / or inclusion of footnotes. The draft report was commended for its objectivity but the peer reviewers nevertheless asked HSE to go beyond simply stating facts and to express views on a number of issues – these are presented in Annex 1-7 to this Phase 1 final report. Any remaining comments have been addressed through additional briefing or discussion, as required, with the Chair and peer reviewers.
INTRODUCTION
On 4th December 2008, the Rt Hon James Purnell MP, then Secretary of State (SoS) for Work and Pensions, commissioned an inquiry into the underlying causes of construction fatal accidents (Annex 1-1).

Rita Donaghy CBE FRSA, was appointed as independent Chair of the Inquiry. The role of the Chair was to oversee the entire programme of work, provide independent scrutiny and report to the Department for Work and Pensions (DWP) Ministers and the Health and Safety Executive (HSE) Board in June 2009a. A key aspect of the approach, in order to provide rigorous independent assurance whilst enabling HSE personnel with ready access to data and systems to expedite the work, was to engage respected and authoritative academic peer reviewers with detailed knowledge of the construction industry to scrutinise and have further oversight of the work.

A phased approach was proposed and was echoed in the formal notification of the Inquiry sent from the SoS to the HSE Chair (Annex 1-2), with work undertaken as follows:

Phase 1
a) A comprehensive review of recent work to consolidate and summarise existing knowledge of causal factors in construction fatal accidents based on HSE internal and externally commissioned work over the last 10 years, including a 2008 study examining the root causes of 25 migrant / foreign worker fatalities.

b) An independent peer review of the Phase 1 report including recommendations for the conduct and scope of Phase 2. The review was undertaken by three academics who provided independence and continuity throughout the work, including direction and oversight of Phase 2.

Phase 2
c) Research examining recent fatal accidents on construction and wider sources of evidence:
   (i) A review and analysis of a further ‘25’ recent construction fatal accidents focusing on underlying causes, undertaken by HSE with independent direction and oversight from the Chair and peer reviewers.
   (ii) A review of evidence external to HSE from industry / international / insurer / company / trades union sources about root causes of construction accidents and levers within and beyond health and safety systems to make further improvements.

d) Review and oversight of all Phase 2 work by the three independent academic peer reviewers.

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a The Chair met with the SoS and Lord McKenzie of Luton, Parliamentary under Secretary of State (Lords), on 2 April 2009 and, given the volume of material gathered for the inquiry, it was agreed that the date for reporting be extended from the end of April 2009 to June 2009.
Phase 3

e) The Inquiry Chair received and reviewed all aspects of the Phase 1 and 2 work and conducted extensive stakeholder consultation across the industry.

f) Chair’s report to DWP Ministers and the HSE Board in June 2009.

Considerable work in analysing, understanding and learning from fatal accidents had been undertaken at the time the Inquiry was commissioned. The Inquiry complements this existing work and provides additional insights to help determine further steps to improve the safety performance of the industry.

This report is the principal output from Phase 1 and aims to consolidate and summarise knowledge of underlying causal factors of fatal accidents within the construction industry, based on a review of existing HSE work, focusing on the most recent 5 - 10 years. A draft was submitted to the Chair and peer reviewers and this final report addresses the points raised in their individual critiques.

The report is divided into two main sections. Part 1 provides background information on the construction industry, construction fatal accident statistics and the role of HSE. Part 2 pulls together information about the work HSE has done (directly and in collaboration with industry stakeholders) examining construction fatal accidents and the underlying causes.
1 PART 1: BACKGROUND AND CONTEXT

1.1 SCOPE
The purpose of this Part 1 of the Phase 1 report is to provide an introduction to the nature of the construction industry, construction fatal accident statistics and HSE.

Part 1 does not aim to encompass everything with regard to health and safety in the construction industry, nor list in detail every initiative taken or each element of the work of the HSE. The main objective is to provide background information to the reader and to provide context for Part 2 of the report.

1.2 THE CONSTRUCTION INDUSTRY
The construction industry is one of the largest in Great Britain (GB), bringing employment for over 2.8 million people (including an estimated 600,000 in the informal economy) and over the last decade, has seen significant growth in terms of output and employment\(^{(1)}\). The industry is of vital importance, not only because of its size but also because of its output – the built environment – which underpins much other economic activity and contributes to the delivery of social and environmental objectives of the Government\(^{(2)}\).

The industry is also one of the most hazardous, and presents a considerable challenge in tackling health and safety - around one third of all GB workplace fatalities occur in construction. Although the GB construction industry’s safety record compares well to those of other nations, it has a fatal injury rate over four times the GB all-industry average and is the cause of the largest number of worker fatalities of any sector. In the last 10 years, over 800 people (workers and members of public) have died from injuries they received as a result of construction work\(^{(3)}\). Many more have been injured or made ill. The nature of construction work is quite different from most other business activities and as a consequence creates a challenging environment in which to influence and improve health and safety.

Projects and sites are ephemeral in nature, constantly changing in status, covering a huge range of construction processes of varying complexity and scale. The work processes and people change almost daily on sites. Projects involve those who procure, design, specify, manage and maintain buildings and structures as well as those who undertake the process of building them – the supply chain. ‘Construction’ ranges from large, high profile projects such as Heathrow Terminal 5 and the Glasgow Commonwealth Games facilities carried out by major principal contractors for large, competent clients, to small refurbishment projects of shops and domestic roof repairs undertaken by a self-employed contractor.

The industry is also highly fragmented, both in the workforce and professional disciplines. There were over 192,000 private contractors in 2007\(^{a}\), of which more than 93% employed fewer than 14 workers (70% employ 3 or fewer). However,

\(^{a}\) ONS/BERR\(^{(1)}\) estimates. This figure excludes around 600,000 workers as the sole trader definition does not include firms not registered for VAT, self-employed workers working on their own or construction in the ‘informal economy’ (www.berr.gov.uk/files/file20903.pdf)
approximately a quarter of the industry’s output is generated by fewer than 125 large companies each employing a workforce of 600 or more\(^{(1)}\). The majority of the employing organisations are small and medium-sized enterprises (SMEs) and micro companies. The fragmentation is echoed through the considerable number of representative bodies for clients, designers, contractors, suppliers and trades unions. There is no one body that includes all the organisations involved in the construction industry in their representation, and there are some groups who are not represented at all in the bodies that do exist.

The workforce is large and peripatetic in nature, with employment often short-term and part of the informal economy. It is estimated that 600,000 work in the informal economy. There are also high levels of self-employment, estimated as over 900,000 in 2007 from the Office for National Statistics (ONS) Labour Force Survey\(^{(1)}\), a figure which may, in part, overlap with the informal economy.

Historically, the industry has had a low competence threshold for many of its on-site workers, encouraged by the short-lived and itinerant nature of the work and lack of training investment. In addition, the industry has a long-standing reputation as a recruiter of foreign / migrant workers. A recent estimate suggests foreign / migrant workers form around 8% of the construction workforce\(^{(4)}\). However, this percentage is likely to be an underestimate because of the difficulties of monitoring self-employed foreign / migrant worker numbers as they come to this country and return home. Recently, anecdotal evidence suggests that significant numbers may be returning home as a result of greater job opportunities in their countries of origin and changes in the relative difference between sterling and the currencies of the new accession countries of the European Union (EU)\(^{a}\).

1.2.1 Health and Safety Initiatives in the Construction Industry

Significant work, including reviews of construction practices in the UK, has been undertaken since the 1990s to modernise and increase performance of the industry, through improving the culture, attitudes and working practices. Elements of this work have and continue to contribute directly and indirectly to health and safety improvements within the industry\(^{(6)}\).

Key catalysts include the publication of ‘Constructing the Team’ by Sir Michael Latham in 1994\(^{(7)}\) and ‘Rethinking Construction’ by Sir John Egan in 1998\(^{(8)}\). Both reports promoted client leadership, team work and a skilled workforce - all potential drivers in health and safety improvements and key elements of the Construction (Design and Management) Regulations (CDM) 1994 and 2007\(^{(9)}\). CDM 1994 saw the introduction of a clear framework for the management of health and safety within the entire construction supply chain based on the requirements of the EU Directive.

Early HSE construction campaign work in the 1990s demonstrated that with concerted focus on key risk areas, such as work at height, step changes in practices could be achieved. This was notably seen, for example, with the use of

\(^{a}\) Anecdotal evidence is provided from a variety of sources although not all of it is industry specific. Evidence includes media articles\(^{(5)}\), HSE Omnibus survey\(^{(3,4)}\) and information from the Construction Industry Training Board (CITB) ConstructionSkills.
In 2000, ‘Revitalising Health and Safety’ (RHS) was launched by the Government / Health and Safety Commission (HSC), to inject new impetus and re-launch the health and safety agenda, 25 years after the introduction of the Health and Safety at Work etc. Act 1974\(^{56}\) (HSWA). The ten year strategy was designed to achieve a step change in health and safety performance and set out the first ever targets for Great Britain’s health and safety system, for all stakeholders, across all industries including construction\(^{11}\). These RHS targets included the reduction of the incidence rate of fatal and major injury accidents by 10% by 2010.

Around the same time, there was mounting concern over the construction industry’s poor health and safety performance. In 1999/2000, 81 workers were killed and 4749 suffered major injuries\(^{(3)}\). The response was the Deputy Prime Minister’s / HSC’s Construction Health and Safety Summit, ‘Turning Concern into Action’, in February 2001. The purpose and focus was to engage senior executives and the leading firms across the industry to accept responsibility for the poor health and safety performance of the industry and to commit to action to drive through a change in attitudes and culture.

The Summit pushed health and safety to the top of the construction industry’s agenda. Industry accepted that they had to take ownership of their health and safety performance and show leadership in improving it. At the Summit the construction industry, through the Construction Industry Advisory Committee (CONIAC)\(^{(12)}\), set its own health and safety targets (more challenging than the RHS targets referred to earlier) to push for improvements in health and safety and committed to action plans to meet the targets. The targets set were to reduce the fatal and major injury rate by two-thirds by 2010, to halve the incidence rate of ill-health and halve working days lost\(^{b}\).

In the same year the Strategic Forum for Construction (SFfC) was set up by the then Department of Trade and Industry to oversee implementation of construction industry reform through its member bodies, including Constructing Excellence, ConstructionSkills, the Union of Construction, Allied Trades and Technicians (UCATT) and the main construction representative bodies\(^{(13)}\).

Concerns were later confirmed by the significant increase in fatal accidents in 2000/01 – 105 workers were killed, although the number of major injury outcomes reduced slightly to 4708 injuries\(^{(3)}\).

In 2002, in response to the RHS strategy, the HSE Construction Priority Programme was developed and introduced. In addition, the Construction Division (ConD) within HSE was set up to provide a clear focus and responsibility for

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\(^{a}\) Advances in equipment and working methods can effect a step change in safety performance and the search for radical solutions remains a priority. However caution is necessary to ensure improvements are achieved without risk being substituted or transferred from one area or activity to another\(^{(10)}\).

\(^{b}\) The separate targets reflect recognition of the different factors involved and need for appropriately focused intervention strategies.
construction work. Programme working and the formation of the Division enabled inspection and enforcement on individual sites to be complemented by an increased focus on levering HSE’s influence through industry, with the ultimate aim of bringing about the cultural change required for lasting improvements in health and safety performance.

The same year also saw the launch of the industry report ‘Accelerating Change’, compiled by representatives from across the industry, government and unions and chaired by Sir John Egan. Building and reaffirming principles set out in ‘Rethinking Construction’, it set a vision and improvement agenda, with suggested ways forward for everyone involved in the construction industry\textsuperscript{(14)}.

As part of the 2004 government spending review, HSE proposed new three-year Public Service Agreement (PSA) targets, as interim steps towards meeting the 2010 RHS targets\textsuperscript{(15)}. The new targets required the ten-year health and safety outcome indicators used for RHS to be apportioned to the three year period from 2004/05 to 2007/08. PSA targets therefore required the incidence rate of fatal and major injury accidents to reduce by 3% by 2007/08, from the 2004/05 baseline\textsuperscript{a}.

Whilst significant progress in injury and ill-health performance was being achieved, there was a growing realisation that increased impetus was required to meet the targets the industry had set for itself at the original Summit in 2001. In February 2005, a second Construction Health and Safety Summit was held, with the theme of ‘Ownership, Leadership, Partnership’\textsuperscript{(16)}. The aim was to acknowledge achievements since the first Summit and to refresh industry efforts to improve health and safety performance and achieve the ‘Revitalising’ targets. Industry re-affirmed commitment to take ownership and demonstrate leadership and added the priority of working in partnership to improve the impact of their work.

Industry criticism of the public sector’s health and safety performance as a construction client, led to a meeting between the Construction Confederation (CC) and officials at Number 10 Downing Street in 2005. It was agreed that an event to spread best practice in Government construction procurement could have impact and would demonstrate public sector commitment to health and safety in construction. Lord Hunt (then Minister for Health and Safety in DWP) agreed to support such an event, to be taken forward by HSE. ‘Buying for Life: Construction in the Public Sector’, was held in March 2006\textsuperscript{(17)}. It attracted input from senior Ministers, clients, trade union and construction industry representatives as well as attracting an audience of 140 senior delegates.

Over recent years, considerable effort has been expended by the industry, particularly the larger and more structured parts, to improve health and safety in construction, supported by others including the HSE’s Construction Programme, other Government departments and trade unions. This has been coupled with a

\textsuperscript{a} HSE further decided to focus attention on specific high risk areas rather than take a blanket approach and so set construction a 5.3% reduction target in the fatal and major injury rate.
series of wider industry initiatives for reform, which have encompassed health and safety. Industry work has included producing the 2012 Construction Commitments, Integration Toolkit, Respect for People Code of Practice (SFfC\textsuperscript{13}), Working Well Together (WWT) Campaign\textsuperscript{18}, the Construction Skills Certification Scheme\textsuperscript{19}, Benchmarking Toolkit (Constructing Excellence)\textsuperscript{20}, Safety in Design\textsuperscript{21}, Major Contractors Group (MCG) work\textsuperscript{22} and Constructing Better Health\textsuperscript{23}.

The trade unions have also focused considerable effort on improving health and safety in construction. Critical issues and necessary improvements that have been and continue to be campaigned for include increased rights of trade union safety representatives, rejuvenation of the worker safety advisor pilots in construction, partnership training, removal of false (bogus) self-employment, legislative changes including increased penalties and directors duties, increased HSE resources, and minimum standards for site manager training\textsuperscript{24-27}.

In April 2007, the CDM regulations were revised to improve the level of health and safety performance in the construction industry by clarifying the responsibilities of each duty-holder and focusing on effective planning and risk management. Priority was placed on managing risks on site, reducing paperwork, encouraging team work, and getting the right people for the right job at the right time\textsuperscript{(9)}.

However, a significant and sobering 28\% increase in construction fatalities to construction workers was seen in 2006/07\textsuperscript{a}, following a, then, all-time low of 60 worker deaths in 2005/06\textsuperscript{b}. The fatality increases were centred within new build housing and the domestic refurbishment sectors\textsuperscript{c}. This led to a Construction Forum convened by the Secretary of State in September 2007, which brought together key stakeholders to draw up a ‘Framework for Action’ to cut workplace deaths and improve health and safety standards. Progress is being monitored and reported on to Ministers by the SFfC\textsuperscript{29}.

Most recent work has seen the launch of ‘The Strategy for Sustainable Construction’ in June 2008, a joint industry and Government strategy, to deliver a radical change in the sustainability of the construction industry, promote leadership and behavioural change, and deliver benefits to both the construction industry and wider economy\textsuperscript{30}.

\textsuperscript{a} Corresponding construction output rose 1.3\% between 2005/06 and 2006/07\textsuperscript{(1)}. The fatal accident incidence rate change was therefore dominated by the 28\% increase in fatal accident numbers increasing by 27\% (the rate was 3.0 per 100,000 workers in 2005/06 rising to 3.8 in 2006/07). Longer term research covering the period 1986 to 2004 has shown there to be some correlation between trends in injury rates and the cycle of construction industry output\textsuperscript{(27)}.

\textsuperscript{b} It will be seen in Section 1.3 that fatal accident numbers have reduced to 72 and then 53 in subsequent years underlying the importance of monitoring longer term trends beyond year on year fluctuations.

\textsuperscript{c} The increase in these sectors presented new areas of concern to the construction industry. Through monitoring and analysis of the developing trends in fatal accidents through 2006/07, HSE utilised the information to inform the work of Inspectors and the strategic work of the Construction Sector, Policy and Programme. Specific work included intensive inspection initiatives targeting the key topics and sectors and focused on client duties under CDM2007.
Finally, the construction industry and its regulation have both recently come under Government scrutiny through the House of Commons Business and Enterprise Committee investigation of the construction industry\(^{(2)}\) and the Work and Pensions Committee’s investigation of HSE’s work\(^{(31)}\). The first of these investigations has recommended the appointment of a Government Chief Construction Officer, who, it is envisaged, will provide a high-level interface between the industry and Government. The parameters of this influential post have not yet been set, and it is not clear whether a health and safety role is envisaged.

Over the last 15 years there has been a statistically significant downward trend in the rate of fatal injury to workers. However, this trend had levelled off over the last five years and there are wider concerns over the developing profile of the construction industry and the potential underlying causes of accidents. The inherently hazardous environment of construction, its heterogeneous nature, the poor standards compared to other industries, recent fatal accident statistics and wider concerns over the industry structure and demographics, self-select the construction industry for particular attention. The Construction Programme (see Section 1.4.1) is equipping HSE to tackle some of the stubborn, long-running issues associated with worker exploitation, micro firms etc.

1.2.2 Challenges faced by the construction industry
Despite progress in improving health and safety in construction, fundamental challenges continue to face the industry with uncertain impact on health and safety performance. Some of these factors are discussed below.

1.2.2.1 Fragmentation and scale of the industry
It is widely believed that the extensive fragmentation of the industry, combined with the considerable variation and size of project-based work, can impact on and act as a barrier to traditional health and safety management implemented in fixed premises. This includes challenges to the effective dissemination of health and safety messages within the industry (and along the supply chain), and difficulties with the consistency of health and safety standards. In addition from a regulatory role, the multiplicity of sites means HSE simply cannot visit every one\(^{(32)}\).

1.2.2.2 Supply chain and contractual influences
The supply chain is a key determinant of the success of a project, but often those within it have little vertical integration and influence over key decisions such as design, procurement and cost – with knock-on effects to health and safety\(^{(2)}\). In particular, sites are where the health and safety risks are manifested but it is not necessarily on site where the most effective risk control measures (such as design, planning, equipment purchase and supply, and recruitment) can be introduced to remove the fundamental hazard. Once on site, contractors’ options may be limited to reducing or mitigating the risk.

There is extensive reliance on sub-contracting due to the nature of construction projects and specialist nature of many firms. In turn this has consequences for the composition of the workforce, in particular high levels of self-employed workers, the use of agencies and casual recruitment as project demands
fluctuate. Complex sub-contract relationships may lead to the breakdown of communications and a lack of co-operation between workers\(^{(24)}\).

**1.2.2.3 Bogus (or false) self-employment**

Many workers within the construction industry are directly employed and there are a large number of legitimately self-employed workers under Her Majesty’s Revenue and Customs (HMRC) construction industry scheme. The term bogus (or false) self employment is often used where a construction worker, and perhaps the person engaging them, will claim the status for (primarily) tax purposes. There are perceived benefits to both workers and employers to stretch definitions of self-employment.

HSWA provides equal protection for all workers irrespective of their status for taxation or national insurance. However, there can be implications for health and safety if employers use bogus self-employment to try and avoid their health and safety responsibilities for people whose work they contract in terms of providing training, supervision and personal protective equipment. Construction trade unions, in particular UCATT, have campaigned against bogus (or false) self-employment and believe employment status and health and safety performance are directly linked\(^{(25)}\). Annex 1-3 presents a HSE paper on construction health and safety and self-employment.

**1.2.2.4 Skills and competence**

The number of workers in the construction industry in 1992 was around 1.6 million. In 2007 the figure was almost one-third higher at 2.2 million\(^{(1)}\). This has led to difficulties in matching the demand for workers, with the industry until recently facing an acute labour and skills shortage.

In addition there is an ageing workforce, with the number of workers aged 60+ doubling since 1990 and fewer young entrants. The number of workers in the industry aged 24 or under, has reduced by 27\%\(^{(1)}\). This in turn has led to migrant workers filling the labour gap. A recent estimate suggests foreign / migrant workers form around 8\% of the construction workforce\(^{(4)}\). However, this percentage is likely to be an underestimate because of the difficulties of monitoring self-employed foreign / migrant worker numbers.

Concerns have also been raised about the lack of training investment by the construction industry in its workforce, due to poor profit margins and the mobility of the workforce between projects and companies\(^{(2)}\). In addition individual and corporate competence, knowledge and best practice are often lost due to the ephemeral and transient nature of the industry.

The industry has responded to these concerns. For example, ConstructionSkills (the Sector Skills Council for the construction industry) works to ensure a safe, professional and fully qualified workforce\(^{(19)}\). Through a levy on the industry, it provides advice to businesses on their training plans, runs a pre-qualification card scheme (the Construction Skills Certification Scheme) and provides grants for training. Other industry groups provide similar support.
1.2.2.5 Vulnerable workers
Some in the construction workforce may be at a greater theoretical risk of injury, where ‘vulnerability’ relates to a combination of their being exploited / denied employment rights and not having the capacity or means to protect themselves(33). Vulnerable workers may include migrant workers, younger people and / or ageing workers.

These concerns have been examined through a number of initiatives including the Vulnerable Workers CONIAC working group and an HSE Construction Programme cross-cutting strategic project on vulnerable workers. They are also being addressed on a wider basis through the Fair Employment Enforcement Board (FEEB) set up in 2008 as part of the Government’s response to issues identified by the Vulnerable Worker Enforcement Forum(34). FEEB will oversee work aimed at such things as raising awareness of employment rights, streamlining vulnerable worker access to enforcement bodies represented on the Forum (including HSE), closer working between enforcement bodies and improved advice and guidance.

1.2.2.6 Micro, small and medium-sized enterprises
Micro, small and medium-sized enterprises (SME) form a large section of the construction industry for both contractors and professionals. Based on BERR’s Builder’s Address File data for 2007(1), 93% of construction firms in GB employ fewer than 14 and account for some 40% of the construction workforce\(^a\). Fatal accident records over the five years 2003/04 to 2007/08, show two-thirds of those who died were self-employed or with firms employing 15 or fewer and similarly in two-thirds of cases the accidents occurred on small sites (with 15 or fewer workers)(3) – see Section 1.3.1.

Despite the difference in firm size bands, it appears that those working for small firms are at greater risk of fatal injury. The number and diversity of these enterprises, coupled with specific business drivers makes it extremely difficult to develop effective intervention techniques to improve health and safety.

These concerns are being examined through a number of initiatives including the SME CONIAC working group and the HSE Construction Programme cross-cutting strategic project on small sites.

1.2.2.7 Leadership, planning and management of health and safety
Health and safety is a fundamental part of business and effective corporate leadership of health and safety is essential, whether industry-wide, by board directors or by clients. However, some consider that the existing legal framework does not effectively address these issues and believe that health and safety will not improve until there are increased legal duties on directors. The Government is committed to promoting greater director leadership, and supports HSE efforts to achieve high standards of board level leadership through advice, guidance and enforcement. New leadership guidance was published by IoD/HSC in October

\(^a\) At the other end of the spectrum, less than 1% of private contractor firms employ more than 250 workers, accounting for around 25% of the workforce.
Currently Government is keeping the question of new legal duties on directors under review\(^a\).

In addition, effective management of work activities and competent site supervision are essential in maintaining safe and healthy conditions on a construction site. Concerns have been raised that poor site management and supervision are a fundamental factor in injuries occurring on site.

### 1.2.2.8 Public sector clients

Some 30-40% of all construction work is carried out for the public sector as client\(^1\). This puts it in a unique position to influence standards more widely through its supply chains by insisting on the highest possible standards. Government has already publicly stated that its aim is to be an exemplar in all areas of the procurement of its construction work, including health and safety\(^36\). In 2005, Ministers agreed mandatory guidance for all Government departments in England through publication of the Office of Government Commerce’s (OGC) ‘Common Minimum Standards for Procurement of the Built Environment’ (CMS)\(^37\). CMS apply to Government departments, executive agencies and the non-departmental public bodies for which they are responsible. The Local Government Task Force has produced guidance adapting the CMS to be directly applicable to local authorities\(^38\). Similar approaches to public sector procurement of construction are taken in Wales and Scotland. The latter, for example, has a Construction Procurement Manual which is mandatory throughout Scottish Government, its Associated Agencies and other public bodies subject to the Scottish Public Finance Manual.

As referred to earlier, the Government supported the ‘Buying for Life’ event in 2006. A follow-up workshop inviting key public sector clients to discuss preliminary findings from research into the public sector’s performance was held in November 2006\(^17\). The workshop gave rise to a number of suggested next steps and action has been taken - for example, roadshow events were carried out aimed at raising awareness and understanding of CMS.

The construction industry has continued to be vocal in its view that many public sector clients are not performing their client roles to an acceptable standard. Industry criticism has been largely anecdotal, but some research suggests a lack of attention to health and safety issues in awarding public contracts and that, while there are areas where public sector clients perform relatively well, there are also significant shortcomings such as the continuing use of traditional procurement methods\(^39, 40\).

There is no direct evidence to suggest that the public sector performs worse in the health and safety aspects of its construction procurement than the private sector. The evidence available from fatal statistics, while only one part of the picture, suggests that, overall, the public sector out performs the private sector in this area and there are historically fewer deaths on public sector projects than

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\(^a\) An evaluation is underway of the impact on directors’ behaviour of current arrangements promoting director leadership – this is being conducted approximately two years after the launch of the new guidance on director leadership.

private projects\textsuperscript{a}. Research being undertaken in 2009 for HSE follows on from the previous work, and will look in more detail at the public sector's health and safety performance as client.

1.2.2.9 Regional differences
Although health and safety is a retained matter following Scottish devolution, there are significant differences between the construction industry in Scotland and elsewhere in Great Britain (GB). In particular, there is a separate, albeit broadly parallel, structure of representative bodies and industry stakeholders to those which operate outside Scotland. Accordingly, engagement with the construction industry as a whole can only be effective if the distinctions are recognised.

1.2.3 Current economic environment of the construction industry
As noted previously, the construction industry is a substantial but fragmented industry with figures for 2008 showing GB construction output to be around £123.6 billion\textsuperscript{(41)}. From a UK perspective construction contributes some 6% to GDP\textsuperscript{(42)} and is a major player in delivering the Government's agenda for modernising Britain.

Over the last decade the industry has seen significant growth in terms of output and employment, both increasing at around 2% per annum on average although this has recently reversed sharply with the economic downturn\textsuperscript{(1)}. Output figures from ONS (Figure 1-1) show the overall growth and split between new work and repair and maintenance activity, the latter comprising around 45% of the total in 2008. The remainder is divided 16% new build housing, 6% infrastructure and 33% 'other' new-build categories. The insets to the right hand side of the figure show details of recent output in the housing and infrastructure subsectors. Some 30-40% of all construction work is carried out with the public sector as client\textsuperscript{(41)}.

The current economic position for the GB construction industry is uncertain. Recent forecasts\textsuperscript{(43)} ahead of the ONS figures, suggested construction output in 2008 would be much lower than originally predicted, falling by nearly 2% in 2008 and almost 5% in 2009, with a modest recovery not anticipated until 2011. In fact, the recent ONS figures\textsuperscript{(41)} confirm a less than 2% fall in output in 2008 compared with 2007 but provisional figures show the total value of construction output for the 12 months to the first quarter of 2009 fell by 6% compared with the previous 12 month period. Furthermore, the Q1 output was 9% lower than the previous quarter (Q4 2008). The insets in Figure 1-1 demonstrate the contrasting situation in different sub-sectors.

\textsuperscript{a} If the number of fatalities on publicly procured construction projects and standards of procurement can be linked, then the figures (see Figure 1-11) suggest the public sector practice may be slightly better. However these links are tenuous and no direct research to date has been carried out to compare the performance of private and public sectors in procurement allowing for the scale and nature of project involved. OGC currently collect information on performance\textsuperscript{(36)}. 
There have been significant reductions in workload for some sectors. The private housing and industrial sectors have been hit significantly by tighter credit facilities and lower consumer demand. However, others still appear to anticipate strong and growing activity over the next few years, such as infrastructure and public non-housing with work associated with health, education and the 2012 Olympics as examples. Regional variations are also suggested, with greatest activity continuing in Greater London and the South East, followed by Scotland and Wales. Least construction demand is being seen across the remainder of the UK.

Uncertainty in economic conditions for the construction industry is set to continue and different pressures within the industry could influence the overarching sector profiles and create a potential deterioration of health and safety performance. Market forecasts have already indicated the ‘credit crunch’ is creating a greater divide between SMEs and major contractors, with increasing evidence of a two or three tier market and increasing competition on smaller projects.

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*Generally, high outputs lead to high accident rates, particularly when the increase has been rapid. However, there does not appear to be an exact correspondence between accident rates and industry output with examples of the accident rate declining despite an increase in output.*
1.3 THE ACCIDENT PICTURE

The British industry’s safety record compares well to those of other nations overall (Figure 1-2) and in 2006/07 the construction fatal injury rate of 3.8 compared with a 9.5 EU average\(^{(47)}\). However, that construction fatal injury rate of 3.8 was over four times the all-industry average in Britain and reflects the largest number of worker fatalities of any sector. Many more workers are injured or made ill. Over recent years there have been some 70 workers killed, around 4,500 major injuries and 8,250 over three day injuries reported each year\(^{(3)}\).

Deaths, injuries and ill health are reported to HSE under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995\(^{(48)}\). Official statistics are published by HSE via the website\(^{(49)}\) with data and analysis available for the construction industry specifically.

However, whilst there is reliable information on fatal accidents, non-fatal RIDDOR reports are subject to significant under-reporting. Reporting levels derived from the Labour Force Survey (LFS) suggest approximately 55% reporting of RIDDOR reportable injuries in construction, compared with an all industry average around 50%\(^{(50)a}\).

Overall construction accident data reveal progress against the previously mentioned RHS and industry targets (from 1999/00) and PSA targets (from 2004/05), in terms of reductions in the fatal and major injury rates. Figure 1-3

\(^{a}\) The LFS does not differentiate the severity of injury (major vs over three day), the injury type or scenario etc., and therefore it is not possible to determine different reporting patterns. HSE has commissioned research studies to explore comparisons between data collated under RIDDOR and company records\(^{(52)}\) and hospital records\(^{(53)}\) as well as the effects of changes in the mechanisms for RIDDOR reporting\(^{(54)}\). Together these reveal a complex combination of factors, none of which dominates but all confound the dependability of raw RIDDOR records as definitive indicators of injury numbers or risk.
shows the target trajectories (plain / dotted lines) and illustrates the percentage changes in the rate of fatal, major and over-three-day injuries each year relative to the 1999/00 baseline level. This demonstrates that the RHS and PSA targets have been exceeded and considerable progress has been made towards the industry (CONIAC) target. However, the rate of progress in the most recent years had slowed, although newly released fatal accident figures for 2008/09 (provisional) demonstrate a significant rate reduction(49).

![Progress against targets: changes in incidence rates](image)

**Figure 1-3: Progress against targets: changes in incidence rates**

(3, 49) a

(The designation ‘p’ in this and subsequent charts indicates the figures for the year are ‘provisional’)

In addition the ConD specifically maintains its own construction fatal injuries initial notifications database b, to collate early data and capture construction specific information. This allows more detailed analysis of individual parts of the industry, not available from RIDDOR data.

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a HSE calculates the construction fatal accident incidence rate in terms of the number of work-related deaths per 100,000 workers (where workers are both employees and self-employed). Non-fatal injury rates are quoted per 100,000 employees because of the under-reporting of injuries particularly amongst the self-employed.

b The construction fatal injuries initial notifications database is designed to capture construction specific information in addition to that included in the RIDDOR reporting form F2508. This covers construction related parameters such as the size of site, CDM notified and non-notified sites, the nature of the construction work etc. Examples of data obtained from the database are included in the charts / analysis within this report with further details in Reference 3. The additional information is provided in a notification to the Construction Sector after an inspector has made the initial visit to site. The information may therefore be subject to some change or correction as the investigation continues. For non-fatal injuries this level of information is not routinely available on a complete and comprehensive basis.
1.3.1 Fatal injuries

Figure 1-4 and Table 1-1 give the number of worker fatalities (bars) and fatal accident rate (line) showing a clear long term downward trend over a period of some 25 years. The number of worker fatalities peaked at 154 in 1989/90 and figures for the most recent year (2007/08) at the point the Inquiry was commissioned were 72. Newly released figures for 2008/09 indicate there were 53 worker fatalities. The early 1990s’ fatal injury rate (per 100,000 workers) was 6.6; in 2007/08, this rate was 3.4 and the provisional figure for 2008/09 is 2.4.

![Figure 1-4: Fatal injuries to workers in construction, January 1983 - March 2009](image)

For 2007/08 the rate had fallen by 28% compared to the RHS baseline year of 1999/2000 and 42% from the 2001 Construction Health and Safety Summit. However the year by year fluctuations mean that progress is best measured in relation to longer term trends as illustrated in Figures 1-3 and 1-4.

Although, the fatality figure and rate for 2007/08 represented a big improvement since the 1980s, improvement had levelled off over the preceding five years, with an average rate of 3.6. In particular, 2006/07 saw concern mount over the rise of fatal accident numbers from 60 to 79, an increase of 28% over what had been an exceptionally low figure in 2005/06. However, the total number of fatal injuries to workers in construction in 2007/08 reduced back to 72 and provisional figures for 2008/09 are further reduced at 53.

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*a Figure 1-4 and Table 1-1 cover reports made under Notification of Accidents and Dangerous Occurrences Regulations (NADOR) 1980, RIDDOR 1985 and RIDDOR 1995. Changes in these regulations were not significant for worker fatalities. Further information about the regulation changes can be found at [http://www.hse.gov.uk/statistics/history/change.htm](http://www.hse.gov.uk/statistics/history/change.htm)*
Table 1-1: A 25 year view of fatal accidents in construction\(^{(3,49)a}\)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fatalities</th>
<th>Rate = per 100,000 workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>140</td>
<td>9.8</td>
</tr>
<tr>
<td>1984</td>
<td>117</td>
<td>7.9</td>
</tr>
<tr>
<td>1985</td>
<td>126</td>
<td>8.6</td>
</tr>
<tr>
<td>1986/87</td>
<td>125</td>
<td>8.6</td>
</tr>
<tr>
<td>1987/88</td>
<td>143</td>
<td>9.3</td>
</tr>
<tr>
<td>1988/89</td>
<td>137</td>
<td>8.5</td>
</tr>
<tr>
<td>1989/90</td>
<td>154</td>
<td>8.6</td>
</tr>
<tr>
<td>1990/91</td>
<td>124</td>
<td>6.6</td>
</tr>
<tr>
<td>1991/92</td>
<td>97</td>
<td>5.7</td>
</tr>
<tr>
<td>1992/93</td>
<td>95</td>
<td>5.9</td>
</tr>
<tr>
<td>1993/94</td>
<td>91</td>
<td>5.7</td>
</tr>
<tr>
<td>1994/95</td>
<td>83</td>
<td>5.1</td>
</tr>
<tr>
<td>1995/96</td>
<td>79</td>
<td>5.0</td>
</tr>
<tr>
<td>1996/97</td>
<td>90</td>
<td>5.6</td>
</tr>
<tr>
<td>1997/98</td>
<td>80</td>
<td>4.6</td>
</tr>
<tr>
<td>1998/99</td>
<td>65</td>
<td>3.8</td>
</tr>
<tr>
<td>1999/00</td>
<td>81</td>
<td>4.7</td>
</tr>
<tr>
<td>2000/01</td>
<td>105</td>
<td>5.9</td>
</tr>
<tr>
<td>2001/02</td>
<td>80</td>
<td>4.4</td>
</tr>
<tr>
<td>2002/03</td>
<td>70</td>
<td>3.8</td>
</tr>
<tr>
<td>2003/04</td>
<td>71</td>
<td>3.6</td>
</tr>
<tr>
<td>2004/05</td>
<td>69</td>
<td>3.5</td>
</tr>
<tr>
<td>2005/06</td>
<td>60</td>
<td>3.0</td>
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<tr>
<td>2006/07</td>
<td>79</td>
<td>3.9</td>
</tr>
<tr>
<td>2007/08</td>
<td>72</td>
<td>3.4</td>
</tr>
<tr>
<td>2008/09p</td>
<td>53</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Figure 1-5 illustrates fatal accident numbers against industry output (expressed at 2000 prices). Importantly it shows a steady downward trend in the accident numbers against a steady growth in industry output over ten years or more. The fatal accident figures show a similar trend when compared with the numbers working in the industry. To project the context for construction safety, estimated outputs to 2012 are shown (grey) based on Construction Products Association forecasts as noted.

As described above, official (provisional) statistics released on 23 June 2009\(^{b}\) demonstrate a significant reduction in the number and rate of fatal accidents in construction for 2008/09, where the latter figure also accounts for the numbers working in the sector. Obviously this safety improvement is welcome but it must be acknowledged that this corresponds to a period when the economy entered recession (see Section 1.2.3) with a complex interaction between pro-active safety measures and external structural influences affecting the out-turn.

\(^a\) Figure 1-4 and Table 1-1 indicate a significant fall in the number and rate of fatalities in the early 1990s. This is commonly associated with the recession affecting the industry at the time and is considered within IER research\(^{(27)}\). That work demonstrates a disproportionate effect of significant changes in output on accident rates. However the early 1990s also coincided with the introduction of various HSE construction campaigns directed at specific high risk activities (work at height, steel erection, etc) with clear benefits observed. This demonstrates the difficulties in analysing the impact of different confounding factors on safety performance.

\(^b\) www.hse.gov.uk/statistics/fatals.htm
Figure 1-5: Fatal accidents to construction workers versus industry output, 1981 - 2012

Looking at fatalities by kind of accident in Figure 1-6, falls from height remain the biggest cause of fatalities in construction and for 2007/08 and 2008/09p made up 50% of the fatal accidents for workers. The other main causes shown were being struck by a moving/falling object, being struck by a moving vehicle and collapses of buildings and structures or overturning plant. Other kinds such as electrocution, drowning and asphyxiation, etc., account for the remainder.

Figure 1-6: Number of fatal injuries to workers in construction by kinds of accident, 1996/97 – 2008/09p

Although this section focuses principally on fatal accident data, qualitative insight to the types of accident and activities is important. The HSE construction intelligence report (3) contains pen pictures of all fatal accidents – those for 2007/08 are reproduced in an Appendix to Annex 1-3 in this report, broadly grouped by accident kind.
Looking by sector, the rise in construction fatal accidents in 2006/07 was found to be linked to significant increases in the relative number of fatalities in the housing new-build and refurbishment / repair categories. The proportion of fatal accidents in these sectors reduced in 2007/08 but compared with the average over previous years, the new-build housing category was still significant (Figure 1-7) and was a specific focus of the Construction Division’s operational activity.

Provisional figures for 2008/09 show the new build housing proportion to have reduced, apparently offset by civil engineering and road building increases, reflecting the changing pattern of industry and economic activity. Figure 1-7 also demonstrates refurbishment and repair activity constitutes a fairly consistent proportion of fatal accidents at around 50%. ONS statistics show repair and refurbishment activity to comprise some 45% of industry output (Section 1.2.3).

Figure 1-8 gives the number of fatal accidents in recent years broken down in groups who might be considered to be vulnerable workers. The number of fatal accidents to foreign / migrant workers had generally increased over this time, as

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a Comparison with output data for the sector, demonstrated the number of fatal accidents to have increased disproportionately, so the absolute number of deaths and the rate singled the sector out for particular selection.

b Such comparisons provide a basis for determining relative risk but care is necessary because of different definitions for the various categories, and discontinuities over time, that can affect the compatibility of datasets. Statistical precision is necessarily balanced with the cost of data gathering and the imperative to use data as one of a range of indicators to determine where resource can be directed effectively to reduce risk and / or tackle other hot-spot areas by concerted action, timed to lever influence from industry groups or political will.

c The first column (left) in Figure 1-7 shows the breakdown of fatal accidents over a number of years and this gives an ‘average’ of past performance. The second column presents the comparison seen in 2006/07 when fatal accident numbers increased from 60 to 79 precipitating the Construction Forum. Changes in the breakdown of the accidents can be easily detected in this way and compared with, for example, changes in the output of the particular part of the industry. It is important to note that the columns represent different numbers of fatal accidents, given for reference at the head of each column.

have the numbers working in the construction industry as a whole. The number of fatal accidents to foreign / migrant workers increased from 8 in 2006/07 to 12 in 2007/08\(^a\). The proportion of construction fatal accidents involving foreign / migrant workers was 17% in 2008/09p, at the same level as 2007/08.

Figure 1-8: Fatal accidents to workers in construction, 2002/03 to 2008/09p\(^{(3)}\)

Figures 1-9 to 1-11 further illustrate the type of additional information that can be drawn from the HSE’s Construction Sector initial notifications database and published in the Intelligence Reports\(^{(3)}\). The data are split as proportions within each year and some caution is needed as the absolute numbers fluctuate year on year. However, the presentation enables patterns, trends and any sudden changes in the profile to be detected and used as one measure alongside other qualitative and quantitative indicators.

Figure 1-9 illustrates fatal accidents by size of the site involved, in particular with regard to sites larger or smaller than 15 workers. Consideration is also given to the size of the organisation within which the deceased person worked. Although both small firms and small sites dominate the mapping is not exact with some small firms on large sites and vice versa. Figure 1-10 shows how fatal accidents divide between sites which are either notifiable under CDM 2007 or not (e.g. small short duration jobs or work for domestic clients). Finally, Figure 1-11, shows the breakdown of fatal accidents between public sector and private sector projects. It is notable that despite the significant reduction in fatal accident numbers in 2008/09p, the proportions are remarkably consistent with previous years across all three aspects.

\(^a\) It is difficult to draw any conclusions about changes in the actual level of risk that apply to foreign/migrant workers in the workforce due to the limited data availability. Furthermore, the definition adopted in the initial notifications database over a number of years is broader than that assigned typically to ‘migrant’ workers today (see Section 2.2.5.2). Here foreign / migrant workers are overseas national, irrespective of the time in the UK.
1.3.2 Major and over-3-day injury accidents

Detail on construction major and over-three day accidents is not provided in this report, given the Inquiry terms of reference. Data are available through HSE statistical web pages\(^{(49)}\) and the HSE construction intelligence report\(^{(3)}\).
1.4 THE HEALTH AND SAFETY EXECUTIVE (HSE)
The Health and Safety Executive is a non-departmental public body, sponsored by DWP. The HSE was created by the Health and Safety Work etc. Act 1974 (HSWA) and reported to the Health and Safety Commission (HSC) until 1 April 2008 when the two bodies merged. The role of the HSE is to protect the health, safety and welfare of workers and safeguard others who may be exposed to risks from the way work is carried out. HSE uses a range of interventions to help enable improvements in health and safety, including partnership working, stakeholder engagement, information and advice, inspections, investigations and formal enforcement.

An HSE Strategy was launched in 2004, aimed at helping achieve RHS and PSA targets and provides the context for much of the work covered in the Phase 1 report. It was also designed to promote the HSE vision to see health and safety as a ‘cornerstone of a civilised society’ and, with that, to achieve a record of workplace health and safety that leads the world. HSE’s mission, working with Local Authorities (LA), was expressed as protecting people’s health and safety by ensuring that risks in the changing workplace are properly controlled.

The 2008/09 business plan (current at the time of writing) set out key business areas that cover the full scope of HSE’s roles and responsibilities: delivering health and safety outcomes; enabling justice; providing support to government; demonstrating public accountability; and supporting HSE’s priorities at a corporate level (including engaging with stakeholders and undertaking generic research and analysis). As reflected in the work described in this Phase 1 report, each business area contributes towards the vision, mission and targets as well as fulfilling HSE’s other statutory responsibilities under HSWA. Following completion of the Spending Review 04 PSA period and the 2007 Government Spending Review, HSE now works towards meeting the DWP Departmental Strategic Objective (DSO) and RHS targets.

In December 2008, HSE launched for consultation a new Strategy for workplace health and safety in Great Britain and HSE’s role within it. The Strategy reinforces the principles of HSWA and is aimed at not only the work of HSE and LAs but also specifically dutyholders and employees themselves. It seeks to build on existing strengths but also recognises the changes affecting workplaces and consequent new challenges for the health and safety system as a whole.

HSE deals with all aspects of construction work in England, Scotland and Wales. CONIAC advises HSE on the protection of people at work (and others) from hazards to health and safety within the building, civil engineering and engineering construction industry. CONIAC’s current constitution expired at the end of December 2008. Work is in hand to reconstitute CONIAC with a new plan of

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^ The new Strategy was formally launched on 3 June 2009. The mission is the prevention of death, injury and ill-health to those at work and those affected by work activities. The Strategy endorses the same fundamental values and places emphasis on, for example, leadership, building competence, involving the workforce, creating healthier and safer workplaces and customising support for SMEs reflected in the priorities being worked on in construction.

The HSE business plan for 2009/10 was also launched in June 2009 to implement the Strategy. http://www.hse.gov.uk/aboutus/strategiesandplans/businessplans/plan0910.pdf
work, although with the merger of HSC and HSE the role of bodies such as Industry Advisory Committees (IACs), which originally existed to advise the Commission, is under review.

1.4.1 The Construction Programme

In 2002, the HSE Construction Priority Programme (ConP) was developed and introduced. In addition, the Construction Division (ConD) was set up within the Field Operations Directorate (FOD) to provide a clear focus and responsibility for construction work. It was established as a nation-wide division under the management of the Chief Inspector of Construction - consisting of sector and policy units, four operational units and until recently, a technology unit.

The development of the ConP and establishment of the ConD provided the opportunity for HSE to improve its impact within the construction industry. This was achieved by establishing an overarching strategy and developing detailed annual work programmes.

The ConP was planned to last at least ten years. It has evolved and matured, building on experience and most recently forming part of the PSA1 ‘Fit for Work, Fit for Life, Fit for Tomorrow’ (Fit3) Strategic Delivery Programme. The Fit3 programme was established initially to run until March 2008 to facilitate delivery of HSE’s PSA targets but the Fit3 agenda was rolled on by the HSE Board to 2009.

The ConP aims to ensure that the risks to those working in the construction industry or who may be affected by it are properly controlled. It seeks to reduce the rate of fatal and major injuries suffered by workers and to contribute to the reduction in work-related illness and working days lost in line with the targets. Central to the strategy are the objectives of ownership by the industry, leadership from senior industry figures and partnership working between those who create, manage and are exposed to risks (Annex 1-4).

The ConP is designed to engage with stakeholders to deliver a targeted programme of work that supports industry in achieving its own challenging targets, encourages those who are striving for excellence and takes a robust enforcement line with those who are not. Industry creates the risks and must accept that it is their responsibility, moral and legal duty, to manage them properly.

1.4.2 Development and Continued Evolution of the Construction Programme

The ConP is evidence based and outcome driven. A wide range of statistical information and intelligence is utilised and combined together to target work posing the greatest risks to workers and to maximise impact on all those in the construction procurement and supply chain. This includes:

- Accident statistics - based on accidents reported to HSE under RIDDOR 1995\(^{(48)}\)
- Fatals initial notifications database - in particular the ConD specifically maintains its own construction fatal injuries database, to collate early data and capture construction specific features (see Section 1.3)
• Quantitative and qualitative information - from HSE operational inspection including Risk Control Indicator (RCI) scores and reflective reports on outcomes
• Surveys - Labour Force, Omnibus and Booster (specifically tailored to the Construction industry)
• Qualitative and quantitative information on accident causation research\(^{(32)}\).

All this information is combined to form a wide ranging intelligence picture for construction.

Original development work for the ConP utilised detailed risk-based evidence of industry performance (topics and segments) developed within HSE, stakeholder mapping and models of the paths of influence, all of which helped the ConD select where to place resource to maximise its impact.

In particular, early research to support the development of the ConP, and priorities for action by HSE and industry, reviewed accident data to help understand causal factors underlying construction accidents. This information on accident causation was then structured using an Influence Network (IN) to provide a basis for quantifying risk and the benefits of improvement. The model considered the technical and human activities in construction in the context of site organisation, corporate policies and wider environmental factors. Key findings of the work illustrated critical paths of influencing factors on construction health and safety including company culture, management / supervision, competence, situational awareness and communication. In turn the ConP was developed to target these issues, to have maximum effect on health and safety in construction\(^{(59)}\).

The programme elements were selected to address specific risk issues and thus achieve RHS / PSA targets, whilst also dealing with the underpinning regulatory framework and cultural issues affecting industry practice. The evidence based approach covering safety, health, regulatory and cultural themes delivered change in a planned and balanced way, in relation to procurement and supply chain practices, sectors of the industry, stakeholders, process activities and trades. The points for intervention reflect the specific goal. The most appropriate route for delivery (whether through Construction Operations, Sector, Policy and / or 3\(^{rd}\) party intermediaries or dutyholders) was considered, with techniques geared to the level of maturity of the issue.

The development of the ConP has led to key initiatives and a wide variety of intervention techniques tailored to achieving the outcomes which have been set (Annex 1-5). The ConP has delivered considerable changes in the way health and safety is managed, particularly with the larger more structured part of the industry. Continued, regular discussion with CONIAC (including employers and unions) and associated working groups also informs the programme development. Importantly the flexible design of the programme allows quick response to ‘in year’ pressure and potential statistical trends. Enforcement is also an integral part and reactive work (such as investigation of accidents and complaints) also contributes to the aims.
The ConP is outcome driven and the ConD continues to develop and refine the collection of outcome evidence / indicators. The importance of not only collecting information on what is done - progress with delivery and interactions with dutyholders – but also on health and safety improvements is fundamental. Current project work is exploring the continued development of outcome intelligence collation for the ConP across the Division.

### 1.4.3 Strategic Review of the Construction Programme

Whilst there is considerable evidence that the programme is achieving results and, over the long-term safety in construction has been improving, the rate and number of fatal accidents over the last few years had remained on a plateau.

To increase effectiveness still further, a strategic review of the content and structure of the programme was initiated by the ConD in late 2006. The overall aims were to maintain progress where work was having good effect and refocus effort in areas which give rise to the biggest risks. The review reflected on the areas of success, the structure of the industry and high risk areas and activities. It was based on analysis of the statistics, especially fatalities, coupled with other intelligence, operational experience and industry contacts.

In particular, five new areas of work, known as cross-cutting strategic projects, were identified to extend the reach of the programme as well as enhance its effectiveness with influential stakeholders (Annex 1-6). The five projects are:

- Vulnerable Workers (VW)
- Small Sites and Small Construction Firms
- High Impact Interventions (HII)
- Local Authority Construction Engagement (LACE)
- Major Accident Potential (MAP).

### 1.4.4 Work of the Construction Division

All work within the Construction Division’s sector, policy and operational units contributes to the annual delivery plans and the objectives and overall aim of the ConP. In turn this has created close relationships between the sector, policy and operational teams, developing, delivering, supporting and enhancing large elements of each others work. This is evident in the Construction Plan of Work (CPW) – which is the annual plan integrating, proactive operational delivery, in-year sector and policy support, and refinement and continued development of new work.

The construction policy team acts as the primary lead on construction policy issues both within HSE and with other Government departments, legislation and parliamentary matters. The construction sector plays a pivotal role, acting as a link and support between construction operations, other parts of HSE and stakeholders, alongside construction policy. Functions include statistics and intelligence, communications, topic leads in specific safety, health and CDM areas and frequently a lead on project work.

There are four operational units and within these currently 20 field management units (FMUs), consisting of HM Inspectors of Health and Safety, Health and Safety Awareness Officers (HSAOs) or Compliance Officers and administrators.
The FMUs work solely with the construction industry and seek improvements in health and safety standards.

HSE is committed to maintaining the resources it devotes to the inspection work of these operational units as part of a wider commitment to maintain its front line inspection force. To enable this commitment to be met, HSE is seeking to release resources to the front line and undertake targeted, affordable recruitment. For example, HSE has recently sought to recruit additional inspectors with a construction industry background in a site supervisory role and with experience of implementing CDM 2007 on larger projects. They are being recruited on two-year fixed term appointments, starting in June 2009, and will support the work of existing inspectors by carrying out site inspections to ensure that risks arising from work activities in the construction industry are properly controlled using advice, inspection, and, where necessary, formal enforcement.

1.4.5 The Role of HM Inspectors of Health and Safety
The role of HM Inspectors of Health and Safety is to ensure that dutyholders manage and control risks effectively, thus preventing harm. Inspectors are highly trained and professional individuals, who use judgement, their technical and legal training, communication and investigative skills to give advice, enforce health and safety law and promote and regulate the safety and well-being of all employees and others. The work of an inspector includes:

- Site inspections
- Planned interventions such as specific topic campaigns
- Reactive interventions including investigation of accidents and complaints
- Providing guidance and advice at visits, by phone or at public events
- Educational and promotional activities
- Enforcement where appropriate.

An inspector can use a range of tools (including advice and guidance, improvement and prohibition notices and prosecution) to secure compliance with the law - in accordance with HSE’s ‘Enforcement Policy Statement (EPS)’. The EPS is intended to ensure appropriate enforcement action is taken, so that the highest risks and the most serious offences attract the firmest enforcement action. It sets out in a public document the purposes and principles of enforcement that HSE and LAs should be working to, and is in accordance with the statutory Regulators Compliance Code and regulatory principles required under the Legislative and Regulatory Reform Act 2006. An inspector’s approach to enforcing health and safety law should therefore be proportionate, consistent, targeted and transparent.

HSE places great importance on the consistent use of enforcement action. The aim is to take enforcement action that is proportionate to the risk or breach of law, supporting the principles of sensible risk management. When making such

a As of June 2009, HSE has recruited 24 additional construction inspectors with a construction industry background, on two-year fixed term contracts.

b HSE has undertaken two Regulatory Decision Making (RDA) audits in 2005/06 and 2008/09, to evaluate whether the regulatory decisions following selected accident investigations by HSE and LA staff are in accordance with HSE’s EPS. In addition the EPS itself is periodically reviewed and evaluated.
enforcement decisions, inspectors are supported by the Enforcement Management Model (EMM), a framework for helping make enforcement decisions that are in line with the principles in the EPS(61).

Sections 20 to 25 of HSWA provides inspectors with a wide range of powers to enter premises, inspect and investigate, obtain information and take statements, safeguard evidence and take enforcement action etc.(61).

1.4.6 Health and safety law
The basis of the health and safety law that HSE and LAs enforce is HSWA (this is also used by the Office of Rail Regulation (ORR), some police in London, and can be also used by the Crown Prosecution Service (CPS) and Crown Office Procurator Fiscal Service (COPFS)). The Act applies to all work activities, and to the risks arising from work activities, within Great Britain, and also applies to certain activities in territorial waters and in relation to offshore structures. The Act sets out the general duties that employers owe to their employees and to members of the public affected by their businesses, and employees have to themselves and to each other. In addition it sets out duties the self-employed have for their own health and safety, and other workers and members of the public affected by what they do(62).

Regulations made under the Act (HSWA) make the general duties of the Act more explicit. One of the principal sets of Regulations for the construction industry is CDM 2007 which integrates health and safety into the management of a construction project. The Regulations cover main duties applicable to all construction projects, including those which are non-notifiable, and the additional duties which apply to CDM notifiable projects and general duties applicable to all construction work(9).

The CDM 2007 regulations are construction specific, they are complemented by the Management of Health and Safety at Work Regulations 1999, which are of general application(63). These regulations apply to all workplaces (except ships) and make more explicit what employers are required to do to meet their obligations under HSWA. At the heart of these regulations is the requirement to assess risks and identify the measures necessary to deal with those risks ('risk assessment') and thereby comply with relevant statutory provisions. The regulations also cover, but not exclusively: provision of health surveillance; procedures for serious and imminent danger; co-operation and co-ordination between employers when they share a workplace; capabilities and training; temporary workers; and young persons.

1.4.7 Fatal accident investigation
An investigation is a reactive process which includes all those activities carried out in response to an incident to:
- Gather and establish facts
- Identify immediate and underlying causes and the lessons to be learned
- Identify breaches of legislation for which HSE is the enforcing authority
- Take appropriate action, including formal enforcement

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\(^a\) With the exception of S51 of HSWA.
• 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.

An initial investigation is carried out for every work-related workplace death (unless there are specific reasons for not doing so e.g. instances where the death was clearly unrelated to the work activity being carried out). All HSE’s investigations, including those into fatal accidents, are conducted in accordance with published procedures\(^\text{64}\).

Following a work-related fatal accident in England and Wales, there will, in any investigation, be liaison between HSE inspectors (or the LAs, or ORR, etc) and the police in accordance with the ‘Work-Related Deaths: a protocol for liaison’ (the Work-Related Deaths Protocol or WRDP)\(^\text{65}\). The WRDP sets out the principles of effective liaison between the signatory parties in relation to any work-related death investigation. It seeks to ensure that decisions on investigation and prosecution are closely co-ordinated. Other non-signatory organisations, such as the Maritime and Coastguard Agency (MCA), Civil Aviation Authority (CAA) and Chief Fire Officers Association (CFOA), have agreed to try and abide by these principles when they are investigating work-related deaths.

The police will initially have primacy in any investigation. Where the investigation gives rise to a suspicion that a serious criminal offence (other than a health and safety offence) may have caused the death, they will retain that primacy. The ‘serious criminal offences’ would include murder, corporate manslaughter and gross negligence manslaughter. Where it becomes apparent during the investigation that there is insufficient evidence to suggest that such a serious criminal offence has been committed, the investigation will usually be handed over to the relevant health and safety regulator.

In Scotland, responsibility for investigating sudden or suspicious deaths rests with the COPFS and a separate work-related death protocol has been agreed\(^\text{66}\). The police will again lead the investigation of any potential offences related to culpable homicide / corporate homicide. HSE (or LAs or ORR etc) will investigate any possible breaches of health and safety offences. Investigation will be co-ordinated and evidence shared. In addition, COPFS is required to hold a Fatal Accident Inquiry into the circumstances of a death arising from an accident during employment. It may also be held where it appears to be in the public interest\(^\text{60}\).

In England and Wales, the police will take the lead if a charge of manslaughter / corporate manslaughter seems a possibility. If the police or Crown Prosecution Service (CPS) decide not to pursue these charges, HSE (or the LAs, or ORR, or MCA, CAA, Fire and Rescue Service, etc) will then take over the lead to investigate possible health and safety offences.

All work–related deaths are subject to a coroner’s investigation, which may include an inquest (e.g. in cases where a prosecution for manslaughter etc. has taken place, the coroner may decide that a full inquest is no longer necessary). An inquest into a work-related death is held before a jury, and seeks to establish
the identity of the person that died, along with the place, time and cause of their death. HSE will not usually complete its investigation, and so be able to make a final decision on whether to take any enforcement action, until after the inquest is complete. There are circumstances when HSE (or another regulator) may consider it appropriate to take enforcement action before an inquest, though this is not common.

Any decision to prosecute following an investigation is taken on a case-by-case basis and takes into account the detail of the alleged breach of health and safety legislation, whether there is sufficient evidence to secure a realistic prospect of conviction and whether the prosecution is in the public interest. In Scotland the decision to prosecute is entirely for the COPFS based on evidence and reports gathered by the investigators.

All accident investigations are thorough and often time consuming processes, that can take months or even years, but HSE aims to complete investigations with as little delay as possible. The time taken will depend on a number of factors including involvement of others such as the witnesses, police, CPS / COPFS, coroners and the potential complexity and scale of the incident itself. It is therefore the case that a decision to prosecute cannot be made for some considerable time after a fatal accident has occurred(67).

Part 2 of this report examines work that has been done within HSE and through externally commissioned research to examine the underlying causes of fatal accidents. These have drawn on the findings of fatal accident investigations, where appropriate, combined with evidence from other sources.
1.5 **PART 1 - REFERENCES**

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NEWS RELEASE

MINISTER ANNOUNCES INQUIRY INTO CONSTRUCTION FATALITIES

James Purnell, Secretary of State at the Department for Work and Pensions (DWP), has today announced he has commissioned an inquiry into the underlying causes of construction fatalities.

In appointing Rita Donaghy as independent Chair to the inquiry, James Purnell said:

“The construction industry is one of the most dangerous sectors in the country - over 2,800 people have died from injuries they received as a result of construction work in the past 25 years.

“No one can find it acceptable that this number of people have died directly as a cause of their work and we are not making sufficient progress on preventing this total of human misery.

“The high number of fatalities in construction sector continue to be of particular concern to us which is why I have asked Rita Donaghy to Chair an inquiry looking at the underlying causes of construction fatal incidents to see what more can done to reduce this terrible toll.”

Rita Donaghy said:

“I am keen to get started and work with the trade unions, the industry and the Health and Safety Executive to see what lessons we learn from the root causes of
construction accidents so that we can improve the health and safety of construction workers.”

The inquiry will be undertaken in three phases; firstly a comprehensive review of existing work to consolidate the understanding of fatal injuries in the construction industry with specific reference to vulnerability. Secondly, to carry out a deeper analysis of underlying causes including factors outside the health and safety system, and thirdly reporting to Ministers and HSE’s Board.

Independent academic peer reviewers with detailed knowledge of the industry will be involved in assisting Rita Donaghy and the inquiry will report to Ministers next year.

-ENDS-

Media Enquiries: John Stevenson  0203 267 5126
DWP Press Office: 0203 267 5144
Out of hours: 07659 108 883
Website:  www.dwp.gov.uk

NOTES TO EDITORS:

1. Rita Donaghy was Chair of ACAS between 2000-07 and has held a number of other public appointments including a Member of the Committee on Standards in Public Life and Low Pay Commission. Rita was President of the TUC 1999-2000 and a Member of the TUC General Council 1987-2000.
CONSTRUCTION HEALTH AND SAFETY – FATAL ACCIDENTS

Thank you for your letter of 26 August outlining proposals in response to my commission for an inquiry reviewing the underlying causes of construction fatal accidents.

I am broadly content with your proposals and process for delivering the inquiry. In my letter of 2 August I stressed that the inquiry should be overseen and Chair by an individual who is trusted by both the industry and trade unions and it is important that they have oversight of all stages of the work.

I have considered a number of individuals as the independent Chair and my view is that Rita Donaghy is the right person to carry out this role. Rita is someone who is highly respected by both employers and trade unionists and through her work at ACAS is highly experienced in working with stakeholders. I have written to Rita asking her to carry out this work and explaining that you will ensure the support and expertise of HSE will be available to her throughout the different stages of the work.

My expectation is that stakeholders should be able to contribute pertinent issues at each stage of the work and also be informed of progress and I have every have confidence that Rita will ensure that this happens.

I am keen that inquiry is proceeded with as quickly as possible and I expect Rita to report back to both Ministers and the HSE Board by the end of April 2009.
I am pleased that construction remains a priority for HSE and that you will continue to build on the progress you have made over the last few years. This inquiry will provide you with further insights into taking your construction programme forward, particularly in tackling the unacceptable number of fatal accidents.

A formal announcement of Rita’s appointment is planned for 1 December.

A copy of my letter Rita Donaghty and revised proposals reflecting the above are enclosed.

Yours truly,

James Purnell
1. What is a construction fatality? a
A construction fatality is a death which is reportable under RIDDOR b that results from an incident where:

- the death is not the result of natural causes or suicide – as determined at the inquest c;
- the incident arose out of or in connection with construction work; and
- for statistical purposes, where the person involved dies within one year of the incident.

For the purpose of the published statistics the term ‘workers’ describes both employees and self-employed combined. Those on a training scheme, or on work experience, are classified as employees. References to a ‘member of the public’ are those persons killed as a result of an accident, which has arisen out of or in connection with work activity, although they are not ‘at work’ themselves.

Road traffic accidents on a public highway, which involve people travelling in the course of their work, are generally not reportable under RIDDOR. These are covered by road traffic legislation. (However, injuries connected with road maintenance are normally reportable if the maintenance is being carried out at the time of the accident.)

Construction work involves a business activity where the SIC (Standard Industrial Classification) of the activity is construction d. This is similar to, but not exactly the same as, the definition of construction work in the Construction (Design and Management) Regulations (CDM). Determining whether some activities constitute construction work can be difficult. Brief outlines of construction fatalities in 2007/08 and some examples of cases where the construction connection was marginal are given in Appendices 1 and 2.

2. Self employment: definitions and implications
Self employed is a defined term in the Health and Safety at Work etc Act 1974 Section 53(1) as an individual who works for gain and reward otherwise than under a contract of employment, whether or not he employs others.

The distinction between an employee and a self-employed person for tax purposes is subject to a complicated set of legal tests. HM Revenue and Customs is responsible for the Construction Industry (tax) Scheme (CIS) and has the overall lead in government e on tackling false or ‘bogus’ self-employment. The CIS

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a See also http://www.hse.gov.uk/statistics/fatalinjuries.htm
b The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995
c This is often not clear at the time of the initial investigation
d See http://www.statistics.gov.uk/methods_quality/SIC/structure_sectione_f.asp#sectionf
e An HMRC-chaired Construction Employment Forum which HSE contributed to the development of an employment status indicator tool (ESI) on the HMRC website. However UCATT is concerned
considers a sub-contractor's employment status, based on a number of indicators of direct employment:

- the contractor has the right to control what the worker has to do—where, when and how it is done—even if the contractor rarely uses that control;
- the worker supplies only his or her own small tools;
- the worker does not risk his or her own money and there is no possibility that he or she will suffer a financial loss;
- the worker has no business organisation, for example, a yard, stock, materials, or workers; and
- the worker is paid by the hour, day, week or month.

This contrasts with the following indicators of self-employment, also defined by HMRC:

- within an overall deadline, the worker has the right to decide how and when the work will be done;
- the worker supplies the materials, plant or heavy equipment needed for the job;
- the worker bids for a job and will bear the additional cost if the job ends up costing more than the worker's original estimate;
- the worker has a right to hire other people who answer to him or her and are paid by him or her to do the job;
- the worker is paid an agreed amount for the job regardless of how long it takes.

These are similar to the more detailed guidance provided to HSE Inspectors\(^a\). Ultimately, however, only a court can decide employment status and that decision depends on the precise facts of each case.

False self-employment occurs when someone is treated as being self-employed when they are clearly an employee. It was considered as part of the recent Ninth Report\(^b\) by the Select Committee on Business and Enterprise. No clear link was established with health and safety. UCATT has a strong, longstanding interest in the issue of false self-employment.

In their submission to the TUC's Commission on Vulnerable Employment\(^c\) UCATT stated: "the vast majority of workers on the CIS have the characteristics of employees, as they have set hours, cannot refuse work, have to obey orders and have materials and tools provided. However, many of these workers are classified as self-employed. Unlike other employees, this group of bogus self-employed workers are taxed 20 per cent at source (30 per cent before registration occurs); however, they can claim much of the tax back through making an end-of-year tax return. The employer pays no National Insurance contributions and the worker pays at a lower level."

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\(^a\) http://www.hse.gov.uk/enforce/enforcementguide/investigation/status/intro.htm - as of June 2009 this guidance is under review to add in more recent case law.

\(^b\) http://www.publications.parliament.uk/pa/cm200708/cmselect/cmberr/127/12708.htm

\(^c\) http://www.vulnerableworkers.org.uk/cove-report/
In his report The Evasion Economy, commissioned by UCATT, Mark Harvey said: “After a short period of decline, the evidence now is that false self-employment is once more on the increase. On the basis of statistical and empirical evidence, the report concludes that between 375,000 and 433,000 workers are currently falsely self-employed. As a round figure, we estimate mass false self-employment currently standing at 400,000. This leaves a figure of genuinely self-employed at between 270,000 and 325,000, a high level by any international standards.”

HSE’s view is that using self-employed workers does not, in itself, have a detrimental effect on health and safety. Whilst the genuine self-employed cannot be appointed as safety representatives, or employee representatives under the relevant legislation, CDM 2007 requirements for consultation apply to workers regardless of their employment status. However, using self-employed workers can potentially increase the fragmentation or casualisation of the supply chain and workforce resulting in an indirect effect where:

- management and control are made more difficult by the typically large numbers of short-term periods of employment in the industry;
- it is hard to organise training, consultation, communication and cooperation and similarly hard to build trust and understanding;
- the incentive to invest in people, eg in their training, is reduced where they are only employed for short periods;
- people are unlikely to feel committed to a particular project when little is invested in them; and
- similar projects enable people to get to know one another, improve expertise and make continuous improvement possible.

3. How do you test for self-employment in the Omnibus Survey?
In the two surveys carried out for HSE by the British Market Research Bureau (see Reference 4 to Part 1 of this Phase 1 report), we adapted the tests of self-employment into the following simple questions:

<table>
<thead>
<tr>
<th>Question</th>
<th>Possible Answers</th>
<th>Self-employed coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you currently working...</td>
<td>Don't know, As an employee, Self-employed, On a government scheme, Not Stated</td>
<td>1</td>
</tr>
<tr>
<td>Do you have a CIS4 tax exemption certificate?</td>
<td>Don't know, Yes, No, Not Stated</td>
<td>10</td>
</tr>
<tr>
<td>Which of the following best describes how you are paid?</td>
<td>Don't know, Hourly, Daily, Weekly, Monthly, Quote for the job/work in hand, Not Stated</td>
<td>100</td>
</tr>
<tr>
<td>How are your hours of work set?</td>
<td>Don't know, Specified by employer, Decide yourself how many hours to work, None of these, Not Stated</td>
<td>1,000</td>
</tr>
<tr>
<td>What are the arrangements for providing tools and materials?</td>
<td>Don't know, Tools and materials supplied by employer, You supply tools and materials, Not Stated</td>
<td>10,000</td>
</tr>
<tr>
<td>Do you work for the same firm / contractor all the time?</td>
<td>Don't know, Yes, No, Not Stated</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Assigning a code as an indicator for each response that indicates self-employment, totalling those codes and grouping them into 3 groups, essentially employed / self-employed and the others, where the employment status is unclear because of contradictory indicators gives:

The result in chart 1 is a coding where each ‘1’ indicates a self-employed indicator and each ‘0’ an employment indicator. Most respondents who said that they were employed passed all of the other tests, but significant minorities work hours as necessary to get the job done; supply their own tools or work for different firms. None of these is necessarily incompatible with being an employee. The clearly self-employed respondents are well grouped, though surprisingly some were not registered with CIS; paid by the job and did not determine their hours themselves. The unclear group are well distributed with no clear grouping.

By comparing these responses with answers to other questions it is possible to test whether the three groups face the same risk of injury or ill health. Some of the combined results from the two surveys are shown below.
40% of workers claimed to be self-employed (40% in Phase 1 and 39% in Phase 2). However, 53% of those interviewed (the same in both phases of the survey) were clearly employed\textsuperscript{a} and 24% were fairly clearly self-employed\textsuperscript{b}.

8.8% of employees and of the self-employed reported having at least one accident (not necessarily reportable) in the previous year. (7% for both main groups in phase 2 with 8.6% unclear, down from 9.6%, 7.6% and 7.3% in phase 1.) This suggests that the self-employed are not more likely to have an accident than the employed.

Respondents were also asked how many accidents they had in the previous 12 months. For the two surveys combined the three groups reported 12.3, 12.9 and 10.1 accidents per 100 workers. It would, therefore appear that the self-employed have less accidents than the employed, but there was hardly any difference in phase 2.

![Chart 4](chart4.png)

Self-employed workers took much less time off work than employees (1.00, 0.96 and 0.39 days per worker for the two phases combined.) This may, however, be influenced by payment for time off, rather than severity of injury.

In both surveys the self-employed reported having more health problems in the previous 12 months (4.7%, 5.7% and 5.9%) – see Chart 4.

4. Do Inspectors change employment status as the result of their investigations? If so does this affect the published statistics?
This happens in some cases. In a study of construction fatalities in 2003/04 there was a net change to employment status in 8 out of 71 cases – from self-employed to employment. Over the last 5 years the proportion of fatally injured construction workers classified as self-employed has varied from 20% to 32%, with an average of 26%. (Much less than the 40% of workers who claimed to be self-employed in the two Omnibus Surveys, but close to the 24% of clearly self employed workers identified in the surveys.)

5. Does employment status influence investigations?
All fatal injuries are investigated, irrespective of employment status.

The question of employment status will be part of the investigation where it is relevant. This depends upon the offences being investigated. Much of the legislation HSE deals with places duties on employers or self employed (and indeed employees). Consequently there is a need to establish the status of the duty holder when investigating offences under such legislation. Employment

\textsuperscript{a} Gave no more than one or two answer's indicating self-employment
\textsuperscript{b} Gave no more than one or two answer's indicating employment
status cannot always be decided with absolute certainty; HSE will need to reach a view on the question in order to determine the charges it lays. In cases of doubt alternative informations may be laid before the court.

The legislation affecting construction activities is framed to cover a range of duty holders and to protect a range of people (employed, self employed, person under his / her control, person at work etc). The "employment" relationships within the construction industry are complex and this avoids technical legal arguments about legal employment status – see also discussion under Point 6 regarding the general provisions of the Health and Safety at Work etc. Act 1974 (HSWA).

Establishing employment status can place a considerable workload on Inspectors, particularly when:

- the employment status is ‘casual’ – workers picked up for a day’s work often don’t know who they are working for and have no paperwork;
- people work for a large group – they may be employed by one member of the group while the construction work may be being done by another. In these circumstances people often don’t know which of the group companies is their actual employer, especially if new companies are often created;
- people work for a company created for a particular project. These are sometimes created for large projects which are being undertaken by major companies in collaboration. In other cases they are created only for tax or legal reasons to distance the ‘employer’ from the company actually doing the work.

6. How is employment covered in CDM and other relevant legislation?

Many people think that health and safety law does not cover self-employed workers. In fact they are covered, whether or not they are self-employed for tax or national insurance purposes. Indeed, people may think they are self-employed, but if they work under the control of others, they are usually employees under health and safety law.

To avoid arguments that focus on the employment status of a worker rather than the risk and those best placed to eliminate or manage it, construction regulations have long extended the duty beyond that owed by employers to employees. For example the Construction (Health, Safety and Welfare) Regulations 1996 also placed duties on: “every person (other than a person having a duty under paragraph (1) or (3)) who controls the way in which any construction work is carried out by a person at work to comply with the provisions of these Regulations insofar as they relate to matters which are within his control.” Regulation 4(2).

This approach was carried forward into the Construction (Health Safety and Welfare) Regulations 1996\(^a\), the Work at Height Regulations 2005\(^b\) and also into


part 4 of the Construction (Design and Management) Regulations 2007\textsuperscript{a} (CDM). The standard of protection in law regarding the key practical construction risks is therefore the same for all workers carrying out work under the control of another person.

The legal protection under CDM extends further than it did in the older construction legislation because these Regulations also address the planning, design and management aspects for and of construction work. These duties (in parts 2 and 3 of the Regulations) are placed either on everyone “on whom these Regulations place a duty” or those fulfilling particular roles in a construction project (eg clients, designers, contractors) irrespective of the employment relationship that they have with individual workers. This means that they are always accountable for the health and safety implications of their decisions and actions on the workforce.

The only exception to this approach is for regulation 45 which confers a right of civil action under these regulations only to employees against their employer. This decision was taken following explicit consultation on the point.

Of course, in addition, HSWA provides legal protection for employees, the self-employed and anyone other than employees who use non-domestic premises made available to them as a place of work or as a place where they may use plant or substances provided for their use there.

7. How does employment status influence the way we present statistics?
HSE publishes statistical information derived from reports made under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) on its website\textsuperscript{b}. Charts 5 and 6 below show the numbers and rates of fatal and non-fatal major injuries reported to all enforcing authorities between 2003/04 and 2007/08\textsuperscript{p}. It is taken from tables on the website\textsuperscript{c}. This data appears to show that:

- there are about three times as many fatal injuries to employees;
- the risk of fatal injury for employees is about twice as high as it is for the self-employed;
- there are about five times as many non-fatal major injuries to employees;
- the risk of major injury to employees is about 3½ times higher than that to the self-employed.

\textsuperscript{a} The Construction (Design and Management) Regulations 2007, http://www.opsi.gov.uk/si/si2007/uksi_20070320_en_1
\textsuperscript{b} http://www.hse.gov.uk/statistics/index.htm
One might, therefore, conclude that the best option for improving construction health and safety would be to make all workers self-employed. This might not be totally successful in reducing injuries because:

- the degree of underreporting (excluding fatalities) for the self-employed is much greater than for employees;
- the employment status of the injured person is usually that stated by the reporter (but may be corrected by the Inspector investigating in fatalities) and, for the reasons discussed previously, may well be wrong; and
- estimates for the number of self-employed workers in construction are much less reliable than those for employees – making rates of injury to the self-employed doubly uncertain.

Consequently HSE published statistics for construction provide the numbers and rates of fatal injury to workers (i.e. employees and the self-employed) and separately the numbers and rates for employees. No meaningful conclusions can be drawn about the relative risks between employed and self-employed workers from the RIDDOR data.

8. Conclusions

That employment status is of such interest arises principally from the unique system of income taxation operated within the construction industry. The CIS scheme, which allows for lower rates of income tax and National Insurance for participants (who by definition cannot be under a contract of employment), is led by HMRC who reviewed the scheme in 2007. Employment arrangements in the construction industry incentives introduce substantial uncertainties into accident statistics. These uncertainties can lead to false assumptions about the degree to which employees and the self employed are protected.

Critics of CIS have attempted to show a link between false or bogus self-employment and fatal injury rate, claiming that CIS participants, as self-employed persons – who perhaps do not consider themselves as such - have no employment rights. HSE’s position is that the evidence does not support this view.

Similarly, there are dangers in attempting to place too much confidence in comparisons between enforcement rates following fatal accidents between the employed and the self-employed. Where the deceased was self-employed, in a significant number of cases they may have been the only legal dutyholder, so no prosecution can result.

During accident investigations HSE focuses its attention more on the control of risks to workers than their employment status. Whilst establishing employment status of workers in investigations is important, it should not unduly distract from establishing the key factors of causation and culpability.
Annex 1-3, Appendix 1 - Construction Fatal Accident Summaries 2007/08

Transport

**Reversing:**
Crane driver was struck by lorry which reversed along narrow jetty without any banksman. Project involved repair work to docks.
Roadworker was struck by tipper wagon which reversed within work area. Project involved resurfacing road to coned off nearside lane.
Construction worker struck by works van which reversed / crushed him against wall. Project involved resurfacing driveway / domestic premises.
Construction worker was struck by telehandler as it was reversed. Small scale project involved construction of a slurry tank at a farm.

**Overturning:**
HGV driver crushed by roll bar when fork lift truck he was operating overturned. Truck used in yard of construction plant hire contractor.
Groundworker was crushed by roll cage when articulating dump truck he was driving overturned on stockpile. New build housing site.
Roofer was crushed when telescopic materials handler overturned landing on car occupied by tilers parked on site. New build housing.

Road Traffic Vehicles:
Motorcyclist collided with stationary crash cushion vehicle in lane 3 of dual carriageway. Road maintenance team removing warning sign.

**Site Plant:**
Groundworker was struck by dump truck which had lost control / veered towards him / trapped him against a wall. Construction school building.
Excavator driver run over by own machine. Cleaning out cab / stood on tracks / inadvertently forward / lost balance. Construction school premises
Roadworker was struck by bucket of excavator which inadvertently moved forward as he stood in trench. Part of rainwater gulley repairs.

Falls

**Fragile Materials:**
Migrant labourer fell through rooflight of adjoining premises used for access as he was carrying out repairs to roof at industrial premises.
Technician undertaking maintenance to safety on roof and fell through. Project to maintain warehouse type retail premises (LA enforced).
Roofer fell through skylight at warehouse type retail premises. Project involved replacement of an existing skylight at the store.
Roofer fell through skylight from which fixings had been removed. Project involved replacement of rooflights to empty warehouse.
Roofer fell through fragile rooflight during roof replacement work. Large warehouse with numerous rooflights to be replaced.
Roofer fell through skylight of empty industrial unit. Access to roof via MEWP. Project involved repair / cleaning of roof prior to reoccupation.

Migrant glazer fell through fragile roof of warehouse after replacement of glazing to atrium. Appears to have been additional repair work.

**Ladders:**

Self employed contractor fell from combination ladder, slipped as he installed exterior soil pipe. Domestic flat premises over parade of shops.

Self employed builder fell from ladder as he attempted to remove guttering using crow bar. Replacement of guttering to domestic premises.

Electrical contractor fell when ladder collapsed above first floor opening and he fell through. Construction of extra storey to bungalow.

Surveyor fell from stepladder whilst measuring up new glazing, single storey extension. Found on floor, steps beside him. Domestic client.

Migrant fitter fell when ladder in A Frame position slipped. Installation of two eco-friendly treatment units at warehouse premises.

Migrant agency surveyor fell from tied access ladder. Reason for fall unclear. Project involved major extension to hospital premises.

Site agent fell from ladder which he moved into position / subsequently thought to have slipped. Project was construction of private houses.

Roofer fell from ladder which was not fitted with stabilising device or footed. Working alone to replace damaged soffits, domestic property.

Roofer fell from tied access ladder to scaffold. Wheelbarrow found in vicinity, thought was trying to carry it down ladder. New build housing.

**Edges and Openings:**

HGV driver slinging trusses from back of lorry, crane lifted / chains swung / hit driver, causing him to fall off lorry. New build housing site.

Migrant fitter fell while descending from wind turbine. Still attached to fall arrest system at base. Project involved mechanical fit out turbine.

Guttering contractor fell from van roofrack whilst loading roofing materials. Project involved replacement of gutters / soffitts, HA premises.

Migrant labourer fell / was struck as he was cutting out concrete from upper floor. Project involved conversion of former cinema to night club.

Foreman fell down shaft of operational lift when he unlocked lift doors thinking lift car was at landing. Commercial refurbishment project.

Self employed builder fell through opening in roof that he had created. Project involved refurbishment of disused out building, domestic client.

Roofer slipped from edge of pitched tiled roof in wet conditions. Part of routine inspection of roof anchorage points at Golf Club (LA enforced).

Self employed builder fell from edge of slated pitched roof during repair work. Wet & very windy conditions. Maintenance of HA premises.

Migrant labourer fell through one of 3 skylight openings in new flat roof (possibly covered by tarpaulin). Conversion of old bakery to bistro.

Heating engineer fell from edge of pitched roof, two-storey mid-terraced domestic property. Replacing domestic gas boiler / fitting flue.
Electrical fitter working for a property company fell from the edge of the roof at domestic premises. He was attempting to install an aerial.

Electrical fitter fell from roof, 4 storey domestic premises, access via dormer. Attempt to repair satellite dish, working alone / no access equip.

**Scaffolds / Work Platforms:**

Stone mason fell from a scaffold loading bay. Project involved construction of an extension to a secondary school academy.

Construction worker fell from a tower scaffold used to replace a large glass panel to viewing area. Project involved repairs to zoo premises.

Roofer fell from system scaffold when he sat on guard-rail to get within reach of tiles. Replacement of gutters / soffits to domestic premises.

Steeplejack fell when platform he was dismantling failed / fell away from disused chimney. Project for repair work including repointing brickwork.

Carpenter fell through scaffold platform as he attempted to move boards / ladder to get to hop-up. Project involved new build housing.

Scaffolder fell while he was erecting a scaffold bridge. Project involved demolition of premises and clearance of site prior to redevelopment.

Scaffolder fell as he was dismantling access platform to fourth floor. Wearing harness. Extensive new build apartment block development.

Steeplejack fell onto high platform, preparation chimney for painting. Project involved 3 week outage, planned maintenance Power Station.

**Struck By Moving Object / Crushed**

**Fall of load / equipment:**

Labourer releasing retaining straps on bed of articulated lorry when pipes from top of load fell on him. Construction water treatment works.

Welder was struck by a 2 tonne beam which fell as it was being lifted by crane. Construction of an energy plant on an industrial estate.

Apprentice joiner / builder struck by surplus pallet of bricks which fell as it was loaded using lorry mounted grab. Domestic extension project.

Bricklayer was struck by tipping skip which fell from telehandler as it was carried along. Project involved construction of domestic housing.

Foreman groundworker struck by bucket full of concrete which became detached from excavator. Underpinning work, refurbishment housing.

Foreman groundworker struck by bucket of excavator which detached from quick hitch / fell. Drainage / roadway, new power station warehouse.

Architect struck by bucket of excavator which became partially detached / fell on him. Involved small scale extension work to garden centre.

Agency carpenter was crushed when a precast concrete plank fell on him. Project involved construction of university building.

**Demolition / collapse:**

Young groundworker crushed when wall collapsed onto him / was trapped against concrete shed. Building swimming pool at large house.
Demolition worker was crushed when two concrete beams from floor above collapsed. Demolition / redevelopment of commercial premises.

Demolition worker was crushed when building collapsed as he removed plasterboards. Demolition of wooden demountable classroom.

Migrant agency worker drowned as barge tilted as it was jacked down, cranes struck cabin / fell into sea. Construction LNG Terminal jetty.

**Falls of earth:**
Migrant groundworker was crushed when side of excavation collapsed after supports removed. Underpinning work at commercial premises.

**Electricity**
Plumber electrocuted whilst carrying out electrical work in airing cupboard. He was carrying out repairs to boiler at rented domestic property

Self-employed general handyman / carpenter electrocuted, contact with live cable. Removing sink unit / installing stud wall at domestic premises.

Electrician was electrocuted whilst carrying out electrical work to the exterior at business park premises.

Fitter electrocuted whilst plumbing in washing machine / tumble dryer. Possible socket miswired causing electric shock / domestic apartments.

**Other**
Self-employed fitter sub-contracted to repair concrete crusher. Fellow fitter turned on machine and he was crushed. Demolition power station.

Lift engineer either struck by counterweight or knocked from ladder in lift shaft. Construction of airport terminal.

Cladder was trapped between the cage of the cherry picker he was working in and the steel frame of the building under construction.

Migrant security guard overcome by fumes in cabin with built-in diesel generator for power. Roadside excavation for jointing of electric cables.

Plasterer, working alone, was overcome by fumes whilst using generator. He was carrying out plastering work in a newly built house.

Security guard overcome by fumes in an apartment which had petrol generator / butane gas heater. Apartment was in newbuild block of flats.

Dumper driver drowned when he drove over the edge of earth bank into disused flooded quarry. Earthworks for fishery and bird sanctuary.

Elderly pedestrian fell into trench left open over weekend. Went past streetworks barriers / blocked pavement. Installation ductwork / cabling.

Migrant worker in trench shovelling concrete from excavator bucket over pipework. Circumstances death still unclear. Installation pipework.

Migrant worker / others adjusting position of beam to fit bolts, beam swivelled struck him. High rise mixed commercial / residential tower.

Elderly householder tripped on exposed gripper rod in hallway of own home. Work undertaken involved putting studwork in for wall / doorway.
Annex 1-3, Appendix 2 - RIDDOR fatal accidents – reportability examples

**DIY (Not reportable)**
A domestic householder was demolishing a detached garage to the rear of his home. He was receiving help from a friend and the indications are that this was done as a favour rather than as part of his friend’s building business. The garage had brick walls and a cast concrete roof. It appears that the rear wall of the garage had been removed and attempts made to break off part of the roof which was propped with a single support. The roof had then collapsed lengthways and fallen into the garage crushing those inside. There were no witnesses to the accident so the precise time / details are uncertain.

**RTA (Reportable)**
The northbound carriageway of a dual carriageway road was completely closed for night-time working as part of a major road resurfacing project. A car driver proceeded through / around a blocked access slip-road into the works area but was stopped by the workers and told to follow a TSO vehicle escort through the works area to rejoin the running road. The driver unexpectedly overtook the escort vehicle and collided with the lowered front bucket of a JCB excavator which was being used adjacent to the verge. The JCB operator sustained minor injuries but the car driver was killed.

**RTA (Not reportable)**
A car driver had entered a coned off dead lane area on the main road probably adjacent to the entrance to his farm. Road not a dual carriageway [3 lanes split 2 and 1] but normal speed limit 50mph. He had travelled some distance before striking a section of metal barrier that was protecting an area where piling equipment was installed near the carriageway. The vehicle left the ground, somersaulted and landed some 30m away. The car driver later died. The accident occurred after work had been completed for the day.

**Natural causes (Not reportable)**
The deceased was doing re-roofing work on a domestic house. There were 2 other workers on site. Whilst attempting to ascend a ladder onto a scaffold he fell to the ground. After further investigation by both HSE and the police, and at the conclusion of the post mortem / inquest hearing it was concluded that he had suffered a heart attack, and then fallen from the ladder.

**Natural causes (Reportable)**
The deceased, a plasterer, was walking on the pavement outside domestic premises that were being refurbished for the local council. A telescopic handler was using the public highway as a means of access to enable the delivery of mortar tubs onto the scaffolding. Whilst reversing, the telescopic handler mounted the pavement and struck the deceased. His injuries included a broken pelvis & fractured ribs. He was in hospital for a few weeks but he collapsed / died at home, several weeks later, after suffering a pulmonary thrombosis.
ANNEX 1-4 – AIM AND OBJECTIVES OF THE CONSTRUCTION PROGRAMME

The Construction Programme Aim:

To ensure that the risks to those working in the construction industry, or who maybe affected by it, are properly controlled.

Our overall objectives are:

- To reduce the rate of fatal and major injuries suffered by workers in the construction industry
- To contribute to the reduction in work-related illness and working days lost
- To secure ownership by the industry of the health and safety challenges it faces
- To encourage clear leadership within the industry to bring about improvements
- To promote partnership working between those who create, manage and are exposed to risks to address the challenges
- To achieve a cultural change in the industry, with competence throughout all levels of an organisation and intolerance to risk
- To secure commitment by the industry to provide decent working conditions and effective engagement with all
- To maintain a modern, fit for purpose regulatory framework
- To communicate effectively the key health and safety messages to industry.

This is done by:

- A targeted yet flexible programme of work to maximise impact on high risk areas
- An intervention strategy that targets all those in the construction procurement and supply chain
- Engagement and partnership with key intermediaries, stakeholders and other enforcing authorities
- Use of statistical information and intelligence to prioritise hazards and sub-sectors for engagement
- Encouragement to those who are striving for excellence and taking a robust enforcement line with those who are not
- Reinforcement our programme and health and safety messages through reactive work.
ANNEX 1-5 – EXAMPLES OF ACTIVITIES OF THE HSE CONSTRUCTION PROGRAMME

Early Campaigns

- Roofwork campaign 1992
- CDM 1994 – focus on construction management
- Industrial roofing, use of nets 1998/89
- Fragile rooflights, campaign 1999/00
- Steelwork erection – use MEWPs, don’t walk the steel, mid 1990s – all but eliminated fatalities
- Scaffolding erection safety, 2000

Programme Development

- Stakeholder mapping communication research / audience profiling
- Influence Network modelling to map HSE levers to press and routes for influence through the practices in industry and procurement supply chains.
- Construction Summit
  - Turning concern into action
  - High level political involvement
  - CONIAC performance targets
  - Clear commitments from key stakeholders
  - High impact video with testimonies

Delivery

- Working Well Together (WWT) campaign – help for the industry from the industry – targeting SMEs
  - Regional organising groups
  - National publicity buses and vans to sites
  - Advertising campaigns – every week one of us dies
  - Safety, Health and Awareness days (SHADs)
  - Risk assessment workshops
  - Mock trials
  - Designer / client awareness days
  - Absolutely essential cartoon based toolkit
  - High ‘5’ branding / leaflet
- MCG - best practice benchmarking clubs
- Temporary Traffic Management (roadworks)
- Elimination of chrome VI in cement products – work with manufacturers
- HSG150 guidance – Health and Safety in Construction
- Construction Health and Safety Summit 2005 – Ownership, Leadership, Partnership
- Competence agenda
  - CSCS passport scheme
  - CDM competence assessments
- Take your designer to site campaigns
- Supply chain projects to eliminate practices hazardous to health
Process of awareness, working groups, standards, promotion, enforcement
  - Heavy blocks, kerb lifting, vibrating tools, silica etc.

- Work at height
  - Link to 2005 Regulations
  - Intermediary engagement – Dulux paint events
  - Work with hire shops / builders merchants

- High impact interventions
  - National lead inspectors for key dutyholders
  - Sector leads with key intermediaries
  - Early intervention on major projects
  - Repeat clients (e.g. commercial refurbishment) multi-site evidence and head office leverage

- Industry engagement and consultation in CDM Regs revision
  - Securing client influence
  - ‘Manage the risk not the paperwork’
  - Communication, cooperation, coordination
  - Revised ACoP – a best-seller

- Public sector focus – with DTI / BERR and OGC
- Worker engagement toolkit
  - Behavioural change
  - Research and implementation – large sites to small

- Construction webpages (HSE’s most successful sub-site)
- E-bulletins, Text messages
- Good order campaign
  - Slips and tips in a meaningful construction context

- Site Transport
  - Designated pedestrian routes, logistics planning, build sequences (particularly housebuilding)

- Construction Occupational Health Management Essentials (COHME)
  - Occupational health and risk management information and advice

- Targeted inspection
  - Within topics / sectors

Preparing the future
- 5 Cross-cutting strategic projects
ANNEX 1-6 – CONSTRUCTION PROGRAMME CROSS-CUTTING STRATEGIC PROJECTS

Major Accident Potential (MAP)
The aim of the major accident potential project is to achieve recognition and action in relation to high risk construction activities and specifically those (such as crane collapse, scaffolding collapse etc) where there is the potential for multiple injuries or fatalities. This builds on extensive work by the former Construction Division technical unit and endorsed by the CONIAC Safety Working Group which categorised major construction accidents.

High Impact Interventions (HII)
This project is divided into two main areas of work:

a) High impact interventions.
An important aspect of the Construction Division’s work is ‘High Impact Interventions’ which, based on the timing or focus, have the potential to lever significant health and safety improvement for the extent of HSE resource involved. The aim is to update the ‘HII strategy’ to ensure efforts continue to be directed appropriately to maximise impact.

b) Public procurement
Public procurement standards and provision for health and safety have become a focus of political concern and commitment needs to be secured throughout the public sector. The aim of this work is to update the ‘Public sector as exemplar client’ strategy.

Local Authority Construction Engagement (LACE)
The aim of the local authority construction engagement project is to firstly increase the extent and effectiveness of Local Authority intervention in the construction process to improve standards of health and safety in construction; and secondly, to consider opportunities for moving towards integration of CDM, building control and planning regimes.

Vulnerable Workers (VW)
This cross-cutting project seeks to ensure that ‘vulnerable’ construction workers benefit from the protection of existing H&S law where ‘vulnerability’ relates to a combination of their being exploited / denied employment rights and not having the capacity or means to protect themselves. Migrant workers, young people and ageing workers are the initial focus.

Small Sites and Small Construction Firms (SMEs)
Although the focus is often on small firms, this cross-cutting project is anchored in the small site context and aims to establish a sustainable strategy to influence SMEs to adopt sensible risk management principles. The work is learning lessons from approaches tried by HSE and others to date to identify the elements of success.
ANNEX 1-7 – HSE VIEW

Background

1. Part 1 of the Phase 1 Report sets out the history and development of HSE’s Construction Programme. The Report focuses on safety and accidents, but it needs to be recognised that far more construction workers die from the chronic effects of ill health caused by or made worse at work.

2. Following comments from the peer reviewers to the Inquiry, HSE was asked to set out its view on where focus should now be directed to reduce fatal accidents in the construction industry.


4. HSE’s Construction Programme is a 10-year programme, and is currently in its 6th year; it has evolved and matured during that time. The Programme’s themes of Ownership, Leadership and Partnership have remained constant and their validity has been reinforced with the publication of HSE’s new Strategy - ‘The Health and Safety of Great Britain: Be Part of the Solution’ (June 2009). The aims and objectives of the Construction Programme are set out in Annex 1-4 of the Phase 1 report.

5. Considerable improvements have been made, in both health and safety, with a statistically significant downward trend in the rate of fatal injury to workers (taking account of the activity in the industry) over the last 15 years (and before). The statistics and examples of achievements are covered in the Report. However, improvement has levelled off over the last few years, and in 2006/07 fatal accident figures rose from 60 to 79, an increase of 28% over the 2005/06 figure – the lowest ever to that point in time.

6. Whilst much has been achieved, more needs to be done to address the unacceptable level of injury and ill health in the construction industry, which remains one of the most hazardous in the UK.

Underlying Causes of Fatal Accidents

7. Construction has a challenging, constantly changing workplace and the industry’s ability in managing this dynamic environment is essential to delivering improvements. The industry has a largely macho culture, which too often is associated with a willingness to take health and safety risks to get the job done.

8. The prime responsibility for managing health and safety in construction sites has always rested with those who manage and deliver construction work. It
is essential that the industry and individuals working within it take and maintain ownership of these issues.

9. There is significant scope for improvements in the planning of work, and learning lessons from previous projects. The key challenge is how to achieve the cultural changes necessary to make a real difference to the industry. The underpinning work carried out when the Construction Programme was established, described in the Phase 1 Report, remains valid.

10. Technical changes and innovation have delivered health and safety improvements and are examples of positive cultural change. Good examples include the use of lower weight cement bags, removing the operative from danger by mechanisation of demolition, alternatives to manual handling of kerbs, the use of Mobile Elevated Work Platforms (MEWPs) by steel erectors, eliminating walking on steel beams, the use of netting during roof work and specialist vehicles for laying out cones on high speed roads. Further work is needed on finding technical solutions to common problems, and managing the new risks that can be created (e.g. crushing injuries in MEWPs).

Leadership and commitment

11. Many companies provide leadership in health and safety. However there are too many occasions where companies do not manage health and safety through their supply chain. Examples include:
   • failures to ensure that competent sub-contractors and workers are engaged, particularly at the tail end of the supply chain;
   • a reluctance to engage with workers in a meaningful way, including arguably the recent blacklisting of individuals;
   • acceptance of self-employment, where workers are employed in every sense, except for tax purposes.

12. Clients who show leadership have a huge influence on standards on sites. Experience shows that where clients show leadership and promote collaborative working health and safety and other benefits ensue. Encouraging and helping clients to understand these benefits, both in terms of preventing accidents and ill health, and also as an indicator of commercial performance remains a challenge.

13. The industry has been slow in showing leadership by investigating incidents (both injury causing and near misses) to identify trends, underlying causes and in sharing the learning.

14. HSE has seen an increasing number of companies adopt a policy of challenging HSE and Police investigations to the point of being obstructive. This sends the message that those companies do not fully accept their health and safety responsibilities, and raises concerns that they may not be
actively seeking to prevent repetition. Any delays have an unfortunate knock on effect for victims in securing justice, and can add to costs.

Competence

15. Competence continues to be an important issue in the underlying causes of fatal accidents. This is supported by the analysis undertaken of a selected sample of recent fatalities in Phase 2. The culture is one of “anyone can do construction work”.

16. HSE has done good work to promote competence in the industry. Progress has been made in this area; the Construction (Design and Management) Regulations 2007 (CDM 2007) Approved Code of Practice gives advice on assessing competence of both individuals and organisations. Schemes such as Construction Skills Certification Scheme (CSCS) touch screen test provide evidence of basic health and safety knowledge, but this on its own is not sufficient to establish competence. Even the basic CSCS test has not penetrated to smaller construction sites. There may be levers that could be explored, to set minimum competence requirements for individual competence, before any construction work can be undertaken.

17. Experience has shown that the competence of supervisors and site management is a critical factor in ensuring good health and safety standards on site; they can raise the performance of otherwise poor companies, and limit what even the best companies can achieve. Good site managers have not only the technical knowledge, and health and safety expertise, they also have the communication and leadership skills to ensure that workers are properly engaged, and the risks controlled. There are Construction Skills courses for both supervisors and managers in health and safety management that, if more widely adopted, would raise standards. The best sites have a culture that delivers effective risk control throughout all levels of management.

18. Organisational competence is also an important factor. Small construction companies often lack competence in health and safety and business management; this results in companies taking on work beyond their expertise, relying on individual workers to manage their own health and safety. This is supported by evidence from the analysis of fatal accidents undertaken as part of the Inquiry. Work undertaken by these companies will typically be poorly planned, so the necessary resources in terms of equipment, access to competent advice, competent workers and time are not available. A good example of this is refurbishment work undertaken without obtaining advice of a qualified structural engineer, when significant modifications are being undertaken.

19. HSE is working with stakeholders to improve and simplify the assessment of organisational competence, through the Safety Schemes in Procurement (SSIP), using the standards set out in the CDM 2007 Approved Code of Practice as the minimum requirement. In simple terms, this means that any client wishing to procure the services of a business which has achieved
accreditation can be confident that a reasonable and robust judgement has been made that the standards of CDM 2007 have been met, for the first stage of procurement. This should form the benchmark for all companies undertaking construction work.

20. The SSIP competence accreditation, if widely adopted, should act as an incentive to those companies who are accredited, and demonstrate basic health and safety competence. It should also help small businesses in simplifying the paperwork required when tendering for work.

Worker Engagement

21. HSE’s Construction Industry Advisory Committee (CONIAC) has produced a declaration that re-affirms that every construction worker has a right to work in places where risks to their health and safety are properly controlled and that they should have a voice and be given opportunities to influence health and safety. Experience shows that those sites where workers are actively involved and consulted have good health and safety standards and operate productively.

22. HSE is working with Trades Unions and other stakeholders to produce and promote guidance for the industry, including a Worker Engagement Decision tool (located on the HSE website) to help construction managers. Improved take up of the guidance and tools available resulting in improved worker engagement would deliver significant improvement in safety performance.

23. Worker engagement should be the norm on all sites (large or small). There should be commitment from site leaders to worker engagement and a range of two-way communication strategies should be in place that ensures that workers’ views are taken into account. At the most simple level, this means ensuring that workers have the opportunity to discuss (and influence) the method of work with their supervisor, to ensure that they understand what is expected of them and any precautions that need to be taken.

24. Worker engagement is a cross cutting theme for all Construction inspections, specifically encouraging employers to adopt formalised stop work procedures, to carry out daily briefings with all site staff, to send site managers and supervisors on appropriate training courses to improve communication skills, and to promote a variety of mechanisms to encourage effective consultation.

Proliferation of Small Sites and Small Companies

25. There are approximately 200,000 construction companies in Great Britain, of which around 93% employ five or less. Approximately two-thirds of fatal accidents occur on small sites or to workers of small companies. Evidence reviewed in developing the Construction Programme’s Small Sites Strategy shows that there is a considerable turnover of companies within this sector and they often work on sites of short duration. They are known to be hard to reach, and not always responsive to health and safety messages.
26. There is no barrier to entry to undertake construction work. Small companies usually work for small clients, often on domestic properties, and are “below the radar” of HSE. Evidence shows that those companies, who have experience of working on larger sites, have a better awareness of health and safety norms.

27. HSE has carried out research to understand these companies better and has invested considerable effort in trying to influence them, including working with intermediaries such as builders’ merchants, running communication campaigns, and the Working Well Together (WWT) Programme, as described in the Phase 1 Report.

28. HSE has recognised that other regulators, such as Building Control (BC) and Planning have regular contact with small builders and tradesmen, and has established the Local Authority Construction Engagement (LACE) project to explore closer working with Local Authorities. There are many examples of good liaison and co-operation between BC and HSE, and current work includes using BC to convey information to both clients and contractors through website links and written advice.

**Manage the risk not the paperwork**

29. When the CDM Regulations were revised in 2007 it was recognised that the paperwork generated in response to the earlier Regulations was a barrier to improving further health and safety outcomes on sites. The revised Regulations had five specific objectives:

- Simplify and improve clarity;
- Maximise flexibility;
- Focus on effective planning and management of risk;
- Improve co-operation and co-ordination - encourage better integration;
- Simplify competence assessment; reduce bureaucracy.

30. The intention was to reduce the volume of paperwork, and focus on the management of risk on site. Early indications of the effectiveness of CDM 2007 show that there is still too much paperwork that is not used to manage health and safety. Examples include method statements and risk assessments that are generic, do not reflect conditions on site, and are of no value to those doing the work.

31. There is evidence from the analysis of fatal accidents and inspectors that too much effort is directed at producing paperwork, rather than managing the real issues. The focus should be on controlling and managing risks. Documents should support this and not be produced as a defensive response.
Supply Chain Integration

32. CDM 2007 requires all those involved in a project, clients, designers, principal contractors, the supply chain and workers to co-operate and work together, and plan to deliver health and safety on site. Each duty holder has a role to play, and in particular, clients have a key influence on standards on site.

33. There are examples of good practice; the evidence shows that where projects are well planned with shared ownership of risk, this delivers both improved value and improved health and safety. Too often, clients and their principal contractors do not involve the supply chain. There are too many examples of a chain of sub-contracting, where those actually engaged to do the work (usually through a string of sub-contractors) are informally engaged, with no checks of competence or suitability for the work or ways of going about health and safety.

34. Too often, the client’s professional advisers are not fulfilling their health and safety obligations in a practical and proportionate manner. Many designers are still in denial or pay lip service to their health and safety responsibilities. There is still reluctance by designers to engage with the supply chain or indeed speak with construction operatives to find out how designs could be developed and improved so that they are safer to build or maintain.

35. Despite numerous recommendations, case studies, and encouragement from Government, progress on supply integration has been slow, and this has an adverse effect on health and safety standards for larger and smaller projects.

Role of Public Sector

36. As outlined in the Phase 1 Report, there is no direct evidence that the public sector performs worse in terms of health and safety outcomes than the private sector. However, Government, both central and local has an opportunity to act as an exemplar and promote client leadership to deliver both value and health and safety. The Office of Government Commerce (OGC) has produced guidance on health and safety in procurement that is binding on Government Departments.

37. Government procurement represents 30-40% by value of all construction work. However, in many instances, Government finances work but the funding department is not the client within the meaning of CDM. HSE has commissioned research to identify the barriers to take up of OGC advice on health and safety.

38. Local Authorities acting as clients are particularly important as they often employ smaller companies. Typically, a Local Authority will have a preferred tender list, and will engage local small to medium sized companies to undertake work, particularly maintenance and repair, the highest risk work. Promoting the OGC Guidance and the SSIP accreditation work will provide
an opportunity and a tool to Local Authorities. Evidence from the analysis of fatalities in Phase 2 shows not all public sector clients are showing leadership, and in some cases not even fulfilling their basic responsibilities under CDM 2007.

Conclusion

39. During the current economic downturn, the number of workers killed by construction work is reducing, and this must be welcomed. Evidence shows that in the past increased construction activity associated with economic recovery will result in increases in both numbers and rates of worker fatalities. The challenge for the construction industry is to put in place arrangements now, to ensure that when economic conditions improve, construction health and safety is properly managed and history does not repeat itself.

40. HSE through its Construction Programme continues to employ a wide range of intervention techniques to improve health and safety and reduce the numbers of workers killed, injured or made ill by construction work. This includes enforcement when required, but HSE will never be able to police the whole of the industry, with an estimated 2 million sites in the UK. The responsibility for health and safety lies with those who manage the work, and it is only through a significant cultural change with the industry taking ownership of the issues, showing leadership and working in partnership that sustained improvement will be achieved.
2 PART 2: INSIGHT TO UNDERLYING CAUSES OF FATAL ACCIDENTS IN CONSTRUCTION

2.1 INTRODUCTION
2.1.1 Scope
The purpose of this Part 2 of the Phase 1 report is to pull together information about the work HSE has done (directly and in collaboration with industry stakeholders) addressing construction fatal accidents and the underlying causes. The objectives are:

- To demonstrate what is known about causal factors in construction fatal accidents including insight from recent studies of vulnerable workers
- To demonstrate that the work HSE / ConD undertakes looking at causes / learning / novel approaches / emerging issues etc helps develop understanding for resources to be targeted on effective action.

The required focus is on external research commissioned by HSE and complementary analyses performed by HSE in support of operational and / or programme development work. Studies conducted by or for other industry bodies are largely excluded as they form the basis of the external research for Phase 2 of this Inquiry. However, the demarcation is for reporting convenience and such studies are drawn on equally by HSE as part of its intelligence gathering, also providing source references for many of the HSE studies covered. This report does however include in Annex 2-1 a short review of studies in the recent academic literature identified for HSE by HSL, HSE’s in-house Health and Safety Laboratory to help inform the appropriate scope and coverage in Phase 2 (Loughborough University, 2009).

2.1.2 Nature of HSE studies
HSE’s ongoing work on fatal accidents in the construction industry takes many complementary forms. It extends beyond reactive enforcement action to wider examination of causal factors to inform proactive intervention. Given the diversity of construction activity, common factors can be related to individual attributes (e.g. age, trade etc), prevailing circumstances (e.g. task, type of project etc), or generic human and organisational factors (e.g. fatigue, supervision etc). Each dimension presents different opportunities for intervention and the investigative approaches seek to identify where greatest impact can be achieved. Furthermore the significance of particular factors is revealed by supplementary work on their prevalence.

The Inquiry focuses on recent deaths in the construction industry. It is recognised that insight into causal factors is also important to reduce the toll of injuries and ill-health and, conversely, that understanding the causes of non-fatal incidents can help prevent fatalities. However there are inherent differences in the robustness of different evidence sources which need to be considered:

- HSE believes that records of work-related fatalities are comprehensive; even if reports are not received under RIDDOR, Coroners provide reliable supplementary notifications. However, although every fatality is significant and should be prevented, the absolute number is small as a basis for robust statistical interpretations of trends even in a large and hazardous industry such as construction.
• HSE investigates all fatalities and adheres to enforcement guidelines in selecting non-fatal accidents for investigation.

• Fatal consequences are a more likely outcome from certain construction incidents than others (e.g. falling through a fragile roof compared with manual handling heavy blocks) and some caution is needed when extrapolating information about underlying causes between non-fatal and fatal cases.

• Reporting of the more numerous non-fatal accidents under RIDDOR is incomplete, with the Labour Force Survey (LFS) indicating only 57% of reportable accidents in construction are notified (but published data do not distinguish the type or severity of injury to determine how the reporting of major and over-three-day injuries differ). Amongst the self employed, the proportion of accidents reported is substantially lower, at around one-tenth of the reporting level for employees. Reporting is also biased with more reliable reporting by larger firms than SMEs which affects the degree to which different types of construction activity are represented in the statistics.

For these reasons understanding is derived from a range of sources as outlined in Part 1 of this report. Furthermore whilst recent work provides particular new insight for vulnerable workers, this needs to be seen in the context of accumulated analysis of causal factors from different sources over a number of years.

The purpose in understanding the causes of construction accidents is to identify critical factors on which influence can be exerted cost-effectively to secure safety improvement. The ‘construction industry’ encompasses a wide range of activities presenting different degrees of risk, undertaken at contrasting scales, involving numerous parties through long supply chains and requiring workers with a variety of skills. Inevitably the underlying causes of accidents can relate variously to human and organisational factors, and issues with specific hardware or physical circumstances. Certain accidents can also be associated with different hazards, trades, types of construction project etc etc. Effective action relies on identifying these strong associations as well as causal factors. Specific underlying causes may not be common to all accidents and these subsidiary analyses of associated factors are needed to provide appropriate focus to interventions. This report therefore covers both the analysis of contributory or associated factors as well as work on direct and underlying causes.

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a LFS rolling three year average for construction 05/06-07/08
b A paper to the Work and Pensions Committee from HSE on under-reporting in 2008 used 04/5-06/07 LFS figures where across all industries reporting was at 52% and construction 59%. Some comparison between incidence rates of injuries by kind was made suggesting RIDDOR over-estimates the proportion of accidents due to handling, slips/trips on the level etc but under-estimates the proportion of falls from a height. However the comparison is made across all injury severities and industries with falls from height constituting just 5% in RIDDOR and 8% in the LFS. Although HSE is continuing to do work on the data for wider purposes, it provides little insight specific to serious, potentially fatal, accidents. Latest figures are available from www.hse.gov.uk/statistics/causinj/datasources.htm. This suggests that the actual rate of reportable non-fatal injury has fallen more significantly than implied by RIDDOR data because of improved levels of reporting (see Section 1.3 in Part 1 for further discussion).
2.1.3 Coverage in this Report
In line with the brief for the Inquiry, the focus of this report is to demonstrate the learning about the underlying causes of construction fatal accidents from recent studies commissioned or undertaken by HSE. It is important to acknowledge that this presents a snapshot in terms of both:
- The full sequence of steps involved in improving safety
- The wider information relevant to understanding underlying causes of fatal accidents in construction.

The focus provides for a thorough examination of this crucial aspect in line with the Inquiry brief. This is not to suggest that the wider picture is unimportant and indeed the considerations feature significantly in the work of HSE and the ConD. The subsections below explain the wider picture and context for this review and note the additional contribution to the picture from other phases of the Inquiry work.

2.1.3.1 The steps for improving safety
Work undertaken by and for HSE’s ConD and the ConP reflects the well-established sequence of steps necessary to effect safety improvement:
- a) Problem analysis
- b) Development of control strategies
- c) Dissemination to relevant stakeholders
- d) Implementation
- e) Evaluation of effect and effectiveness.

Figure 2-1, taken from a review by the Institute for Employment Studies of the impact of the HSC/E (IES, 2001), demonstrates comparable stages and the through running indicators of effect and effectiveness.

As described in Part 1, this sequence is fundamental to the evidence-based and outcome-driven approach of the ConP. At any point in time different issues are subject to activity at different stages of the cycle. For example, ongoing sector
work and specific projects focus on a) and b), with the ConD communications team also involved, as appropriate, in c). Annual work planning takes projects into the implementation phase, d), involving field inspectors, sector or technical specialists, as appropriate. Evaluation, e), draws on baseline data gathered as part of a) and combines it with specific measures of effectiveness and outcome monitoring geared to the intervention type.

Other recent studies have looked at the work of HSE in general (DWP, 2008) and its impact and effectiveness, with specific reference to construction (NAO, 2004a). The principal focus here is therefore on that research which is specifically geared to understanding underlying causes of construction fatal accidents and to place that work in context by illustrating the ways in which this has linked to finding, disseminating and implementing solutions and determining their impact.b

2.1.3.2 Relevant information for understanding the underlying causes of construction fatal accidents

Many veins of research contribute to understanding the underlying causes of construction fatal accidents including:

1. Deep research into factors generically and in specific contexts (such as fatigue, non-compliance etc) to understand how they occur and can affect safety
2. Wide investigations of industry structures (supply chains) or safety improvement measures (worker involvement), again with generic and sector specific aspects, which determine both the arrangements and outcomes of safety management.
3. Evidence gathering and analysis of the prevalence, significance and inter-relation between these diverse factors in specific industry contexts

All aspects are important and complementary. However, as set out in the new Strategy (HSE, 2009a), HSE’s goals include setting priorities “and, within those priorities, to identify which activities, their length and scale, deliver a significant reduction in the rate and number of deaths and accidents”. For HSE’s Construction Division charged with reducing fatal accident numbers, its research focus is on identifying the underlying causes that dominate in the construction industry context and designing interventions which take account of the state of knowledge in these areas (reflecting the cycle described in Section 2.1.3.1).

The studies covered in this Phase 1 report therefore provide a practical and evidence-based interpretation across the many theories demonstrating which factors contribute most to the occurrence of accidents and which have greatest potential for improvement to save life. The work is underpinned by and draws on

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a The 2004 NAO report “examine[d] the approach taken by the HSE to improve the health and safety performance of the construction industry and the impact of this approach”. It noted the ConP Intervention Strategy provided “a more strategic focus” engaging, and welcomed by, stakeholders. It confirmed HSE had “used its own research findings to identify workers most at risk” supplementing site-based work with targeted interventions. Assessing the impact of the strategies was noted by NAO to be difficult “partly because of the long term nature of the intended impact and the need to account for the impact of other influences on health and safety performance; the difficulties in establishing baseline data; and the characteristics of the industry”. Examples of impact presented in this Phase 1 Inquiry report draw on some of the survey instruments and other evaluations introduced in response to NAO recommendations.

b Annex 2-2 includes a short summary of recent evaluations to demonstrate the ongoing attention given by HSE to determining its success in influencing health & safety improvement and the most effective forms of engagement.
a much wider body of fundamental and cross-cutting research too extensive to cover in detail here\textsuperscript{a}. The Phase 2 research forming part of the Inquiry extends the Phase 1 coverage to collate complementary information about underlying causes from the academic literature and industry sources external to HSE.

2.1.4 Terminology
The Inquiry refers both to ‘underlying’ and ‘root’ causes and some clarification of the terms to be used is needed. There are varying definitions but in essence the ‘underlying’ (or ‘distal’) causes can be thought of as the system failures explaining ‘why’ the accident scenario came about, as distinct from the ‘immediate’ (sometimes termed ‘direct’ or ‘proximal’) causes which define ‘what’ happened (i.e. unsafe acts, omissions or unsafe conditions).

Sometimes ‘underlying’ and ‘root’ causes are used interchangeably. In other contexts root causes are a specific type of underlying cause which, if corrected, would have meant the specific scenario would not have occurred (and possibly others prevented). Other underlying causes may be thought of as ‘contributory’ causes – correcting any one might not have prevented the incident but uncorrected it has made it more likely.

In terms of HSG65 (HSE, 2003a), HSE’s treatise on safety management, immediate causes are related to personal and job factors and underlying causes to management and organisational factors. In construction it is appropriate to recognise supply chain and wider industry / fiscal influences including culture beyond the health and safety system which affect working practices and thus can also constitute underlying causes.

In addition the ‘attributes’ of accident groups are also examined but should be distinguished from the specific definition of causes. The grouping of cases with common attributes can help us make like for like comparisons, identify solutions and / or identify effective channels for targeting.

2.1.5 Part 2 Report Structure
The remainder of this Part 2 report introduces and summarises key points from HSE studies and commissioned research. The presentation is broadly chronological, structured under the following sub-headings:

- Context
- Investigation methods for determining underlying causes
- Research identifying underlying causes
- Focused studies on specific causal (or preventative) factors
- Recent operational studies of underlying causes
- The impact of incidents
- Structuring underlying causes
- Concluding summary

It should be noted, however, that there is considerable interaction between these aspects within individual studies. For example, early operational and specialist inspector research within HSE has provided primary source material for the

\textsuperscript{a} Readers are referred to the HSE research pages to access the wider body of HSE studies which contain extensive references to the wider literature (www.hse.gov.uk/research/)
part of this work has been to try and develop a unifying model of fatal accident causation in construction bringing together the underpinning theories and research findings that have been put forward. This is demonstrated in the penultimate section and, although preliminary and warranting further considered development, it provides a consistent basis for communicating the Phase 1 and Phase 2 findings from the Inquiry.

2.2 INVESTIGATIONS INTO THE UNDERLYING CAUSES OF FATAL ACCIDENTS

2.2.1 Context

2.2.1.1 Overview

Figure 2-2 gives an overview of the coverage in terms of ‘recent’ work with particularly relevant studies set in the context of other industry activity (see Part 1 of this report for more detail). Whilst underlying causes of recent fatal accidents in construction are the focus of this report, this perspective cannot be isolated from the continuous attention paid by HSE and industry over decades. Work from the last decade is covered in most detail but the preceding period (shaded on the timeline) included significant influences such as the Lathan and Egan reports discussed in Section 1.2.1 which have shaped today’s construction industry.

Table 2-1 gives a further overview of the principal references covered in the reviews that follow. There is considerable simplification in the distillation to a single table but there is some advantage in seeing the juxtaposition of risks, approaches, evidence sources, construction emphasis, accident types, steps in the control cycle and periods covered.

As discussed in the previous section, the prime focus is on work published in the last decade commissioned from a construction perspective, predominately analysing the underlying causes of construction fatalities. It can be seen that complementary information has been identified both to illustrate the wider examination of the issues through research and to supplement the other sources.
Figure 2-2 – Phase 1 Research Context / Timeline

Key

HSE INTERVENTIONS:

INDUSTRY INITIATIVES:

LATHAM – CONSTRUCTING THE TEAM

EGAN – RETHINKING CONSTRUCTION

CONSTRUCTION SUMMIT

SFfC – ACCELERATING CHANGE

OWNERSHIP, LEADERSHIP, PARTNERSHIP

SoS – CONSTRUCTION FORUM

SUSTAINABLE CONSTRUCTION STRATEGY

HSE Support / Ops Research:

Externally Commissioned Research:

CRR 325/2001 Root causes analysis techniques

CRR 387/2001 Influences on Construction fatalities

RHS / CONIAC H&S performance targets

Note: This schematic is illustrative and cannot be both complete and legible!

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**KEY**: Models: IN (Influence Network). Construction focus: C (construction specific); C+ (multi-industry with construction sub-focus). Evidence types concatenates: R (RIDDOR from HSE); Inv (Investigation reports/records from HSE); Spec (HSE specialist inspector reports); Co (Company records); FG (Focus group); Sur (Survey – postal / telephone); Int (Interview/discussion); Case (Case study examples).
2.2.1.2 Early insight
An HSE report entitled ‘One hundred fatal accidents in construction’ was produced as a basis for learning lessons and concluded that “If employers are to draw up adequate and relevant systems of safe working, then they will be helped by a broader knowledge of how ordinary building workers .......met their deaths. This knowledge is best provided not only by diagrams and charts, but also by blunt, detailed narrative accounts.”

The report also highlights the complementary roles of the regulator and industry: “The practical realities demand a ..... complex interplay of interests in which architects, designers, manufacturers, customers, trade associations, employees, unions and lawmakers all have responsibilities, and therefore parts to play in the reduction or elimination of hazards. The Inspectorate must continue to enforce the law, but the two approaches can, and should, co-exist. The industry, in improving its safety record, should be developing strategies for dealing with all parties with an influence on safety in construction.”

In its final paragraph the report focuses attention on ‘underlying’ system measures to protect the individual: “..... the fullest answer must lie in the development of the approach which controls the behaviour of the individual by means of safe systems of work, training, and adequate and imaginative supervision. This is what Part I of the HSWA is all about. These are the legal intentions that have to be turned into practical realities on every site.”

The final emphasis gives the lie to the fact the report was published over 30 years ago (HSE, 1978) drawing on experiences from 1969 to 1975 and reflecting the changed attitudes to accident prevention in the Robens Report and the HSWA. The report opens noting that 181 men were killed in 1975 and as Figure 1-4 in Part 1 shows, the situation in 2009, whilst still of considerable concern, is much improved with fewer deaths (and much reduced fatality rates) suggesting real progress has been made. However, many of the accident narratives are timeless and, despite being less frequent, the falls from unprotected height, workers being struck by machines, trench collapses etc still occur.

Sharing the insight to fatal accidents has continued through the following decades, whether collated in HSE publications related to specific activities such as roof work or maintenance (in 1985) or distributed to delegates in the Construction Summit pack in 2001. Formerly known as ‘blackspot’ reports, the Construction Intelligence Report (available on the web) brings together statistical data with pen pictures of accidents and emerging research findings about causative factors. The information is shared routinely – a presentation by HSE’s Construction Sector to the July 2008 meeting of the ConstructionSkills HS&E committee with inter-governmental, industry and union participants provided a recent example as this report was drafted. Following the presentation, the FMB (Federation of Master Builders) made a specific approach for permission to publish the full list of accidents in their Master Builder journal. The reason was exactly that identified in the 1978 report “it is important to get this information out there to show people how these things happen”.

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The use of short vignettes simply conveys what happened - with investigations ongoing (from employer and HSE perspectives) and in many cases legal cases pending, speculation about underlying causes is not appropriate. However, the power of the vignettes is that for those working in the industry even the simple narrative triggers immediate recognition of the measures that could / should have prevented the scenarios unfolding. It is that thought provoking process, reminding the reader of measures necessary to avoid anything similar occurring on their site, which is valuable irrespective of whether their inferences applied to the specific case.

Whilst the appetite for basic insight to what went wrong persists, considerable developments have taken place to enable immediate and underlying causes of accidents to be identified in a comprehensive and consistent way. These have then been applied to deliver practical understanding on which HSE and the construction industry can act.

2.2.2 Investigation Methods for Determining Underlying Causes

2.2.2.1 HSE guidance to industry on underlying causes – HSG65

Underpinning the essential view of underlying causes of construction accidents is HSG65 entitled ‘Successful health and safety management’ (HSE, 2003a). First published in 1991, this pivotal guidance set out the linkage between corporate policy and the organisational management systems, and health & safety performance (and by implication the link between deficiencies as underlying causes of ill-health and injury). Initially most clearly associated with major hazards industries, the generic elements of HSG65 are now reflected in the way many major construction firms operate and, in a less formalised way, some smaller firms.

Publication of companion HSE guidance HSG96 in 1993 setting out the cost of accidents at work was followed by research by WS Atkins to explore the linkage between the two aspects. The key question was whether the costs of an accident could be broken down and linked back to specific management failings, thus enabling cost-effective targeting of improvement effort. In addition to capturing data on the costs of accidents, a root cause analysis tool was developed from first principles. Revised to its second (current) edition in 1997, HSG65 now presents the framework for analysing accident and incident causation comprising immediate and underlying causes (personal & job factors and management & organisational factors respectively) and gives guidance on incident investigation. The initial Atkins research involved a literature review to compare existing theories and models, something that had not been done comprehensively before. Originally completed in 1995 the review informed the second edition of HSG65 and was updated to cover models introduced up to 1998 before being published in HSE’s contract research report series (WS Atkins, 2001).

The research found that none of the existing models was adequate, specific limitations being identified in each case, and so set out the three key components that need to be applied for effective root cause analysis incident investigation, namely:

1. A method of describing and schematically representing the incident sequence and its contributing conditions.
2. A method of identifying the critical events and conditions in the incident sequence.
3. Based on the identification of the critical events or active failures, a method for systematically investigating the management and organisational factors that allowed the active failures to occur, i.e. a method for root causes analysis.

Underpinning these three components were the following concepts:
- The barrier / energy transfer model of incident causation
- Incidents typically have more than one causal factor.

Theories and models for causal analysis have continued to multiply over the years and a European Thematic Network (SAFERELNET) taking a pan-European, multi-industry view of safety in which HSE was an industry partner, included an updated review in 2006. Many approaches are customised for specific applications or to reflect a particular causal emphasis but none has emerged to dominate the market. However, as will be shown later, there is clear agreement that the causes of accidents go beyond the immediate actions of an individual and these underlying causes comprise a combination of human, organisational and environmental factors.

### 2.2.2.2 HSE guidance to industry on investigating incidents – HSG245

Equipping industry to investigate accidents effectively, to identify immediate and underlying causes so that lessons can be learned, improvements made and risk eliminated or reduced, has formed a continuing part of HSE work. In particular around 2001 there was the prospect of a legislative change imposing a duty to investigate and to take findings into account in revised workplace risk assessments. Although it was decided not to introduce new duties, HSE continued to produce practical guidance in consultation with industry, unions and health & safety specialist bodies (HSG245, HSE 2004) particularly to help small and medium sized enterprises (SMEs) – HSE, 2003b. The guidance still stands and continues to be available from HSE Books.

### 2.2.2.3 Early industry investigation practices

HSG245 was informed by research undertaken by Human Reliability Associates (HRA) for HSE (Human Reliability Associates, 2001) looking at the then current pan-industry practices in incident investigation, with particular emphasis on the resources expended and quality of the investigations. The findings were based on a comprehensive telephone survey of 1500 companies and 100 follow-up face to face interviews. Construction companies comprised 7% of the telephone survey (11 companies) and 8% of the interviews (8 interviews). The small numbers obviate sector specific conclusions but the overall findings are informative.

As a baseline the main elements of a successful investigation were taken to be:
- A causal model that represents a system-based approach to incident investigation
- The involvement of relevant individuals within the investigation
- Procedures or protocols to structure and support the investigation
- The identification of both immediate and underlying causes
- The development of recommendations that address both immediate and underlying causes
- The implementation of these recommendations and the updating of relevant risk assessments
• Follow up to ensure that actions taken are successful in reducing the risk of further incidents
• Feedback to relevant parties to share immediate learning
• The development of an accessible database.

Practice was characterised from undocumented approaches without support to causal analysis utilising analytical tools and techniques. Most investigations fell in the middle area with some formality mostly focusing on immediate causes and sometimes more sophistication purporting to look at underlying causes. Findings of particular relevance to the current Inquiry were that the (all industry) interviews revealed that ‘the majority of companies do not effectively discriminate, or indeed understand, the distinction between immediate and underlying causes’ a situation which the external research revisits in Phase 2. The work included some case study reviews of company investigations and, despite limitations identified by the researchers, the vast majority of respondents felt that their current approach had enabled them to identify what they considered to be the relevant underlying causes for the incidents.

The only case study based on a construction fatality within the report (from 1999) illustrates this. In summary, a steelwork erector fell from a steel beam 5m up when his harness was not connected. The company investigation (company employing >200) concluded ‘human error’ and one of the follow up actions the company took was to introduce a permit to work system for the use of fall protection PPE. [It is important to recognise the incident occurred nearly a decade ago and the widespread use of MEWPs (mobile elevated work platforms) has transformed steel erection practices to be inherently safer minimising reliance on PPE at the very end of the fall protection hierarchy.] The inadequacies of the investigation for the time are however self evident.

The study also demonstrated that only 24% of respondents used investigation findings to update risk assessments. The fundamental problem was seen to be the absence of integration of investigation and risk assessment processes, in part due to inconsistent models and taxonomy. HRA recommendations to HSE centred on the need for integrated approaches to be promoted, together with the value of addressing both immediate and underlying causes. They also highlighted the specialist skills and resources required to investigate properly and the particular challenges this presented for SMEs, even if persuaded of the benefitsa.

The HSG245 methodology, software tools and leaflets were the major output precipitated by the research. Company practices in incident investigation have progressively improved with direct evidence of action being taken and lessons shared within industry groups. As part of the Inquiry, current practices and application of the lessons learned are examined in the Phase 2 external research.

2.2.2.4 HSE investigation practices and developments
In addition to the external focus, HSE has also kept under review its own approach to accident investigation and causality. With a clear function to identify

a It should however be noted that persistent use of the question ‘why’ each time a ‘cause’ is proffered can take investigations a long way.
breaches of health and safety law and take enforcement action accordingly, HSE investigations historically have not necessarily embraced a comprehensive dissection of the underlying human and organisational factors. However, regulations are changing reflecting greater recognition of the formative influences on safety provision. The construction CDM 2007 regulations illustrate this, penetrating deep into the supply chain, with duties for cooperation and coordination and assuring competence, for example.

In parallel investigative practices have changed with FOD inspectors now being trained in analytical investigation techniques for use in appropriate cases. In addition to HSG65 investigation methods, training covers Events and Conditional Factors Analysis (ECFA+) to guide the identification of a clear sequence of events to support robust root cause analysis using 3CA (Control Change Cause Analysis) techniques. The ECFA+ events are analysed in terms of barriers and controls, differences between expected and actual practices, and those failings in system and organisational factors which caused the discrepancy. Although detailed review of the methods is not necessary here, relevant guidance is given about casual relationships being generic or linked to an individual situation and the potential to generalise specific causes into generic relationships. Similarly the need for evidence to determine a sequential causal connection is highlighted and the distinction between causes (satisfying the criteria) and contributory factors (where the proof is incomplete) is noted. Finally the challenge of deciding which of the cause(s) is / are most important is highlighted. All these points are relevant to the validity of work on underlying causes reported here.

Relevant to the current review are other background research and development studies undertaken by HSE inspectors. A report by Crick (2000), as part of a project in Operations Unit, developed a pan-HSE Classification Model on Underlying Causation, proposing the accident information model shown in Figure 2-3 to offer a basis for structured investigation and analysis. Notably the report provides a thorough review of the underpinning literature considered in the development process.

In support of the development, the method was applied to a range of cases providing an auditable record of the events chain, causal factors with supporting justification and reasonably practical precautions that should have prevented the accident or loss.

A follow up study of HSE practices by HSL (2004) examined the extent to which analytical approaches to investigate were being used, how they compared with a normative model and any scope for improvement. They reported widespread exposure to the methods within HSE but some challenges, for example related to resource implications. However, the importance of pursuing analytical methods in line with enforcement principles for consistency, transparency, targeting and accountability was highlighted with specific recommendations for the adoption of ECFA+ in specific training. This is now reflected in operational practice as described above, with senior management additionally being provided with training to help encourage application in appropriate circumstances. Furthermore COIN, the system recently introduced for case data management, includes
specific provision for capturing underlying causes which should provide useful information in future years.

**Figure 2-3 – Proposed Accident Information Model (Crick, 2000)**

HSE develops staff in various ways, including the sponsorship of MSc degrees. Mullins (2006) in his MSc thesis held a series of focus groups with inspectors confirming the potential for HSE investigations to benefit from the use of analytical investigation methods with suitably trained inspectors.

Walker (2007) in his thesis (as part of his transition from being a construction inspector to a human factors specialist in HSE’s Corporate Topic Group, CTG) looked specifically at applying the Human Factors Analysis and Classification System (HFACS) developed for the military aviation environment, to incidents in
the UK construction industry. Based on initial trials some changes to the base model were needed to reflect the multi-party structure of the industry. The HFACS-C development drew on HSE research by BOMEL (2001) and Loughborough University & UMIST (2003) reviewed later, to provide a more comprehensive and relevant set of causal factors as shown in Figure 2-4. Initial application was trialled relying on narrative accounts of accidents which revealed limited evidence of underlying causes. However, work has continued within the human factors CTG with further application to live cases based on an interview with the investigating inspector, now delivering more comprehensive and balanced insight to causative factors in an efficient manner. The approach centres on identifying errors associated with the incident and tracking back up through the table (as shown) to identify the factors contributing to each error. This contrasts with the more prevention oriented structure in the Crick model (Figure 2-3).

<table>
<thead>
<tr>
<th>1st Order</th>
<th>2nd Order</th>
<th>3rd Order</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(A)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Influences</td>
<td>(A.1) Regulatory Environment</td>
<td>(A.1.1) Clarity/sufficiency of regulatory standards</td>
</tr>
<tr>
<td></td>
<td>(A.2) Economic Climate</td>
<td>(A.1.2) Effectiveness of regulator</td>
</tr>
<tr>
<td></td>
<td>(A.3) Societal Influences</td>
<td>(A.1.3) Conflicting requirements of regulators</td>
</tr>
<tr>
<td></td>
<td>(A.6) Other</td>
<td>(A.1.0) Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(B)</th>
<th>Organisational Influences</th>
<th>Client</th>
<th>Designer</th>
<th>Main Contractor</th>
<th>Sub Contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B.8) Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(C)</th>
<th>Preconditions for Unsafe Acts</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(C.1) Environmental Factors</td>
<td>(C.1.1) Uncontrolled or hidden hazards</td>
<td>(C.1.2) Noise/Lighting/Ground conditions</td>
<td>(C.1.3) Welfare and hygiene facilities</td>
</tr>
<tr>
<td>(C.2) Personal Factors</td>
<td>(C.2.1) Training/experience</td>
<td>(C.2.2) Ability</td>
<td>(C.2.3) Attitude</td>
</tr>
<tr>
<td>(C.3) Task Factors</td>
<td>(C.3.1) Task Type</td>
<td>(C.3.2) Task Tempo</td>
<td>(C.3.3) Equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(D)</th>
<th>Unsafe Acts</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(D.1) Accidental</td>
<td>(D.1.1) Skill-based Errors</td>
<td>(D.1.2) Decision Errors</td>
<td>(D.1.3) Perceptual Errors</td>
</tr>
<tr>
<td>(D.2) Deliberate</td>
<td>(D.2.1) Deliberate contravention of procedures</td>
<td>(D.2.2) Action tolerated by supervisory system</td>
<td></td>
</tr>
</tbody>
</table>

| (E) | Other | |

Figure 2-4 – Failure categorisation tool HFACS-C (Walker, 2007)
2.2.2.5 Investigation methods – concluding remarks

Whilst these documents deal with process rather than revealing specific insights, the support for active development of new applications of analytical investigation methods in HSE provides important background. The work was considered in selecting the preferred approach for examining the recent fatal accident cases as part of the Phase 2 Inquiry scope. Although the rigour of the ECFA+ and 3CA techniques used in current HSE Inspector training were attractive, the study was to be retrospective rather than an instrumental part of investigations so, coupled with the very tight time and logistical constraints, it was concluded that a version of the HFACS-C model and interview approach offered a sufficient and pragmatic methodology.

2.2.3 Research Identifying Underlying Causes

2.2.3.1 Early construction research

An early study addressing management, organisational and human factors in the construction context was commissioned from Human Reliability Associates (HRA) by HSE and published in 1992 (before the framework of CDM regulations came into force), at a time of recession in the industry. The objective was to examine the extent to which safety performance in the construction industry was being undermined by factors beyond the control of the individual worker. In particular, the research sought to identify the nature of the management and organisational factors which led to poor safety standards and to assess the industry’s response to its safety problems. The research was largely qualitative, being based on an analysis of 30 serious accidents, interviews with managers from 24 construction companies, a postal survey of a further 21 construction companies and interviews with a number of major clients. None of the serious accident cases was fatal but the information was drawn from 30 reports provided by four construction companies. The output was used to inform the implementation of the CDM 1994 regulations and, in particular, the CONIAC supporting guidance.

The HRA report captured the nature of the industry identifying specific management and organisational factors judged to undermine safety performance including:

- Fluctuations in demand
- Structural changes with the major shift at the time away from direct employment by large contractors to much greater dependence on subcontractors (bringing additional challenges in relation to control, coordination and communication, reduced site supervision, inconsistent standards, accountability through the supply chain, lack of strategic R&D, lack of investment in training, limited organisational learning between projects, poor strategic risk management with issues relegated to contractual arrangement between parties)
- Diverse nature (safety risks) of work
- An industry culture fundamentally resistant to change.

Significantly, the consensus amongst all respondents was that the main problems lay with the lack of basic skills and training within the workforce, and the financial and time related pressures which dominate decision making during the project life cycle (which managers perceived to be beyond their control).

The response of the industry to these problems was judged in terms of (i) the overall philosophy of safety management, and (ii) the basic safety defences developed.
(i) Whilst in most large construction companies safety management was said to be explicit, specific weaknesses were identified, including:

- Failure to successfully integrate safety with other company goals
- Lack of a systematic and proactive approach
- An inhibiting safety management culture (reactive, prescriptive, blaming).

(ii) Inadequacies in the control systems included:

- Costing and allocation of resources (a particular function of competitive tendering)
- Identification of hazards on site / RA carried out too late for effective planning
- Selection of contractors not addressing safety
- Planning and scheduling of work (with inadequate / belated consideration of safety)
- Ensuring safety procedures are maintained on site (impractical, poorly communicated, inadequate supervision, time / cost pressures, limited monitoring, absence of sanctions)
- Assessment of safety performance on site including failure to collect performance data, identify root causes or formally address safety performance.
- Training – poor quality or complete absence – said to be one of the most critical areas of concern, exacerbated by the shift from the employment of direct labour to the increasing use of subcontractors.

In turning to solutions, the authors referred to the deep rooted and complex nature of the problems and the need for action to reflect the realities of the operating climate in the industry. They called for fundamental change in the way safety management is perceived by both contractors and clients. In modern parlance, the recommendations are for strategic policy level ownership of safety integrated with wider company objectives, with clear leadership and lines of responsibility and control. At the site level specific recommendations, geared to different sizes of company, included:

- Establishing the safety competence of contractors
- Establishing common safety standards / requirements
- Introduction of a more systematic approach to risk management and the formal allocation of responsibility for safety issues
- The preparation of project specific safety plans to ensure that safety issues are systematically address over the project life-cycle
- Improvement in the level and quality of first line supervision
- Greater involvement and participation of subcontractor management and workforce
- More effective sanctions and enforcement policy
- The development of a safety monitoring system addressing issues at the organisational and policy level as well as project and site management levels
- Improved standards for management and workforce, by encouraging large companies to take the lead in providing training on critical safety aspects for regularly employed subcontractors.

To bring these about, industry-led initiatives and changes in the general operating climate were proposed, including:

- Development of a more effective industry training infrastructure
- Development of a policy in respect of training and provision of site management, in particularly first-line supervision
- Improved information flow across the industry in respect of accident data and technical aspects of project and risk management
• Establishing a yardstick of common safety requirements
• Changes in the legal climate - promoting of a more proactive approach to safety management through the contractual chain, making more explicit the responsibility and liability of the client
• Changes in the commercial climate – commercial and financial inducement to invest in safety and penalties for non-compliance
• Changes in the insurance climate – premiums reflecting standards of safety management
• Changes in the regulator’s role – greater emphasis on companies’ management of safety rather than the way failures are manifest, collation of richer data, development of practical guidance particularly for SMEs.

The attention to this 1992 report may seem disproportionate in the context of a review of knowledge about the underlying causes of recent fatal accidents in the industry in 2009. However, it provides a powerful demonstration on key points:

• Major issues affecting the safety performance of the industry were highlighted by the research demonstrating the early attention being given to the underlying causes of accidents by HSE, and the willingness of HSE and industry to take action
• Many of the recommendations have been implemented with positive effect and now form an integral part of the construction industry in the 21st century (e.g. within the basic requirements of the CDM regulations, through the CSCS and similar competence schemes, with worker engagement tools, promotion of the Working Well Together (WWT) network directed at construction SME subcontractors etc etc)
• Progress in tackling the underlying causal factors means some of the criticisms could not be levelled at the construction industry in general today, although attention to some specific aspects (such as training for front-line supervisors) may still be warranted and take-up of the wider points may be incomplete across the industry (e.g. risk management).

Significantly, the work also introduced recognition of the different layers of remote and direct influence on accidents as illustrated in Figure 2-5. Furthermore, in addition to discussion of individual factors it was noted that account needed to be taken of the interaction between the factors, and the influence one factor exerted on another. Parallel thinking underpins the structuring of the Influence Network model in some of the studies which follow.

![Figure 2-5](attachment:image.png)

Figure 2-5 Representation of the sequential influences on accidents reflected in different types of projects (HRA, 1992)
2.2.3.2 Hypothesis Testing

Research by Entec (2000) took a novel approach to exploring causation. Based on analysis of early RIDDOR data 1993/94-1997/98, they demonstrated steel erectors, roofers and scaffolders face an order of magnitude greater risk of fatal injury than electrical, plumbing & heating, and bricklaying construction trades, for example. From HSE data published by RoSPA, it was also suggested that the fatal injury rate to employees was twice that for the self-employed but uncertainty in the data was noted. The researchers then conducted a series of 43 interviews involving 89 interviewees drawn from different sectors of the industry (process industry, house building etc), roles (client, designer, contractor, planning supervisor, insurance, trade association etc), sizes of organisation, and projects. The interviews were built around testing a series of hypotheses, five of which are reproduced below giving some indication of concerns and potential underlying causes of accidents:

- **Hypothesis:** Health and safety improvements are not being implemented effectively due to organisational obstacles;
  - **Conclusion:** The construction industry is complex covering a large number of players. The CDM regulations are thought to have had a positive role in helping to define the responsibilities of the different roles, however some organisational issues are still outstanding. The interaction in the supply chain is thought to often be divisive rather than supportive.

- **Hypothesis:** Health and safety improvements are not being implemented effectively due to operational obstacles;
  - **Conclusion:** Although it is considered there have been improvements in areas such as planning, there are thought to be still considerable operational obstacles which cause poor health and safety performance, most notably a lack of resources.

- **Hypothesis:** Health and safety improvements are not being implemented effectively due to insufficient health and safety knowledge and skills;
  - **Conclusion:** There is perceived to be considerable short falls in the knowledge held by certain groups, most notably the client, designer and worker, and this gap is not currently being met through training provision. In contrast, site managers and supervisors are perceived to have an increased level of understanding of health and safety, but can improve. The extent of refresher training to consolidate understanding is poor.

- **Hypothesis:** Standard safety technology (management procedures, equipment, safe working procedures etc.) does not meet the special needs of the construction sector, such as temporary work sites, temporary staff, changeable physical work environment, etc;
  - **Conclusion:** Although the construction industry considers it has unique characteristics, it does not feel these should be used as excuses for poor health and safety. Procedural controls and other documentation are felt to have improved considerably with the introduction of CDM and guidance is available. The major issues surround implementation on site.
Hypothesis: There is insufficient focus on the “soft” aspects of safety such as safety culture.

- Conclusion: There is general agreement that an effective and proactive safety culture is essential to improve the safety record. The current position within the construction industry is there is insufficient focus on this area due mainly to the short term view commonly taken by the industry.

The research also went on to look at the focus of construction safety in France, Sweden and the USA based on discussion with regulators, academics and industry representatives. Despite differences in relative emphasis the themes were found to be similar in relation to: client effectiveness; health risk awareness; safety skills; design for safety, and management commitment and none of the countries raised topics that had not been noted in the UK consultation. A number of activities were noted from the international trawl that it was suggested might offer benefits to construction safety if applied in the UK. All three are listed below and interestingly now form core elements of HSE/ConD’s operational work [as indicated in parenthesis]:

- Mentoring schemes in which proactive companies are linked to less well performing companies [Working Well Together, WWT- see Part 1]
- Inspectors focusing on high hazard site activities [Evidence-based ConP design]
- Inspectors targeting poorly performing companies [ref. Hampton review and better regulation agenda: www.hse.gov.uk/simplification/hampton.htm].

2.2.3.3 Construction Influences and Modelling Network

It was in 2000/01 that a sharp increase in the number of construction fatalities occurred (see Part 1). At that time BOMEL were commissioned by HSE (BOMEL, 2001) to:

- Collect and review data in support of RIDDOR to help understand causal factors underlying construction accidents
- To structure the information on accident causation using an Influence Network (IN) to provide a basis for quantifying risk and the benefits of improvement measures

The analysis of fatal accidents (1996/97 to 2000/01(half year)) was thorough combining data from RIDDOR reports with details, for example, on site size held in the Construction Division’s Sector fatsals notification database together with additional information captured in the FOCUS system (now superseded by COIN).

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a Where the term ‘safety culture’ has been used in the research on which this report draws, it is repeated. However, it can be a rather nebulous term and is addressed more meaningfully in terms of its component parts. Safety culture of an organisation is frequently defined as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation’s health and safety management. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures” (ACSN. ‘Study group on human factors, 3rd Report Organising for Safety’ Advisory Committee on the Safety of Nuclear Installations (1993), reprinted 1998, see also www.hse.gov.uk/humanfactors/comah/common4.pdf). It is made up by individuals at all levels in an organisation of basic assumptions, guiding principles/values, behaviours, SMS and safety outcomes. Tools to measure safety ‘climate’ typically look at indications of management control, communication, workforce involvement, training/information provision, motivation, procedures & compliance, and the learning attributes of the organisation. This is an area of HSE generic research (e.g. Human Engineering, 2005 or The Keil Centre, 2001).
in the course of investigation. The base data confirmed falls from height as the most frequent type of incident leading to fatality, with roofers falling through fragile roofs (due to a combination of poor construction materials from past practices and inappropriate current work methods) and scaffolders falling from scaffolding dominating. In most cases they occurred within small sites and small companies replicating the pattern seen in construction industries worldwide (see Annex for literature review). In the context of the recent rise in fatality numbers at that stage, nothing in the data revealed any statistically significant change in the pattern or profile of fatal accidents.

Whilst recognition of the circumstances is important, the RIDDOR records of statutory reportable facts give little insight to causes. The investigation coding goes some way to indicating cause and included options such as ‘inadequate training’ or ‘inadequate supervision’ etc. However, with only two categories to be assigned, the most commonly assigned to fatal falls from height were ‘unsafe transient work’ and ‘failure to control risk’, factors which really reflect the changing nature of construction work and give no understanding of the specific failure(s) in controlling risk.

Information on causation was also gathered from studies that had relied on expert judgement from within the industry and from the occupational psychology literature. The studies were found to give a reasonably consistent view of ‘problems’ in the industry such as inadequate planning, insufficient allowance for safety, undue pressure on schedule (cost), need for more occupational training, uninformed clients etc etc – the foregoing review of the work by HRA (1992) provides a typical example. However, in the absence of an explicit causal model, few were able to give an indication of the significance of the factors or suggest how things might be improved and, if so, what the impact would be.

This prompted application of the Influence Network (IN) technique used previously by the Maritime and Coastguard Agency in work for the IMO to account for human & organisational factors alongside technical and operational considerations in developing risk-based regulations. Illustrated in Figure 2-6, the model considers direct (immediate) and progressively more remote (underlying) causes in terms of organisational factors, policy influences and wider ‘environmental’ factors. Although the diagrams show a simple summary term (e.g. competence) each is underpinned by a specific definition together with a behaviourally anchored rating scale to ensure clarity and consistency. The scope of human and organisational characteristics is based on the academic literature in relation to causation and is supplemented by factors such as ‘contracting strategy’ and ‘design’ which have specific influences and relevance in the construction context. The representation is two dimensional but the model application develops a network of interactions between the factors across the diagram.
The basis of the approach is to bring together data and practitioner experience (particularly in areas where there is limited hard evidence) and assess the rating of current practice across the best to worst scale and then separately to determine the relative weighting of factors one to another. Importantly the method helps develop paths of influence, focusing on factors which together have significant impact, and provides a framework for structuring and understanding new data and experience. It also enables the potential effectiveness of proposed interventions on underlying influences to be tested in terms of the consequent changes necessary for benefit to cascade to performance in the construction site environment. The model makes the role of underlying influences more transparent with a practical representation of significance. The underpinning mathematics also enable some quantitative indicators calibrated to the evidence to be developed alongside qualitative insights. All these elements were applied in the research.

The IN has been used as the framework in HSE and wider research in a range of sectors (including agriculture, waste and recycling, chemical industries, work-related driving, and offshore oil & gas, for example) and to support a range of safety purposes (including risk modelling, intervention design & optimisation, performance monitoring and impact evaluation, for example). A strength is that it brings together remote underlying influences with direct factors in a structured framework. As a consequence some consolidation is necessary (for example, aggregating issues of fatigue, physical health, drugs & alcohol and considering the role of 'impairment'). Depending on the circumstances being considered, a more meaningful model may result if some factors are broken down into more detail so that their influence can be separately allowed for, while for others grouping factors may simplify the model without losing nuance. There is inevitably a compromise between a consistent model enabling direct comparisons between different circumstances (that would be of valuable here) and the detailed insight from customised models to inform the design of targeted interventions.
As a consequence, the IN appears in a number of different examples that follow, often in slightly different forms. Each time the model was optimised to maximise the relevant insight for focusing interventions at specific risk areas often pre-selected for scrutiny based on risk profiling of accident data. Some work will be shown that sought to identify key factors overall for construction and this is extended in the Inquiry report to compare the findings with other model types.

Focusing on fatal falls from height, a workshop involving HSE and industry specialists rated current practices as they applied to relevant work at height and then weighted their degree of influence on controlling the risk. Small and large site conditions were contrasted revealing different weighting structures for some of the underlying factors, showing the model to be sensitive to the different organisational processes and relationships that exist. Data from the literature and industry surveys were mapped onto the workshop ratings supporting the participants’ judgements and demonstrating the robustness in the workshop process. Proposals for action from the Construction Summit were also mapped onto the influence model, exploring the sequence of factors to be affected.

The use of practitioner judgement but this necessarily supplements for the absence of hard evidence to define the inter-relation between underlying factors and their impact on performance in all circumstances. The framework the model provides enables data and judgement to be combined and moderated as the study showed. It is not intended as an alternative to detailed research in specific areas but it offers complementary benefits in bringing together the range and interaction of direct and underlying influences whilst also including external influences on the industry and health & safety systems from market, societal and other political factors. The positioning of HSE as the regulator at the outside of the organisations, on which the H&S legislation imposes duties, but within the influence of external factors, to which it has to react but over which it has less control, has a logical basis.

Based on the IN workshop models developed, sensitivity studies were performed showing quantitatively that environmental factors such as the ‘market’, policy factors such as ‘contracting strategy’ and ‘contractor safety management’, organisational factors such as ‘training’ and ‘design for safe construction’, and direct influencing factors such as ‘situational (risk) awareness’ and ‘compliance’, are predominant areas for effective risk control. Comparisons were made between a large site (with sophisticated management controls stemming from strong client commitment and a clear expectation for exemplary standards communicated through the contracting process) and a small family run building enterprise. Certain important influences were common to both as potential underlying causes of accidents and areas where improvement would help reduce risk, namely:

- Market influence
- Competence
- Compliance
- Situational awareness
- Quality of inspection and maintenance
- Availability of suitable resources.
However four ‘deficiencies’ for the base (large site) case were not so significant for small construction and by inference are better handled in the latter case:

- Quality of communications
- Team working
- Availability of information / advice
- Design for safe construction.

Conversely the factors emerging in the top ten with the potential to improve safety in small construction but which are relatively better handled in the base case are:

- Procedures
- Regulatory influence
- Equipment operability
- Safety management.

It was demonstrated that sustained improvement in the base case could only stem from policy and organisational commitments. Similarly the strength of impact in the small construction case demonstrated by the analysis emphasised the root of deficiencies in this sector.

2.2.3.4 Factors Contributing to Fatal Accidents across Industry Sectors

Although in the context of the current Inquiry, the sudden increase in construction fatalities was significant and shocking, the remarkable fact is that the number of fatalities in all top level sectors under the SIC classification saw an increase in fatal accident numbers in 2000/01. A major study was undertaken, building on the methodology already deployed by the Construction Division, to identify the factors and causes which had contributed to fatal accidents to workers across all industry sectors 1996/97 to 2000/01 and in particular any which may be changing and explain the increase. The project triangulated information from:

- Examination of accident data on fatal and major injuries from RIDDOR notifications combined with a review of demographic trends in workplace activity.
- Detailed review of nearly 200 fatal accident investigation (FAI) files - 68 from construction - drawing out immediate and underlying causes from the information available.
- Structured workshops involving experienced HSE Sector personnel, to identify current practices and recent trends observed in relation to factors affecting worker safety and to determine the interaction and strength of influence between them.

The last two provide relevant insight to underlying causes and are discussed below. Preparatory work also encompassed a comparison between the Influence Network, HSG65 (HSE, 2003a), AISIG (Crick, 2000) and FOCUS deficiency code models, demonstrating good correspondence and consistency.

To extend the model to analyse underlying causes from fatal accident records, each factor in the IN (see Figure 2-6 for example) was subdivided into causal factors (e.g. Training was divided into training was required and not provided, training was inappropriate, training was ineffective, etc) with further subdivisions in some cases. Fatal accident investigation files were reviewed covering final inspector reports, specialist reports (HSE external bodies / company), notices, witness statements, evidence gathered etc, as available. The analysis of direct and underlying causes was made by human factors specialists with construction
support. Care was taken to distinguish proved causation from inferences derived from the available material.

An important consideration in reviewing the findings is the purpose of the documentary source material, predominantly to support a prosecution case with, in some cases, the focus on evidence around specific breaches. Inevitably there is stronger coverage and finer evidence about direct and next level underlying causes and the absence of evidence amongst these and other external influences cannot imply they are insignificant. The extensive appendices to the report (BOMEL, 2003a) include a summary narrative for each case, demonstrating the role of the factors highlighted against which the categories are shown. The methodology relied on comprehensive and complete records being available and so drew on closed cases, generally from the late 1990s.

Top level results are presented in Figure 2-7. In the sample of 68 construction accidents reviewed, the most frequently identified deficiency is a lack of situational awareness on the part of the person who was killed. Unusually (compared with other sectors) this was closely followed by work environment although this is almost undoubtedly a result of the number of falls from height accidents reviewed in the sample. In falls cases the detailed deficiency ‘unprotected height’ will have been highlighted as an indication of wider work environment failings. Although the work environment factor is a specific issue in construction, otherwise the factors fitted with a pattern emerging across the sectors. There appeared to be a tripartite relationship between situational awareness, individual competence and deficiencies in planning. As in the agriculture cases reviewed, there was a high frequency of poor situational awareness coupled with poor competence (in the form of ‘inappropriate actions being chosen / applied’) and poor planning in the form of ‘deficient risk assessments and / or method statements’.

![Figure 2-7 – Causative factors in sample construction fatalities (BOMEL, 2003a)](image-url)
From interpretation of the above results it appears there are real failures in organisations’ abilities to assess risks adequately and communicate these risks to workers in order to ensure that they are not only aware of the risks they are exposed to, but also able to behave appropriately in the face of such risks by following a set of practical and workable procedures to which they have contributed and/or about which they have been consulted.

Figure 2-8 shows details of the subsidiary factors associated with some of the more frequent causes and the report provides some detailed discussion regarding the basis for the lack of appreciation of the risks by workers and the potential interaction with apparent failings in competence (incorrect action taken) and compliance.

The final extract from the report illustrates the breakdown of factors related to underlying management and supervision and contracting strategy influences where evidence emerged from the files (Figure 2-9). Interestingly in comparison with the other sectors reviewed, deficiencies in ‘management and supervision’ were highlighted as one of the more common organisational failings in construction along with deficiencies in ‘contracting strategy’ at the policy level. Such weaknesses were linked to the high level of contractorisation in the industry and inadequate attention to its proper control.
Complementary information from the workshops flushed out a range of significant issues detailed by sector in the appendices (BOMEL, 2003a). Common areas of concern at the workshops related to Contracting Strategy and Management and Supervision. The specific concerns for construction expressed (in 2002) are illustrated as follows but it should be noted that comparable detail is presented on a range of other issues:

**Contracting strategy:**
- There is little inclusion of health and safety in standard forms of contract;
- Traditional contract routes allow control over whom you use to carry out construction work. However traditional contracts tend to be used by the less sophisticated (often domestic) clients;
- Newer types of contracts (management contracting), where the responsibility for selecting the other parties lies with one party, tend to be used by clients who understand the business; thus, the least sophisticated clients are taking on the greater workload (and responsibility);
- Local authorities typically have preferred lists where the contractors have to fulfill a small number of criteria to get on the list, but from then on the selection is on price (particularly for maintenance work);
- If health and safety were included in a sensible way in standard contracts then it is more likely that those clauses would be complied with as not only would there be a criminal liability but a civil liability as well. This may reduce the current tendency to pass liability down the supply chain.

**Management and supervision**
- Management and supervision are considered to be particularly critical to controlling the risk on a site, yet poor management is endemic in construction;
- Management have so many other issues to deal with in addition to health and safety thus it is often not given priority;
- Supervisors will tend to be working as well, thus not leaving much time for supervision. Smaller contractors may have roving supervisors looking after three or more sites;
Typically sites do not have sufficient supervision to match the number of trades on site and the speed of the construction programme;

However, there has been a slight improvement, but supervision is still overstretched.

These were amongst the issues highlighted in the report summary. The detail is extensive and the following is simply an illustrative extract:

The principal area of concern across all industries, supported by evidence of reported deficiencies from the fatal accident files related to Management and supervision. Reduced levels of Management and supervision, coupled frequently with increasing administrative demands and inattention to required competencies for managers and supervisors in respect of ensuring workforce safety, characterised the issue such that the ability for the role to be effective was questioned. The significant weight of influence from Management and supervision to many of the direct level factors constituting immediate causes of accidents was revealed. The observation was that managers and supervisors may unwittingly be becoming a barrier to disseminating safety advice and information, as opposed to the conduit that senior management envisages.

A number of issues also emerged where there was common concern about standards but a lack of clarity on where and whether benefits from improvements would be felt. The effectiveness of Procedures, abstracted from the work processes, was questioned. Similarly, the role for Incident management and feedback was unclear, given the difficulties firms may have and the lack of competence in performing objective and ‘just’ investigations to establish root organisational causes beyond the immediate circumstances. A notable change observed was concern about the increasing trend for employee claims, which is potentially acting to deter directors from disseminating the findings from any investigation they conduct to the wider workforce. Thus heightened awareness of health and safety expectations amongst workers could, to an extent, be becoming counter-productive if it is allowed to undermine a key safety management mechanism for learning and continuous improvement.

The principal area of uncertainty, of concern across all workshops, related to the policy level approaches to Contracting strategy. Increased outsourcing, contractorisation etc, means contracting forms and strategies deserve attention, particularly as the workshops indicated there was generally little effective attention to health and safety in contractor selection, within contract terms, or as part of contract monitoring. This also explains the absence of strong agreed paths of influence from Contracting Strategy to specific organisational factors as the evidence base for effectiveness does not generally exist, although some good practice examples were noted.

The role of the research was not to address construction needs specifically and was to identify common themes. Furthermore the passage of time and the subsequent developments (e.g. on investigation guidance in response to points above) means caution is needed before presenting the detail as representing the industry and practices today. There is, however, significant detail in the source report.

The work spawned more detailed work across a range of HSE sectors with industry in areas as diverse as Agriculture and major hazards sectors such as the offshore industry and onshore chemicals. In addition work in construction continued to develop the insight to specific areas (BOMEL, 2004).
2.2.3.5 Learning from Non-fatal Causation

Joint research by Loughborough University and UMIST (Loughborough & UMIST, 2003) was designed to collect data on the factors involved in a large sample of construction accidents and from that to describe the process of accident causation including the contribution of management, project, site and individual factors. The work began with seven industry focus groups which identified the following issues for subsequent investigation:

- Clients and designers give insufficient consideration to health and safety, despite their obligations under the CDM regulations.
- Price competition among contractors gives advantage to companies less diligent with health and safety.
- Key documentation, such as the health and safety plan, method statements and risk assessments are treated as a paper exercise, having little practical benefit.
- Lengthy sub-contractor chains result in elements of the construction team being distanced from responsibility, inadequately supervised, and with low commitment to projects.
- Frequent revision of work schedules leads to problems with project management and undesirable time pressure.
- A long hours culture in the industry results in fatigue, compromised decision-making, productivity and safety.
- Bonus payments act as a strong incentive, but encourage productivity over safety.
- A skills shortage in the industry is leading to increased reliance on inexperienced workers, coupled with difficulties verifying competency.
- Problems exist with the availability, performance and comfort of PPE.
- Training is seen as a solution to all problems, but with content often superficial.
- There have been improvements in safety culture over recent years, but safety still has to compete with other priorities.

One hundred accident cases were then examined. In complete contrast to BOMEL’s work on HSE’s fatal accident files, the researchers relied on company data volunteered from live sites where the cases had not been the subject of an HSE investigation. The work included site visits and interviews with those affected. Some caution is warranted in the context of the Inquiry into recent fatal accidents as the causes related to minor accidents and some more serious injury cases where the underlying causes may differ from primary drivers of fatal accidents. Although only nine of the 100 cases were reportable injuries under RIDDOR (one major, eight over-3-day) a judgement was made of the potential severity given a minor change in circumstances, indicating fatal consequence were likely in four cases and possible in 34. Nevertheless the findings, reproduced from the Executive Summary, have some resonance with the findings of other researchers:

- Problems arising from workers or the work team, especially worker actions or behaviour and worker capabilities, were judged to have contributed to over two thirds (70%) of the accidents. This points to inadequate supervision, education and training.
- Poor communication within work teams contributed to some accidents, due to the physical distance between work colleagues or high levels of background noise.

\* In the current context it would have been useful to be able to separate the influences proven from fatals/majors from more minor cases but the source material does not readily enable this. It does however address the lessons for construction accident causation in general in accordance with the original project objectives.
• In many cases, the accident occurred when those involved were not actually performing a construction task, but moving around site, for example.
• Workplace factors, most notably poor housekeeping and problems with the site layout and space availability, were considered to have contributed in half (49%) of the accident studies.
• Standards of housekeeping and workplace layout with respect to safety are low in construction when compared with other industrial sectors.
• Despite poor weather often being cited as one of the reasons for construction having a poor safety record, this research found little evidence in support of this.
• Shortcomings with equipment, including PPE, were identified in over half (56%) of the incidents. Poor equipment design and inappropriate use of equipment for the task were prominent aspects of this. Designers, suppliers and purchasers of equipment appear to give insufficient attention to the safety of users.
• Deficiencies with the suitability and condition of materials, including packaging, featured in more than a quarter (27%) of incidents. The operation of the supply / purchase chain at present appears to act as a barrier to innovation as far as safety is concerned.
• Originating influences, especially inadequacies with risk management, were considered to have been present in almost all (94%) of the accidents.
• Frequently, no risk assessment had been undertaken covering the circumstances involved in the accident. Where a risk assessment had been carried out, it was often found to be superficial and unlikely to have prevented the accident.
• It appears that PPE is relied upon habitually as a substitute for risk elimination or reduction at source.
• It was judged that up to half of the 100 accidents could have been mitigated through a [permanent works] design change and it was found that, despite CDM, many designers are still failing to address the safety implications of their designs and specifications [in particular, opportunities to reduce risk by reducing the amount of work done on site through increased use of some form of pre-assembly had not been taken].
• Accident investigation by employers or supervising contractors is frequently superficial and of little value as far as improving safety is concerned. It appears that HSE investigations generally focus on safety failures in the activity being undertaken, without capturing the upstream influences upon these.
• The influence from clients on safety appeared limited in the construction sectors predominant in this research (civil engineering, major building, residential). This was, again, despite the responsibilities on clients imposed by CDM.
• Many of the incidents were caused by commonplace hazards and activities that will continue to occur on site whatever design changes might be made. The widespread presence of the many generic safety risks accompanying construction needs to be tackled before the benefits of design improvements will be realised.

Together, these factors were considered to point to failings in education, training and safety culture in the industry. A large majority of those working in construction, both on and off site, were said to have only a superficial appreciation of health and safety considerations. As with the BOMEL work, the authors present detailed discussion on these factors and the basis for their concern in construction together with case study examples of the classification adopted.
Drawing the findings together, the authors conclude with a hierarchical model distinguishing 'originating influences' from 'shaping factors' and the immediate accident circumstances to represent the direct and underlying causes (Figure 2-10).

Although not reviewed in detail here, some earlier research for HSE provided relevant background to the approach. In UMIST (1993), an objective and quantifiable approach to safety measurement was achieved by identifying contributory factors in the chain of events which cause accidents. The method has been developed and now forms part of an HSL site audit tool being applied to provide indicators of risk management standards on current construction sites. UMIST and HSE authors (Suraji et al, 2001) had also set out a causal model of construction accident causation (Figure 2-11). The properties assigned to the
distal and proximal factors were derived from an analysis of 300 investigation reports held by HSE in the FOCUS database. These again relate to fatal, and generally more serious injury cases with the deficiency codes, supplemented by the inspection summary, used to give some indication of the relevant proximal factors. The annotated percentages indicate the frequency with which the factors were identified in the sample cases.

Figure 2-11 – Pattern of accident causation for 300 fatal and serious injury cases (Suraji, et al, 2001)

2.2.3.6 Notifiers of Major and Over 3 Day Injuries
Fatality defines the nature of the outcome of specific accidents. Some by their nature have fatal consequences but many all but identical scenarios may result in injury or indeed a near hit. Although the principal focus of this report is on the underlying causes of fatal accidents in construction, insight from incidents with less severe consequences can be relevant and should not be ignored. Many parts of the industry take steps to learn from near hits as more serious injuries are relatively rare on a company basis and present limited opportunity to determine trends\(^a\). By contrast HSE has limited opportunity to gather insight to near hits on any substantial scale (although benefits from open-ness of industry bodies in sharing information). However it does have the ability to look at the patterns across injuries occurring throughout the industry.

Reports under the ‘RIDDOR’ regulations require notifiers to detail basic information about the kind of accident (e.g. fall), the occupation of the injured party, the nature and severity of injury etc, together with a short narrative. The data are analysed extensively by HSE to identify high risk activities and vulnerable groups to which proactive inspection and programme work is directed; these statistics are also openly available on HSE’s website. However, information about the wider context is not gathered under RIDDOR and so the Construction Sector commissioned technical support in 2001 to contact around 1000 notifiers of major and over-three-day injuries (BOMEL, 2003b).

\(^a\) However, it is important that this aspect of the learning process concentrates on near hits with the potential of serious consequences, otherwise safety management activity may be directed to prevent and control risks of less serious incidents.
The work not only expanded the knowledge of construction accidents but also informed the then imminent review of the RIDDOR regulations in respect of Construction Division needs. The telephone survey covered 23 questions and, in part, mirrored the structure used in the expanded Sector database of fatal accident initial notifications described in Section 1.3 of this report to enable direct comparison. With reporting levels of non-fatal accidents estimated by the LFS to be 55%, there were proportionally more notified injuries from large sites (15 or more people), from sites where CDM applied and, particularly, from large contractors (employing 15 or more) as the responsible party, when compared with the profile from fatalities. Recognising this is a biased sample from an industry perspective, the findings are nevertheless instructive. For example:

- In relation to time / budget pressures, often mooted as causes of accidents:
  - only 13% of injury notifiers thought the job schedule was more demanding than ‘average’
  - only 8% thought financial rewards for the job where the injury occurred were poorer than average.
- 95% of cases notified said method statement and RAs were available and up to date – but these were sometimes described as ‘generic’.
- 80% of cases notified said a safety induction had been given to the worker involved.
- Where 14% of accidents were notified involving ‘self employed’, in all cases questioning about the form on contract, payment terms, line management etc suggested all were effectively working as employees. The confusion was also evident with 39 of those surveyed saying the injured party was self-employed when originally it had been notified under RIDDOR as an ‘employee’.

Two areas of questioning were unsatisfactory, albeit in different ways:

- In relation to method statements and risk assessments, they were almost universally recognised and said to be in place but self-evidently were ineffective or inadequately linked to work activity on site.
- Respondents generally considered H&S was addressed in the contract but recognition of the detail was rare, suggesting the absence of effective communication from the contract to site or any coverage had no impact on site practice.

Asked about how similar accidents could be prevented in future (as a proxy for what the causes of the accident were), the responses were mapped onto an IN of immediate and underlying causal factors (see Figure 2-12). This revealed a similar pattern of key influences to those emerging in construction workshops in parallel HSE research (BOMEL, 2004).

The figures under each box indicate the number of times prevention measures corresponded to a particular factor; the highlighted factors are those most frequently identified. For example:

- Better Situational Awareness / Risk Perception and Compliance were often associated with calls for greater care and attention and adherence to site rules, method statements and procedures amongst the workforce.
- The Operational Equipment deficiencies observed in response to this question generally related to use, with (correct) footing of ladders being a frequent example.
In relation to PPE, recommendations generally centre on wearing equipment provided, with typical references to eye protection or gloves and only occasional mention of hard hats, perhaps suggesting their use is generally accepted.

Patterns emerging in relation to the Internal Working Environment frequently relate to the covering of temporary openings, housekeeping, and maintenance of clearly defined walkways.

Use of common sense and care and attention are frequent suggestions to aid Competence and Situational Awareness.

Where Training is called for it is notable how frequently manual handling training is suggested specifically.

Together issues raised under Procedures and Planning confirm that pre-thought and more effective safety management controls could have prevented the hazardous situations arising.

Within Communications, at the organisational level, one frequent call was for toolbox talks and for them specifically to address cross-trade / -contractor issues.

It is notable that many of the specific recommendations on specific issues have since been reflected in work by industry and HSE, including:

- Emphasis on housekeeping / good order
- Marked walkways
- Improved site safety awareness in college training
- Altering kerb lifting methods
- Sector specific activity (e.g. house-building).

An important observation, reflected in findings of earlier work by HRA (2004), is that the suggestions for avoiding the recurrence of accidents go beyond the individual involved to potential improvement in organisational aspects suggesting a good ability to analyse what went wrong and address underlying as well as immediate causes.
2.2.3.7 Influences on High Risk Work at Height & Transport Related Activity

A programme of research undertaken by BOMEL (2004) extended the early Influence Network (IN) work (BOMEL, 2003a) to examine the immediate and underlying organisational policy and contextual factors through the supply chain affecting those activities a risk-based analysis of RIDDOR data showed to be contributing most significantly to fatal and major injuries, namely:

- **Work at height**
  - Activities such as scaffolding predominantly linked to fatal consequences
  - New build construction (e.g. primary structural erection)
  - Existing structures (e.g. maintenance and repair).

- **Construction transport**
  - Roadworks
  - Plant
  - Goods delivery (including the association with falls).

The baseline analysis showed that transport-related fatalities comprised one third of all construction accidents (and one quarter of all reported major injury cases) and the three selected categories account for around half the total. Similarly falls from height accounted for more than 50% of the fatal accidents. These were analysed by occupation, activity, equipment etc, which led to a classification of the types of work with distinct characteristics for intervention but a high risk of falls from height.

Funded partly by the Association of British Insurers (ABI), work also examined the applicability of the IN approach to hand-arm vibration syndromes (HAVS) as an example health issue.

All elements of the safety work have direct relevance to fatal accident causation and brought together such data as could be located with insight from workshops involving relevant industry practitioners in each distinct area. The individual reports demonstrate the specific influences pertaining in the different contexts. The summary here provides an overview of the sources used and the recommendations developed from identifying deficiencies and potential causes of accidents. It also draws out some of the common features.

Building the background for the construction transport workshops for mapping onto the IN, an original analysis was performed using results from a Specialist Inspector’s study of investigation reports from plant-related accidents 1986-1996. Linked to specific plant types, Figure 2-13 illustrates the primary and secondary reasons for accidents involving dump trucks, indicating a particular problem with drivers being injured due to dump trucks with their engines running being knocked into gear whilst the driver was getting in or out. This is an example where the findings of accident investigations have been fed into work on equipment design and standards to introduce, in this case, interlock controls. Findings were strengthened by looking at transport accidents in general identifying comparable problems in the agriculture and quarrying sectors, for example.

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* Recommendations flowing from that aspect specifically addressed the supply chain in terms of technological changes and marketing potential of the health ‘benefits’. Understanding the supply chain mechanisms is important for both health and safety interventions and an ongoing evaluation by IES is examining a range of interventions specifically to understand the elements of success in terms of process and outcome for effecting improvement.
In addition, data gathered from transport related investigations 1999 to 2001 were analysed where information on human and organisational factors had been captured over and above RIDDOR coding. Some 83 cases related to construction and Figure 2-14 demonstrates, for example, the prevalence of ‘ground conditions’ and ‘gradient of traffic routes’ amongst workplace factors.

Figure 2-15 shows ‘driving without due care / attention’, ‘not following established systems of work’ and ‘selection of an inappropriate route’ as significant behavioural contributors. In general it was concluded the problems stemmed from a violation of known rules more than a lack of knowledge. Consideration of
the plant / vehicle factors was broken down to illustrate the association with
design, selection, maintenance and use, each having significant impact.

Work extended to look at the influence of management factors as illustrated in
Figure 2-16 where issues of risk assessment, supervision, contractor
management, communication etc come to the fore.

The data were complemented with insight from workshop sessions. In the case
of construction plant, potential underlying factors emerging included:

- Training not always relevant to realities of site
Standards vary - plant operators on the books of hire companies or contractors are potentially better
Hazards and risks may be clearer to plant operators than others
Designers do not understand plant
Few of the foremen left would have known the job
Average age of plant operators is 58 – a concern for the future
Visibility is a key issue.

In addition recommendations for action were identified and have been addressed by HSE and industry, for example in relation to addressing health issues for safety critical workers. Further research has continued in collaboration between HSE and industry bodies such as the Construction Plant-hire Association (CPA) applying the Critical Incident Technique to identify key events in incident causation.

The output from the BOMEL research is illustrated in Figure 2-17 which shows the influences graded in relation to their significance (weight of influence) in affecting safety either with poor standards as underlying causes of accidents or as risk controls when performed well. Separate consideration was given to rating current standards of practice in relation to each factor and to the specific combination of underlying factors exerting greatest influence on that performance. For example, although training was one of the most significant organisational influences on competence, the structure of the internal environment for plant operations on the site was influenced more strongly by whether the risk assessment and planning were adequate or not. Having captured the rating, weighting and inter-relation between factors, it was possible to analyse the model to identify factors where improvements could bring significant overall benefits and which combination of improvement measures could cascade influences along the supply chain. Figure 2-18 traces these critical paths of influence.

Figure 2-17 – Factors graded according to High to Low potential influence on safety of plant operations (based on BOMEL, 2004)
Separate consideration of other transport circumstances revealed some understandable differences in critical factors / paths. In goods delivery, for example, contracting strategy as an underlying factor and situational awareness of the risks at the direct level were highlighted. Specific contributory factors to accidents associated with goods delivery included:

- Unloading is the most hazardous work process - variability of site unloading areas
- Poor communications between contractor and site and in contractual arrangements - responsibilities unclear
- How equipment is used rather than its quality is the issue – safe access to and from cab / trailer may be overlooked
- Driver training needs to include more than just driving skills
- Potentially, small operators, even delivering to larger sites, may only think short term - no complementary safety management or recognition of controls.

Although this summary points at those elements of the report identifying underlying causes, the research reports themselves detail subsequent steps in setting out risk control measures, which, based on analysis of the model, not only tackle the worst areas of performance but exploit strong paths of influence, prioritising those with the greatest potential impact when considered in conjunction with time and resource factors.

Follow on work through the Construction Division’s operational work plan has included specific focus on some of the issues highlighted, such as logistics, planning, provision of equipment etc and HSE’s work transport programme has campaigned on delivery safety issues. A rolling survey of 500 sites commissioned by ConD has demonstrated a statistically significant improvement in risk control in this area with 70% of site managers in 2008 noting improvement in the planning and coordination of deliveries over the past three years.
In roadworks situations, design and planning with public sector clients as well as compliance were seen to be crucial and the critical paths diagram in Figure 2-19 shows the alternative design elimination (blue) and site risk control (red) routes.

**Figure 2-19 – Critical paths identified for influencing construction plant safety (BOMEL, 2004)**

For roadworks the factors included:

- Number of accidents potentially linked to road-building expenditure
- Road users are a significant external hazard for workers at roadworks
- Workers can become 'immune' to the traffic noise around them
- Regional inconsistency in requirements for safety equipment
- Managing Agent Contractor schemes appear to be offering advantages in terms of:
  - Integration of design and maintenance teams allows lessons to be learnt and fed back into new schemes
  - Long-term maintenance contracts giving continuity of workload, investment, stable in-house workforce, knowledge retention & low staff turnover.

Again roadworks, and in particular high speed roadworks which is a significant contributor to fatal accidents, has been a specific area of work for a specially trained team of Construction Inspectors.

The detail presented above in relation to construction transport indicates the importance of addressing the context in which risks, fatal accidents and direct and underlying causes are being considered as the critical factors and consequent risk controls may differ. It also underlines the benefits of customising the models to the context to enable the role of relevant factors to be explored.

In relation to **work at height** there was more commonality in the findings with factors including:
• Working off of ladders is seen as an ‘everyday’ activity so difficult to engender an appreciation of risk (or the need for safety training)
• People are aware of hazards but underestimate risks or people recognise risks but without behaviour modification especially at ‘low’ levels
• Need improved maintenance, training and information for safety equipment and PPE
• Need more of a reporting culture to learn from incidents
• Designers need information on how to design out risks
• Inadequate information - managers lack necessary competence
• Difficult to get balance between someone who is skilled tradesman and competent for work at height
• Selection of equipment is problem as opposed to quality

The potential causes of accidents linked through to recommendations in relation to:
• Competence, Risk perception / Situational awareness and Compliance on site
• Operational equipment and Safety equipment / PPE on site
• Design for safe construction.

The routes of influence for these three categories were largely mirrored in a consolidated model quantitatively combing the results from all the studies (Figure 2-20) a process described in some detail in relation to the underlying causal factors in the summary Volume 1 and Volume 6 reports.

Figure 2-20 – Critical paths identified for the consolidated construction safety IN model (based on BOMEL, 2004)

Essentially two particularly powerful strands of influence emerged: one in relation to site practice (red) and the other through design (blue) exploiting the potential to eliminate hazards and fundamentally affect the risk exposure profile. For both
developments, the Regulator’s ability\(^a\) to influence Company culture and Health and safety management are key and, for design, alternative Contracting strategies and better integration through Organisational structures emerge as significant.

The route from the Policy level to Direct influences on site appears to run most strongly through the provision of appropriate Management and supervision with strong dependence on the pervading Health and safety culture. The combined influence of these, coupled with complementary influences from knock-on effects of Policy changes on Training etc, are seen to impact on the Competence of workers for performing tasks safely based on better Information and advice, improved Recognition of the risks as they might affect them individually, and Communication in the immediate workplace.

The model provided a framework for subsequent consideration of the logic and potential effectiveness of interventions and as a guide for areas to monitor and evaluate impact. The model was also a catalyst for workshop discussions of deficiencies and risk control measures which are recorded in the reports and have been used to inform the Construction Programme. It can be seen that although attention focuses here on the insight to underlying causes the research is an integral part of the improvement cycle outlined in Section 2.1.3.1.

2.2.4 Focused Studies on Specific Causal (or Preventive) Factors

2.2.4.1 Design

An example of scrutiny of the role of a specific part of the construction supply chain in accident causation (and prevention) is the work reported by Habilis (2004). The study sought evidence as to the role designers can and should play in ensuring construction can be undertaken safely as required under CDM regulations. It was prompted by resistance from parts of the design community in accepting their contribution was significant and / or inadequate.\(^b\)

The source material was the reports from construction specialist inspectors who are called in to support front-line operational inspectors in relation to technical aspects of specific incidents. Not all the cases were fatal but the investigation defines the cases as serious. The authors concluded that most could have even resulted in multiple fatalities confirming the role of design in causation to be relevant to this Inquiry.

Two independent engineers reviewed the reports and judged the role the designer could have played (on a five-point scale from 'very little' to 'critically significant') and what they actually did (from ‘nothing’ to ‘what was necessary’). It

\(^a\) This refers not just to frontline inspection but the system of regulation and gamut of interventions for law making, proactive stakeholder engagement, communications, guidance, enforcement etc.

\(^b\) The research ran in parallel with highly publicised field work by Inspectors who met designers on site for them to explain measures they had taken to reduce construction phase risks. Run in successive years, considerable improvement was found; in 2004 60% of those visited were judged to have good or adequate knowledge of their duties under CDM or other relevant legislation compared with 33% in 2003. Similarly 62% had succeeded in minimising risks associated with work at height for construction and maintenance in 2004, compared with 34% and 33% effectively addressing construction and maintenance risks respectively in 2003 (www.hse.gov.uk/press/2004/e04073.htm).
is important to recognise these were ‘judgements’ (albeit expert) in some cases based on assumptions and inferences. Nevertheless, the authors claim to have given designers ‘the benefit of the doubt’ to reach conservative conclusions. Furthermore, the independent judgements were debated and reconciled where necessary. The study distinguished different types of designer (architects, consultants, temporary works designer and others such as product / equipment designers) and excluded the designers’ role in the safe conduct of maintenance activity. The source data also covered a long time period, some incidents having occurred before the 1994 introduction of CDM regulations. Extrapolation of the (quantitative) findings to comment on current practice would therefore not be sound but the work did provide strong evidence of the role designers can and should play.

Of the 91 cases, 73 were considered in detail. Design could have had no bearing on the remaining 18 and it should be noted that many simple cases would not involve a specialist inspector so the dataset is inherently skewed. Nevertheless, in 37 of the 73 cases it was concluded that main designers [architects / consultants] ‘could have but failed to intervene to prevent accident realisation’. The authors also judged the failings and significance to be so severe in 15 of these cases that designer action could have gone so far as to prevent an accident [potential root cause]. In many cases multiple designers (could have) played a part and the report gives further detail with some illustrations of the roles of temporary works designers and the construction products design community. Importantly for the present Inquiry, the report draws out key themes emerging from the incidents themselves but it should be recognised that the following underlying causes are linked specifically to the design focus, as appropriate to the work, rather than giving a comprehensive analysis of all potential underlying causes:

- Poor communication between parties to a contract was often cited as a root cause with consequent incorrect assumptions and not involving expert designers at the right time, despite them being available
- Insufficient attention to identifying and accounting for existing or adjacent structures or the likely impact their existence would have on operator behaviour or ability to access the site with plant and materials
- Lack of understanding of the construction processes
- Inadequate information from construction product designers about the suitability or otherwise for particular situations
- Insufficient attention to identifying and accounting for existing site conditions or the fabric and condition of existing structures
- Lack of attention to operational aspects of a structure and the requirements for it to be maintained
- Procurement routes and design costs to deal with late changes were seen as a barrier without early engagement of designers and constructors.

Importantly the requirements for several of these points are explicitly detailed under CDM and strengthened by HSE in the CDM 2007 regulations. Operational work has, for example, also provided emphasis on coordinated planning of deliveries. In addition, criticisms of the lack of HSE inspection of design activity has been tackled with high profile blitzes of designers and now regular tracking back from site inspections to CDM duty holders including designers in proactive operational inspections as noted above. Additional HSE research (Symonds
Group et al, 2001 and 2004) has also taken a proactive stance with academia and wider government to ensure the management or risk is appropriately addressed in undergraduate construction courses to equip the designers of the future.

2.2.4.2 Refurbishment, Demolition and Structural Instability
Contrasting research focused on requirements at ‘underlying’ levels of construction projects specifically associated with refurbishment involving demolition and structural instability. The work examined practices in the UK and Italy (Loughborough University, Milan Polytechnic and Glasgow Caledonian University, 2004) based on industry interviews and case study material. The study linked some of the key factors at the design stage through to planning and execution as follows:

<table>
<thead>
<tr>
<th>Demolition Phase</th>
<th>Key factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td>Structural knowledge of the structure</td>
</tr>
<tr>
<td></td>
<td>Structural knowledge of any adjacent construction</td>
</tr>
<tr>
<td></td>
<td>Demolition equipment and methods selection</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td>Site knowledge</td>
</tr>
<tr>
<td></td>
<td>Health &amp; safety risk assessment</td>
</tr>
<tr>
<td></td>
<td>Development of safe sequences of demolition activities</td>
</tr>
<tr>
<td></td>
<td>Limitation of the level of subcontracting</td>
</tr>
<tr>
<td></td>
<td>Pre-qualification and selection of specialist contractors</td>
</tr>
<tr>
<td><strong>Execution</strong></td>
<td>Workforce supervision</td>
</tr>
<tr>
<td></td>
<td>Control of method statements implementation</td>
</tr>
<tr>
<td></td>
<td>Communication of unplanned discoveries</td>
</tr>
<tr>
<td></td>
<td>Safety information and training selection</td>
</tr>
</tbody>
</table>

Analysis of HSE’s specialist investigation reports related to structural collapse also informed the work revealing underlying causes corroborating the above factors, including:
- Absence of temporary structures to support unstable elements
- Lack of risk assessment at design stage, neglecting CDM requirements
- Lack of any preliminary structural survey or site investigation
- Poor planning of demolition sequences
- Lack of demolition method statements
- Lack of supervision while undertaking demolition activities.

Recommendations, mirroring aspects of the Habilis (2004) findings, centred on the crucial role of communication to ensure information about complex existing circumstances are understood and accounted for throughout the project. This in turn requires strong involvement of the client to provide sufficient time for necessary preparatory work to be undertaken, including the appointment of competent and qualified professionals and execution of site surveys. The authors conclude the principles of CDM, properly applied, provide for appropriate control.

2.2.4.3 Safety Representatives and Workforce Involvement
Work by Cardiff University (2006) as part of HSE’s cross-cutting research examining the role of safety representatives in influencing workplace health & safety, is an example of generic research with construction specific illustrations. Investigating the most effective arrangement and factors which support or constrain the implementation, also sheds light on poor practices, potentially contributing to accident causation by omission.
Quantitative and qualitative evidence of effectiveness linked to macro-level survey data was complemented by fieldwork studies which included five construction cases backed by a detailed review of the industry structures. The multiplicity of variables and legislative and structural changes affecting the potential validity of source data, prevented detailed conclusions about the effects of health and safety arrangements being reached from the analysis. However, it was clear that ‘top down’ management arrangements alone were not sufficient. In addition, the case studies confirmed that pre-conditions for effective arrangements identified in previous research were indeed essential, including: commitment of senior management to health and safety and its systematic management; competent risk evaluation and control; and effective external inspection. Furthermore, all of these are aspects of good occupational health and safety management practice, already required by law.

The construction case studies reflected typical arrangements across the industry with three non-union sites and two unionised sites, only one of which had a trade union appointed health and safety representative. The fragmentation (or lack of homogeneity) of work organisation was noted to undermine safety management arrangements generally but, in particular, the research team concluded that employees of subcontractors or agency workers fared less well in terms of consultation across all sites. However, on the two sites with trade union presence, the quality of involvement was higher overall, with the representatives stimulating worker participation thus improving communication and enhancing health and safety awareness, whilst also enabling the workers to see their own interests being recognised and represented. The research acknowledged the low trade union density in the industry but the health and safety benefits of worker representation and consultation in conjunction with commitment and cooperation from employers were advocated.

The ConP funded additional work in the construction industry specifically (Glasgow Caledonian University, 2006) focused on the essential elements of management cooperation and support, investment in health and safety training, and an open culture of trust alongside workers having competent advice on how to enhance work engagement. The research sought to measure the success in terms of effective communication and influence on decision making of four different worker engagement approaches, namely:

- Pre-task briefing and feedback cards
- Suggestion boxes and (prompted) safety circles
- Informal approaches – with the site manager and a worker ‘safety champion’ walking round the site hourly to discuss safety issues
- Safety representatives and health & safety committee.

The first three were implemented on different aspects of a project. The last was implemented under the guidance of a trade union safety advisor on a separate site and faced problems with the absence of volunteers for the safety representative role. The trials ran for around 12 weeks with between five and 50 workers on site at any one time; in parallel control sites were monitored without intervention.
The findings demonstrated a strong preference for oral rather than written methods. There was a strong correlation between the breadth and depth of issues discussed and the extent of formal health and safety training previously given to the workers. Most interventions left the workers more positive about their opportunities to express views and about management intentions. Not all cases were successful, one because the site manager was negative about the trial and in another the subcontracted workers were similarly sceptical. Overall the work was affected by the short-term nature of work on the relatively small sites studied which militates against long-term relationships. This does however characterise the reality for much of the construction industry.

One of the recommendations was for wider dissemination of practical guidance which has been followed through on the ConD website\(^a\) where a range of case studies, including the DWP Job Centre Plus examples are given, together with a decision support toolkit. The work has come under the auspices of a CONIAC working group (see Section 1.4 for the role of CONIAC) and one of the aims has been to encourage contractors to move beyond a minimum level of consultation to a point where the workforce is fully engaged in the process of health & safety management. While dealing with health and safety practices in general rather than underlying causes and / or fatal accident specifically, the work is an example of complementary research focused on effective risk control.

2.2.4.4 Regional Variation
Fisca (Factors Influencing Scottish Construction Accidents) was a coordinated project for HSE undertaken by BOMEL, Glasgow Caledonian University and the Institute for Employment Research (2006) with strong input from a large industry committee as the work progressed. It was commissioned to examine the reasons for the higher fatal and major injury accident rates persisting in Scotland compared with the remainder of GB as shown in Figure 2-21.

\[\text{Figure 2-21 – Comparison between Scottish fatal and major injury rates with the remainder of GB (BOMEL, GCU and IER, 2006)}\]

\(^a\) www.hse.gov.uk/construction/engagement/index.htm
The work covered:

- Statistical analysis of comparative sources of data
- Review of construction practices, including workforce interviews
- Expansion of the earlier analysis of underlying causes from fatal accident files (BOMEL, 2003a).

Where some differences in practice were identified, as listed below, which might be expected to be influential, none was considered sufficient to explain the discrepancy. Furthermore, the differing factors were also contradictory with some Scottish practices offering better safety.

- **Training** – the Labour Force Survey data indicated that Scotland has a better academic record, along with more apprentices. However, study of the fatal accidents indicates that the failure to recognise the need for training was identified as a factor in more Scottish fatal accidents.

- **Nature of construction firms** - Scottish firms tend to be slightly larger with more employees. The proportion of accidents in SMEs is the same in Scotland as the rest of Great Britain. There was some suggestion among interviewees that more importance was placed on safety within large contractors.

- **Employment characteristics** - Unemployment in Scotland mirrors the rest of GB over time. However, unemployment is around 1% lower in Scottish Construction – this could reflect a larger skills gap or could reflect a flourishing successful industry. There are no discernable differences in relations to age, travel to work time or job tenure. However, on average, Scottish construction workers work slightly fewer hours than those in the rest of Great Britain.

- **Trade Union representation** – There is a higher proportion of union members in the Scottish construction industry.

- **Client Profile** - Small private house building clients may place less emphasis on safety than public or housing association clients. As private house ownership is lower in Scotland this may lead to safer house building.

- **Physical Environment** - While inclement weather was cited as a factor leading to less safe working conditions in Scotland, interviewees who had worked in both Scotland and the rest of Great Britain did not think that there were large enough differences in climate to affect construction. Monthly accident numbers do not indicate differences in seasonal variation between Scotland and the rest of Great Britain. Distance to hospital can be a factor in outcomes.

- **Work practices** – More system scaffolding is used in Scotland. There are different roofing practices with more general use of sarking boards in Scotland.

In fact, advanced statistical analysis by IER demonstrated that the large majority of the Scottish differential can be explained by differences in the occupational composition of employment. In particular:

- The most significant factor was the differing occupational make up of Scotland and the rest of Great Britain. There are proportionally many more manual (at risk) workers in Scottish construction than in the rest of Great Britain. As a result, it appears that the overall accident rate is higher in Scotland – to understand this, consider head offices predominantly south of the border with many office based workers facing lesser risks but nevertheless linked to a construction SIC; for site based workers the risk both sides of the border is comparable.

- When the difference in the occupational make up is controlled for, there is no statistically significant difference in the major injury accident rate.

- There is still a slightly significant difference in the fatal accident rate, but this is only based upon a small number of fatal accidents and, as such, is not as robust...
a finding as the major injury accident rate. Furthermore the differential is less than demonstrated between the English regions.

The study also expanded the earlier scrutiny of fatal accident files (BOMEL, 2003a) to cover 90 cases in total, split 27:63 Scotland / remainder of GB reflecting typical fatal accident numbers. Figure 2-22 compares the primary factors of significance emerging. Design, training and procedure related issues were more prevalent in the Scottish cases but the small size of the sample for definitive conclusions should be recognised. Given this, it was concluded that the profiles of causal factors were reasonably consistent, although as a general observation, greater evidence of underlying organisational factors could be found amongst the Scottish cases. However, the legal practices and involvement of the Procurator Fiscal affect the reporting of investigations required and this, coupled with the small sample, would need to be eliminated as a factor before firm conclusions could be drawn.

Figure 2-22 – Expanded analysis of casual factors from 90 construction cases divided between Scotland and the rest of GB (BOMEL, GCU and IER, 2006)

2.2.4.5 Procurement

Where earlier work identified issues with contracting strategy and procurement practices (often linked to political influence) coupled with concerns raised by contractors that public procurement should be expected to set exemplary H&S standards, HSE has commissioned specific research to explore this potential underlying cause / control mechanism (Davis Langdon, 2007). Funded jointly by HSE, DTI (then BERR, now BIS) and OGC, the study objectives were to:

- Assess how the public sector is discharging its health and safety obligations vis-à-vis public procurement

Although the study demonstrates the value of examining exposure rates, it also confirms the wider point pertinent to the statistics in Part 1 of this report that for fatal accidents in isolation such measures are not statistically robust particularly for issues affecting sub-groups. HSE targets and supporting risk-based strategies are therefore generally cast in terms of the (combined) fatal and major injury rate.
• Assess the strength of the health and safety input by contractors into the tender process
• Establish the level to which best practice health and safety criteria have been ‘embedded’ within public construction procurement processes

A postal survey of 3000 public sector projects across Great Britain was targeted at the public sector clients and private sector contractors yielding a 13% response in both cases. The findings suggested, generally, public clients exhibited more confidence in terms of their responsibilities as a client than they did with their responsibilities for health and safety risk management. In particular, clients appeared to be most confident appointing competent teams and least confident monitoring project progress, outcomes and performance. Specific shortcomings in the way contracts were developed at various stages were identified in a number of cases, particularly related to the use of traditional procurement methods (see BOMEL, 2003a). The research also demonstrated limited adoption of the mandatory OGC10 guidance Achieving Excellence in Construction Procurement Guide 10, Health and Safety. Follow-on research has been commissioned by HSE in 2009 to go beyond this initial survey to explore in more detail why best practices are not always being followed to identify any obstacles and solutions.

2.2.4.6 Core Competency Criteria

A contrasting but complementary example is the research HSE commissioned to help tackle the perennial problem of ensuring competence – vis a vis contracting strategy, training and competence issues identified variously as underlying causes of accidents. John Carpenter (jzcarpenter, 2006), in consultation with industry, developed core criteria, subsequently adopted in the CDM 2007 ACOP to:

• Establish good practice in the selection of Contractors, Designers and Co-ordinators; and
• Set out an approach to selection which provides reasonable assurance whilst minimising bureaucracy and avoiding unnecessary paperwork.

This enabling research has been welcomed across the industry. Encouragingly, as part of the Booster survey of 500 site managers conducted in January 2008 to test the impact post-implementation, more than 70% already considered that demonstrating to the client that they and their contractors had the right skills and experience for the job was now ‘a fair amount’ or ‘a great deal’ easier. This was one of the most positive areas of response in relation to this initial survey testing the impact of the CDM 2007 regulations. HSE’s work is continuing in supporting efforts to streamline the processes of pre-qualification and accreditation to minimise the burden particularly on SMEs. In the current context, the research serves to illustrate the range of approaches taken in identifying and tackling potential underlying causes of construction accidents.

2.2.4.7 Stress

In addition to work on identifying underlying causes in relation to specific accidents, HSE has also commissioned research into the prevalence of issues within the industry. This research on stress is introduced briefly as an illustrative example (HSL, 2007). A postal survey of construction workers elicited a response from 1732 (a response rate of 35%) of which 5% were experiencing...
stress, depression or anxiety which they felt was caused by or made worse by their job or work done in the past. The most stressful aspects of their work were identified as:

- Having too much work to do in the time available
- Travelling or commuting
- Being responsible for the safety of others at work
- Working long hours
- Having a dangerous job

Those personnel most affected were management grade employees. Along with road maintenance staff, designers and administration staff report more stress than other job roles (primarily construction labourers / operatives). These findings tie in with some of the observations from specific groups identified in the influence network research (BOMEL, 2004).

Research such as this helps both in understanding and controlling such factors which could in certain circumstances become contributory causes.

2.2.4.8 Regulatory Revision

As part of the review of the CDM regulations 1994 a baseline study of practice was made (BOMEL, 2007) against which the impact of future changes could be measured. That process involved extensive surveys, consultation and workshops. Structured interviews with 25 organisations (five each of clients, contractors, designers, planning supervisors and principal contractors) revealed the following issues which could be seen as potential underlying causes or contributors to accidents:

- Duty holders’ lack of awareness of responsibilities
- Ineffectiveness of the [then] planning supervisor role
- A system encouraging risk transfer and self protection
- Implementation of CDM having led to excessive paperwork and bureaucracy
- Lack of clarity
- Incomplete coverage by CDM of project situations / parties
- Missed opportunities to manage risks through design
- Duty holder not using documents created under CDM.

Several of these were mirrored in other parts of the consultation and most have been addressed in the 2007 revision of the regulations the success of which will be tested in a forthcoming impact evaluation, the preparatory phase of which was commissioned by HSE in early 2009. The work forms part of ongoing monitoring of the impact of CDM (see also the Institute of Occupational Medicine, 2005, for example) to test improvement in the quality and effectiveness of the communication and information exchange between parties. Early results from the ConD’s survey of 500 sites around nine months after CDM 2007 came into force, already demonstrated significant improvements in some of the original problem areas as the results in Figure 2-23 illustrate. The ongoing evaluation will delve further to see how this translates into changes in risk control and safety performance.
2.2.5 Recent Operational Studies of Underlying Causes

2.2.5.1 Housebuilding
Research reported to this point has largely been performed by external bodies in collaboration with HSE and industry. However, additional studies are performed within HSE to support operational needs as the review of fatal accidents in domestic new-build demonstrates (HSE, 2007a).

Sector scrutiny of fatal injury notifications gave an early view on the rising number of fatalities in 2006-7 and, in particular, the apparent association with housing (Figure 2-24). The incidents were therefore examined in detail to find out what they revealed about conditions in the industry and whether there were any new issues which needed to be included in the Division’s operational workplan in current or future years.

The resulting report was a primary input to the Construction Forum later convened by the then Secretary of State in September 2007 (HSE, 2007b). The presentation took the failings from the specific cases and grouped them against risk control measures that could and should have been in place to reduce risks. This enabled learning from very recent cases to be disseminated in a desensitised format to enable key lessons about the underlying causes to be learned, as follows:

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a As a general point, although some caution is necessary to avoid policy being buffeted by what with time might be a ‘blip’ in the pattern of accidents, HSE and Government and industry stakeholders cannot take no action and wait to see whether a stable ‘statistical’ trend emerges. This research is therefore an example of the responsible approach taken in monitoring fatal accident patterns even before contemporaneous reference data are available and combining this with qualitative scrutiny of any emerging issues on which specific early action is warranted.
Supply chain management:
- In appointing specialist contractors, the Principal Contractor needs to be assured of their competence and safe working practices and ensure this is monitored against performance standards.
- Appointment of different Principal Contractors by phase demands high standards of communication and cooperation between the parties – the Principal Contractor for each phase must be competent to undertake this role.
- Subcontractors, particularly small firms, need to be integrated with the health & safety management ethos, not just for site compliance but as a fundamental part of managing a successful construction project to quality, time and budget.
- The Homebuilders Charter, Constructing Excellence, demonstration projects, and regional groups offer mechanisms to help share good practices through the supply chain.

Competence:
- Wider take up of the CSCS scheme would equip workers with the fundamental principles and practices for safe construction without damage to health.
- Site induction, training and toolbox talks needs to take place for the entire supply chain, reflecting changing site conditions, behaviour of specific mobile plant etc.
- Requirements for competence apply throughout the management chain so that leadership and commitment to health and safety are visible and continually reinforced.
- Management need to be competent and have access to competent advice for appointing specialist contractors and selecting specialist plant such as cranes. This needs to follow through to onsite monitoring and inspections.
- Workforce supervisors need to be equipped for supervisory aspects of the role including point of work risk assessments and reinforcement of health and safety standards.
- Improved dissemination of information is needed on good housing site practices such as truss handling, stairway openings, temporary support of panels, internal airbags, trench work, lifting operations, joist hangers, spoil heaps etc.
Design and planning:
- Site transport, lifting operations etc need to be considered at the design stage and risk management plans need to be in place, reviewed, kept up to date and communicated effectively.
- Safety can be improved with integrated traffic management and sequencing of selling off plan.
- Opportunities exist for improved building and product design to allow for safe erection, repair and maintenance of structures (e.g. temporary conditions in timber frame housing, opening of windows in plant / machines etc)
- Sharing of experience and lessons learned could enable industry wide safety benefits to be derived from improved methods, rather than leaving problems to be worked around repeatedly on individual sites.

The paper was a catalyst for action and the Strategic Forum for Construction (SFfC), with sustained input from HSE, has made significant progress over the subsequent year with work groups on sharing best practice information, raising levels of competence and encouraging worker involvement. Reporting to Ministers\(^a\) has confirmed the development, implementation and take up of specific measures. In addition specific work in the Construction Division Operational Workplan through 2008/09 has focused on house-building and the issues raised as lessons learnt.

2.2.5.2 Vulnerable workers
Another focus of research within the Division is on vulnerable workers. As described in Part 1, the Construction Programme has introduced five strategic cross-cutting projects to equip the Division with the insight and understanding to tackle the issues effectively. The generic concern in this project was for workers who may be vulnerable for some reason and as a consequence face higher levels of risk in terms of injury or ill-health. Work conducted by CONIAC’s Vulnerable Workers working group, has focused on:
- Young workers
- Ageing workers
- Migrant workers.

In all cases the initial investigation was to establish whether or not the workers were in fact disproportionately vulnerable using the criteria shown in Figure 2-25 and whether or not the grouping is helpful in being able to target support.

The criteria were developed from the definition of vulnerability set out by DTI / BERR / BIS\(^b\) in terms of: “someone working in an environment where the risk of being denied employment rights is high and who does not have the capacity or means to protect themselves from that abuse. Both factors need to be present. A worker may be susceptible to vulnerability, but that is only significant if an employer exploits that vulnerability.”

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<table>
<thead>
<tr>
<th>Risk of being denied employment rights</th>
<th>Capacity or means to protect themselves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Protected by normal employment arrangements</td>
<td>Protected by others</td>
</tr>
<tr>
<td>High</td>
<td>Vulnerable</td>
</tr>
<tr>
<td>Protected by their own efforts</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 2-25 – Criteria for establishing worker vulnerability**

**Young workers**

In the case of young workers, particularly 14-16 year old apprentices coming onto sites for up to 50 days under the DCSF scheme, there was no evidence or experience on which to rely so the lack of experience and inability to protect themselves, by definition, contributed to potential vulnerability. HSE therefore worked with government and industry bodies (the Learning and Skills Council and ConstructionSkills) to develop guidance for employers on how to provide good education without exposing inexperienced young people yet to mature physically, to risk. This work in effect tackled what otherwise might have been an underlying cause of accidents. Updating other guidance and provision of advice to workplace assessors has continued.

**Ageing workers**

A different approach was adopted for ageing workers (HSE, 2009c) based on an analysis of data shared by HSE and ConstructionSkills. HSE’s analysis showed:

- The 60+ age range comprises a steadily increasing proportion of the workforce (~8% in 2007 compared with ~5% in 2000)
- Over the period 1996/97 to 2005/06, data suggest the potential for fatal injury for those 60+ is of the order of twice that for the construction workforce as a whole (with no discernable trend across other age categories)
- The proportion of fatalities to the 60+ in construction, 1996/97 to 2005/06, is comparable to utility, manufacturing and services sectors at around 11% - in agriculture the proportion exceeds 30%.
- Falls (mostly ‘high’ falls) constitute 23 of the 25 construction fatalities to those 65+ in the 1996/97 to 2005/06 period – figures around 50% are typical for the full population
- Falls and trips form an increasing proportion of worker major injury accidents with increasing age categories across the spectrum
- For the 65+ age group, over 60% of fatalities related to the self-employed (comparable figures range from 10% (20-24) and 40% (60-64) in other categories)
- Almost 75% of the 65+ fatalities worked on non-notifiable sites (~40% is more typical for other fatalities)
- For both 60-64 and 65+ categories over 80% of fatalities are on small sites – 60% is more typical

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The ‘Extended Guide for Employers who are taking on 14-16 year olds to provide work experience in construction’ was published in late 2008 and includes new guidance to help employers identify and prevent involvement in work activities which will be unsuitable for young persons, taking into account their physical development and particularly immaturity. [www.cbediploma.co.uk/uploads/HealthandSafetyWorkExperience14-16_tcm20-10370.pdf](http://www.cbediploma.co.uk/uploads/HealthandSafetyWorkExperience14-16_tcm20-10370.pdf)
Around 95% of 65+ fatalities relate to small firms – 70% is more typical
Refurbishment constitutes 75% of 65+ fatalities with younger categories averaging around 50%
A significant proportion of older fatalities had occupations reflecting experience and autonomy (director, proprietor)
No evidence of age playing a part was captured in the incident narratives – descriptions like “fell from a ladder whilst cleaning gutters”, in this case at the age of 77, or ‘apparently fell from a tied ladder when painting the soffit of a two storey domestic property’ are regrettably not atypical of descriptions found across the age range
There is some indication that in a number of cases death followed a few days after the incident, possibly implying a lesser ability to withstand trauma.

In examining these variations and distinct factors affecting accident causation for the older age categories, it seemed reasonable to conclude that:
- the nature of work undertaken by older workers is different and more inherently hazardous than the construction average, leading to a disproportionately high fatality rate when assessed simply against age rather than
- the distribution of work irrespective of age is similar and the older workers are disproportionately exposed / susceptible to accidents leading to death.

This conclusion is consistent with the findings of a study conducted by the Institute of Employment Research reported in HSE research (IER, 2005). Trends in injury rates by age group were examined (the highest category was 55 and over). Based on detailed statistical modelling, it was shown that differing rates of non-fatal injury between older and younger workers is largely explained by the industry / occupational profiles of the working populations in these groups.

Based on the findings there was no evidence that the older workers were necessarily vulnerable per se – on the contrary many were experienced and / or had considerable autonomy in directing their work. In terms of causation, the analysis points to more fruitful intervention relating to work practices in the sectors where older people are employed, rather than directed at older workers alone. This demonstrates the important role the analysis of associated factors has as part of the process of understanding causation.

In presentations to the CONIAC working group, HSE has also drawn in work undertaken by Loughborough University (HSE, 2009c) looking at practical considerations for contractors employing ageing workers and for equipment suppliers in enabling older workers to continue to provide their skills. This extends to work simulating the physical challenges faced by ageing workers and dealing with the acceptance of ill-health by some workers and the potential hostility and lack of appreciation by co-workers. A joint HSE / Loughborough guidance note to raise awareness of the issues is due for publication in 2009.

**Migrant / Foreign workers**
The scrutiny of the vulnerability of migrant workers has been more detailed and has provided another perspective on causation. The work within the cross-cutting project has been built around a number of strands including:
• Examination of 25 fatalities affecting migrant / foreign workers to assess evidence for vulnerability
• Comparative analysis of 25 fatalities not from the migrant / foreign worker population
• Collaboration with the Institution of Civil Engineers’ (ICE) Migrant Worker Task Force, coordinating work by Loughborough
• Collation of summary findings to assess the extent of the migrant worker population in construction
• Communications research into approaches to health and safety issues amongst migrant construction workers in the UK – giving insight to the influences on practices amongst different communities and the general sources they use for information and advice of different types
• Collaboration with ConstructionSkills for joint Loughborough / Glasgow Caledonian university research to both develop a sign based toolkit to overcome language barriers and further understand the true nature of language issues in the construction context
• Work with Labour Agencies
• Delivering a pilot outreach service with Healthworks in Newham for migrant workers in the area, including surveying the experience profile and information needs of migrant workers in the area and disseminating information on ‘know your rights’ building on the benefits and lessons learned from early outreach work undertaken by operational teams around the country.

Focus in relation to the Inquiry is on the first three in this review, but the contribution of other workstreams to expedite improvement in what are feared to be obstacles and potential contributors to accidents is worthy of note.

ICE / Loughborough research

The ICE sponsored Loughborough research (Loughborough, 2007) which focuses on the South East includes a thorough review of such information as is available on migrant workers and includes reference to the work of London Metropolitan University (2005) for HSE reviewed below as well as other sources. In addition, the work involved interviews with 55 recent migrants working in the industry, seven employers and six other stakeholders plus an additional short survey. The sample centred around 11 sites in the South East. The authors warn that the numbers are too small and the focus skewed for universal conclusions to be drawn. The work does however provide some insight to human and organisational factors which need to be tackled if failings are not to become underlying causes of accidents. Examples include:

• Migrant workers were mostly employed by subcontractors but with the individuals having little understanding of their status, employment rights including health and safety rights and obligations
• Communication presented the biggest challenge to employers who believed they were overcoming this with translators or buddy systems whilst recognising the approaches ran counter to effective integration
• Resentment from some UK workers and animosity between other nationalities led to racism and harassment, potentially detracting from cooperation
• Workers claimed good understanding of safety but employers reported some lack of awareness of certain hazards
• Most had or were working towards a CSCS card or similar
• Most were young, working in relatively low skilled jobs, with some in specialist trades or engineering roles
Despite good practice through translations, induction etc, employers felt a central coordinating focus in the industry was needed [something the ICE task group has since stepped up to provide].

HSE survey evidence
This information is complemented by insight from recent HSE surveys – the Fit3 survey of 6000 employers including 680 construction firms and the Booster survey of 500 construction site managers (HSE, 2008a & b). Importantly these surveys provide some reference facts to enable interventions to be appropriately targeted. These confirmed a number of associated factors and concerns, including:

- The proportion of workers in construction who are migrant as indicated from the Fit3 survey is around 5.9%, somewhat below the all-industry average from the survey of 10.2%.
- The proportion of construction businesses employing migrant labour, at 26%, is one of the lowest of all industry sectors.
- Construction businesses are slightly more likely to be employing migrants from Eastern Europe and less likely to be employing migrants from other regions when compared with other sectors. Of those construction firms employing migrant labour, in 83% of cases at least one worker is from Eastern Europe.
- The proportion of employers of migrant workers perceiving them to be at greater risk is considerably higher in construction (22%) than the all-industry average (12%).
- In common with other industries, communication / language issues were the dominant reason for increased risk recognised by construction employers.
- Although, in general, 50% of migrant worker employers had done nothing specific to safeguard migrant workers, the proportion in construction was lower at 31%, i.e. suggesting more active attention is being paid to the risks.
- There appear to be some differences in the risk control approaches being taken in construction compared with other industries. Whilst an understanding of English is least likely to be a precondition of employment in construction compared with other sectors, the provision of induction / training material in other languages is the highest of any sector. In addition the use of interpreters, at 23%, is higher than in any other sector.

The Booster survey actually provides comparable information with around three-quarters of sites reporting no migrant workers but on 3% (29 sites) more than half the workforce was said to be ‘migrant’ – in the recent 2009 update, although a comparable number of sites employed migrant workers, only 1% (six sites) reported more than half the workforce to be migrant. Slightly higher proportions of commercial sites had migrant workers than housing and industrial categories but the spread is relatively even – the recent survey has suggested closer agreement. However regionally, the proportion of sites with migrant workers exceeds 70% in London, the next highest responses coming from Luton (approaching 40%) with nearer 30% for Basingstoke and East Grinstead and Glasgow but figures around 20% for most other HSE regional bases. There was also clear evidence that larger proportions of migrant workers are associated with the more populous, longer lasting sites. In terms of language issues, although many site managers judged that none of the migrant workers had language difficulties, on nearly 40 sites more than 50% of the migrant workers were judged to have language difficulties. Furthermore, on a number of those sites the
migrants comprised more than 50% of the workforce implying that at least 25% if the workforce had language difficulties. Issues of small sample numbers should be considered when reviewing the findings from a subset of respondents to the survey.

**Analysis of 25 fatal accident cases**
The final aspect of the vulnerable workers work covered here, concerns the scrutiny of specific fatal cases. Across the years 2005/06 to 2007/08 the Construction Sector identified 25 of the fatalities had related to migrant or foreign workers. Although since 2008 HSE central investigation records identify migrant workers, the country of origin and status, for an individual working (or who has worked in the past 12 months), and who has come here from abroad to work within the last five years, the Construction Sector fatalities initial notifications database has maintained records over a seven year period. The construction definition differs and relates to nationality irrespective of time in the UK but is more readily determined. It also over-, rather than under-, states the position.

The study purpose was to identify any common factors and to consider whether the workers were vulnerable by virtue of their foreign / migrant status. With the focus on recent cases and a number of investigations / prosecutions ongoing or pending, the purpose was not to determine a comprehensive assessment of the direct and underlying causes, rather it was to identify any underlying causes linked to vulnerability. This scrutiny was complemented by a comparative analysis of a further 25 fatalities in the period, selected at random from the sector database to ensure the findings were set in an appropriate context. It was noteworthy that prior research into migrant issues has almost never included a control sample (Edge Analytics and Leeds University, 2008) and this enabled the significance of findings for the migrant / foreign worker dataset to be moderated. The work was also complemented by a survey of seven of the 20 field management units to collate different aspects of operational experience in dealing with migrant / foreign workers. In particular they were asked to suggest from their experience (of reactive and proactive inspection, engagement with stakeholders, investigation and enforcement, outreach work etc), those issues they considered most likely to put foreign / migrant workers at risk. These were readily grouped, with the following themes coming through repeatedly:

- Language skills
- Unscrupulous managers
- Lack of understanding of UK H&S systems & standards
- Cultural differences.

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\(^a\) A statistically significant change between the 2009 and 2008 surveys is that now 72% of sites with migrant workers (compared with around 55% previously) say none has difficulty speaking or understanding English. Similarly, where around 15% of managers on sites with migrants were saying that more than 50% had language difficulties in 2008, that proportion had reduced to 4% in the most recent (2009) survey.

\(^b\) It is noted that this information may enable those cases where country of origin is incidental to the fatality to be distinguished from the case of recent arrivals where it may be crucial.

\(^c\) Consideration was given to developing a matched sample, for example by sector, however the multiplicity of accident circumstances and the relatively small pool of cases for statistical sampling prevented a rigorous treatment that would not be confounded by factors which could not be controlled for.
Amongst the practical suggestions for improvement were site manager training to include how to communicate with migrant/foreign workers and information on the equivalence of national qualifications.

The main part of the study focused on the 25 migrant/foreign worker fatalities. The operational construction inspector who undertook the work began by reviewing the records for each case and then interviewed the investigating inspector to ascertain detail pertaining to the migrant status, the nature of employment and work control, and the experience, skills and capabilities of the deceased person (DP) – personal and situational factors. These findings enabled a judgement to be made against the indicator to assess the vulnerability of the worker and the potential significance in the accident causation shown in Figure 2-25. These judgements were difficult and distinct. For example considering pay there may be evidence of exploitation but health and safety provision may still have been adequate. In addition, although a worker may have appeared vulnerable, the nature of the accident may mean that the consequence would have been the same for any worker at that place at that time.

For each case the details were recorded including the causation factors from the investigation where it had concluded. Against each of the vulnerability measures (capacity to protect themselves and risk of being denied employment rights), relevant factors were recorded and rated on a scale leading to a vulnerability index. It was concluded that 16 of the 25 were vulnerable (three of the 16 died in a single incident). The same process was repeated for the control group of 25 other cases selected from the same three-year period. Of these seven were considered to match the vulnerability criteria.

The inclusion of recent data in the studies means that many of the migrant/foreign and control group cases are subject to ongoing investigation and formal processes such that specific details of the vulnerability judgements cannot be published at this stage. The bubble chart in Figure 2-26 however shows the extent (radius) to which the vulnerability factor combined across the cases. There are no distinct patterns or groupings differentiating the two datasets and the principal conclusion at this level is that members of both groups may be judged to be vulnerable or not vulnerable against the criteria particularly given the relatively small number of cases involved. However, foreign/migrant workers (blue) can be seen to be more prevalent in the far bottom right of the chart, indicating cases where the denial of employment rights is strong and the capacity to protect themselves weak.
Figure 2-26 – Distribution of the vulnerability factors found for the recent migrant / foreign (blue) and control group (red) cases. The diameter of the ring reflects the number of case at each point on the scale

The detailed findings for the migrant / foreign group\(^a\) included:

- Language skills were noted by the investigating inspector as a contributory factor in 7 cases; amongst those judged not to be vulnerable, 5 of the 9 were noted to have good or fluent English
- On the whole, the non-vulnerable group had spent longer in the UK, although the period was unknown in a number of cases
- Construction experience amongst the vulnerable group was generally less than the non-vulnerable group – for 5 it was none, 5 small, limited or some and for 6 it was unknown; 6 of the non-vulnerable group had extensive experience
- A number of deaths resulted from CO poisoning within site cabins, including 1 member of security staff.

Comparison between the control and foreign / migrant groups revealed:

- Experience levels in the control group were higher than amongst the foreign / migrant group – 15 were considered experienced or very experienced compared with 4 – this affected the judgement of ability to ‘self’ protect
- The experienced foreign / migrant workers were generally employed on large CDM notifiable sites; experienced workers in the control group were working across the spectrum
- The average age of the foreign / migrant groups was on average 10 years younger than the control group – there were 9 over 55s in the control group compared with 2 amongst the foreign / migrant cases.

\(^a\) It is possible that the findings could be driven by the sector in which the migrant/foreign workers were employed but they help, nevertheless, in understanding the circumstances associated with migrant/foreign worker fatal accidents.
The figures suggest a high proportion of fatalities in all groups occurred within the first week on site – however some jobs on a site are short term and some sites are of short duration. Experienced workers were included.

Around a third of both vulnerable groups (but note proportions of small numbers) were described as employed ‘casually’. The prevalence of casual employment across the foreign / migrant worker population appears to be higher.

Falls from height dominated fatalities in both groups. There were no transport related deaths in the foreign / migrant cases – 3 in the control group involved moving plant and a further 3 lifting equipment / plant.

The control cases demonstrated greater levels of supervision / management than evident in the foreign / migrant worker cases.

In considering the findings, it is important to recognise the small number of cases, the variability in construction activity and fatal accident circumstances, and the uncertainties in assessing vulnerability. Nevertheless, no similar study has been undertaken and the work has provided important new insight to the profile of relevant factors. For example work to help ensure adequate training and integration with larger contractors presents one route to improvement but for the smaller sites / rogue employers / informal end of the industry, work with community groups to equip workers to know their rights and understand safe practices is being pursued.

Health and safety risks for migrant workers
Construction Division’s work reported above also draws on centrally commissioned research (London Metropolitan University, 2005) to establish whether migrant workers across all industries face specific or general health and safety risks leaving them more exposed to risk than other workers. This is a comprehensive study, supplemented more recently by a trawl of demographic data sources (Edge Analytics and University of Leeds, 2008), which included interviews with 25 construction workers and eight employers in construction. Specific issues for migrant workers in the industry and covered in a detailed appendix. Consistent with other studies (in part influenced by the recruitment methods) findings included:

- A relatively young group of male workers (typically mid 20s to 30s)
- Many workers with average or good English with evidence of employer checks on adequate communication
- None of the workers directly mentioned lack of English as a perceived risk
- Most (15) were self employed getting work by word of mouth – some had been recruited from their home countries; 5 were agency workers and 5 directly employed
- Compared with other sectors the least number of workers were shifting between industries, reflecting the deployment of specific skills.
- None was considered underqualified
- Most worked regular hours, 40-45 per week
- Most had experience of training and site induction
- Migrant workers felt they were paid less and given the heaviest jobs but were nevertheless generally satisfied.
- There was a reasonable awareness of safety hazards and recognition of precautions.
- There seemed to be adequate safety procedures in place at the workplaces, noted to be enhanced with vigilance from foremen, supervisors etc.
• Greatest concern was for the workers from non A8 countries working without work permits

The smallest businesses in the survey were in the 21-50 worker category with most considerably larger which affects the picture portrayed. Many of the fatal accidents in the HSE study affected workers on small sites.

2.2.5.3 Barrier Analysis focused on Behaviour Change Controls with SMEs
A major area of research being undertaken by HSL for HSE with the involvement of an active industry steering group concerns behavioural change and worker engagement (BCWE), in particular developing practical guidance and a toolkit to enable small to medium construction firms to implement good practice. In order to help determine the most relevant and critical behaviours to be addressed, a barrier analysis has been made of all construction fatalities occurring 2000-2008. The work was undertaken by a former construction inspector, now retrained and a member of HSE’s Human Factors CTG.

In considering the appropriate framework, prior research WS Atkins (2001) and Loughborough University & UMIST (2003) was reviewed together with more recent work undertaken by HSL in reviewing recent Rail Accident Investigation Branch reports. The aims were to:

- Identify common unsafe / risk-taking behaviours
- Identify (where possible) where unsafe behaviour results from violation or risk knowledge gaps (or other forms of human error / failure)
- Identify appropriate risk controls, including ‘behavioural standards’ that would have prevented the fatal accident(s) occurring.

To do this each fatal accident short summary was reviewed and consideration given to foreseeability, the nature of any human failure, potential barriers, the degree of impact the barrier should have and whether it was distinctiveness or commonplace. In particular, criteria for the barrier selection reflecting the focus of the BCWE work were:

- If implemented on its own, and in the absence of other precautions, it would have prevented this (and similar accidents) occurring
- It should be reasonably practicable to implement
- It should reflect existing standards
- It should be targeted primarily at the unsafe behaviours that immediately precede the accident
- It should focus on proximal / downstream factors rather than distal / upstream factors (ie focusing on the ‘coalface’ rather than management systems).

The focus was on accidents that might typically be experienced by SMEs, which should be preventable through applying standard safeguards and solutions, responsive to interventions such as the BCWE initiatives. This meant that, for the following reasons, around 42% of the accidents were excluded from the analysis.

\[a\] The work is not a substitute for fundamental risk management controls to eliminate or reduce risk exposure, but it does provide a complementary means to engage the workforce to ensure that when risks arise a further behavioural ‘barrier’ is in place.

\[b\] Although the Inquiry focus is on underlying causes, the relevance of this work is that it demonstrates HSE’s support to providing layers of defence primarily eliminating causes but ensuring when failures arise that the workforce is adequately equipped.
as they would not provide relevant information to inform guidance for the target audience:

- Certain accidents were so rare as to be regarded as freak events (e.g. temporary traffic management (TTM) workers run over by a runaway horse-drawn hearse). They were neither foreseeable, nor (often) preventable.
- Others were excluded not as much because they appeared to be rare, but more so because they failed to fall into discrete, easily identifiable categories.
- Certain work activities were not relevant to most construction SMEs (thus, though TTM was clearly associated with a high death rate, it was nevertheless excluded because it was regarded as a specialist, stand-alone work category. The same reasoning was applied to steeplejacks).
- Accidents likely to have complex and technical failure modes were excluded (e.g. crane collapses / incidents involving massive mechanical failure).
- Fatal incidents involving (usually elderly) members of the public walking into streetwork areas were excluded.
- Many electrocutions were excluded because it was difficult to identify clear patterns of failure.
- Some accidents were excluded because it was not possible to easily identify reasonably practicable precautions that would have prevented the accident (many of the TTM accidents were of this nature, as were some of the Demolition / Collapse incidents).
- Many accidents were excluded for the simple practical reason that there was insufficient information available to conduct even the most rudimentary of barrier analyses.
- Accidents where post-accident medical complications / hospital infections had a role were excluded.
- Accidents where person had a seizure / fit were excluded.

The above list is reproduced in full because of the insight to aspects of causation in construction fatal accidents more generally. It should also be noted that the selection complements earlier studies of causation (e.g. Habilis, 2004) which relied on specialist inspector reports, more likely to be involved in the cases excluded here.

Based on the barrier analysis it was possible to identify a list of relevant accident categories, many of which are subcategories of the broader terms already used in the Sector fats initial notifications database. The re-categorisation enables specific barriers to be identified and promoted through the BCWE change programme in a practical and meaningful way. Again, although focused on prevention, the underpinning analysis provides pointers to the direct causes and some underlying causes. Table 2-2 summarises the emerging classifications in rank order, demonstrating the significance amongst all fats in the period. The study is ongoing but has provided important insight to direct and focus the BCWE deliverables which are to be trialled with SMEs in 2009.

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This identification of the scenarios underpinning fatal accidents mirrors the Dutch Workgroup Occupational Risk Model (WORM – Hale, A R, et al. ‘Modeling accidents for prioritizing prevention’, Reliability Engineering & System Safety, Vol. 92, 2007) which addresses risk control as a dynamic process keeping work within a safe envelope. It is not a substitute for more fundamental attention to safety management controls but it does demonstrate the complementary learning derived from fatal accidents and the multi-faceted approach being taken by ConD to ensure a full hierarchy of preventative measures is implemented.
Table 2-2 Prevalent accident characteristics from scrutiny of RIDDOR notifications

<table>
<thead>
<tr>
<th>RANK</th>
<th>ACCIDENT TYPE – FATAL INCIDENTS INVOLVING:</th>
<th>NO. OF DEATHS 00-08</th>
<th>% OF TOTAL DEATHS 00-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ladders</td>
<td>72</td>
<td>11.3</td>
</tr>
<tr>
<td>2</td>
<td>Fragile roofing materials (excluding falls through joists)</td>
<td>61</td>
<td>9.5</td>
</tr>
<tr>
<td>3</td>
<td>Tube and fitting and system scaffold (excluding suspended scaffold)*</td>
<td>36</td>
<td>5.6</td>
</tr>
<tr>
<td>4</td>
<td>Pedestrians being struck by moving plant (excluding detachment of quick hitch buckets / mechanical failure / TTM incidents / Driverless incidents / overturns and lifting failures)</td>
<td>30</td>
<td>4.7</td>
</tr>
<tr>
<td>5</td>
<td>Lifting Failures (excluding crane collapse)</td>
<td>24</td>
<td>3.8</td>
</tr>
<tr>
<td>6</td>
<td>Falls through Internal Voids (excluding falls through joists)</td>
<td>22</td>
<td>3.4</td>
</tr>
<tr>
<td>7</td>
<td>Overturns of plant</td>
<td>21</td>
<td>3.3</td>
</tr>
<tr>
<td>8</td>
<td>Working in, on or adjacent to pre-weakened structures</td>
<td>20</td>
<td>3.1</td>
</tr>
<tr>
<td>9</td>
<td>Contact with overhead power lines</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>10</td>
<td>Asphyxiation / Fume Poisoning</td>
<td>14</td>
<td>2.2</td>
</tr>
<tr>
<td>10</td>
<td>Tower / mobile scaffold (excluding tube and fitting and system scaffold)</td>
<td>14</td>
<td>2.2</td>
</tr>
<tr>
<td>11</td>
<td>Excavations</td>
<td>12</td>
<td>1.9</td>
</tr>
<tr>
<td>12</td>
<td>Falls from vehicles</td>
<td>6</td>
<td>0.9</td>
</tr>
<tr>
<td>13</td>
<td>Not turning off before getting off</td>
<td>6</td>
<td>0.9</td>
</tr>
<tr>
<td>14</td>
<td>Quick-hitch failures</td>
<td>5</td>
<td>0.8</td>
</tr>
<tr>
<td>15</td>
<td>Falls from Flat Roofs (excluding falsework)</td>
<td>4</td>
<td>0.6</td>
</tr>
<tr>
<td>15</td>
<td>Wall underpinning / walls being undermined</td>
<td>4</td>
<td>0.6</td>
</tr>
<tr>
<td>16</td>
<td>Falls from mezzanine floors</td>
<td>3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Significantly the work demonstrates how the 10 principal types account for more than 50% of fatal accidents providing a powerful focus for targeting impact. However, it also demonstrates that the remaining 50% reflect a myriad different accident type scenarios for which factors other than accident type will necessarily be the focus if effective action is to be taken.

2.2.6 The Impact of Incidents

For the most part, the foregoing sections have dealt with the causes or factors associated with the occurrence of incidents. HSE has also commissioned complementary research into the vocational, economic, social and psychological consequences of workplace injuries and ill-health on employees and their families (HRA, 2006). The study examined two sectors, healthcare and construction, and so provided valuable insight for the Division.

In relation to construction, the study comprised a telephone survey of 130 workers who had suffered a reported injury or illness (samples of 94 and 36 respectively). This provided quantitative evidence of the emotional impact, with 60% of those who had suffered a construction accident still being affected emotionally at the time of the telephone interview (conducted between 10 weeks and up to a year after the event) and nearly half of those reporting symptoms

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*a The Inquiry Chair has put particular emphasis on the human face of construction fatal accidents and this research demonstrates the priority placed on this by HSE in its research as well as operational activity as described in Part 1. Although not focused on fatalities (because of the obvious sensitivities in conducting research), it does nevertheless provide complementary insight to perceptions of causation and accountability.
indicative of post-traumatic stress disorders (PTSD). Social consequences included 63-77% of construction accident victims experiencing restrictions on daily living (39-67% in the case of ill-health), 80% (39%) restrictions on mobility, and 60% (17%) restrictions on social life. From a vocational perspective, 40% of the construction accident cases and 66% of the ill-health cases reported their job was or was likely to be affected.

Beyond the survey, detailed home interviews were undertaken with the individual and family members in the more serious cases – for construction this covered 20 injury and a further 20 ill-health cases. A small subset was followed up again at a later date. It should be noted that one of the aims had been to examine the impact of fatalities on families and work colleagues with a sample of 20. However, the practical and ethical difficulties of access meant this element was removed from the scope underlining the challenges in this area. Nevertheless, the more serious injuries included cases where the outcome of the incident could easily have been fatal (e.g. 5m fall from scaffolding); similarly, the ill-health cases included people with life limiting diseases (e.g. mesothelioma). These therefore provide some relevant insight for this Inquiry.

Before drawing from the interviews, it is important to note that the study was not aimed at objective determination of causation. The affected parties (AP) were asked where they thought the fault lay particularly as this led to understanding whether claims for financial compensation were being made in the context of economic impacts. Whilst the reports provide some information relevant to this Inquiry, the cases are few in number and are self-reported judgements by the AP, who may or may not have been supported by their employer, involved in a formal process of investigation, constructing a claim or otherwise examining ‘duties’. Despite these limitations (acknowledged by the report authors), Table 2-3 summarises the responsibility perceived by the AP.

<table>
<thead>
<tr>
<th>Whose responsibility</th>
<th>Injury</th>
<th>Ill-health</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-one</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Themselves</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Employers</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Manager / Supervisor</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Colleague / Co-worker</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Main contractor</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Equipment manufacturer</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Industry wide problem</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

NB Total in each column exceeds 20 as responsibility was sometimes assigned to more than one party, typically themselves and employer or manager.

When citing some employer responsibility, follow on comments related to not supplying adequate equipment, absence of appropriate training and insufficient workers to cope with the demands of the work at the time. Similarly a main contractor was blamed for not providing sufficient information to carry out the task safely. Another worker, who fell 15 foot from a ladder, felt he and his supervisor were responsible, the latter for getting him to carry too heavy a load up the ladder. The natural focus on direct causes is also revealed in the case of a man...
trapped against a wall by a roller (resulting in multiple fractures and crushing injuries) who attributed responsibility to a co-worker on the site as did a worker impaled by a scaffold pole and crushed between scaffolding and a skip lorry. Responses covered the full range, with one AP, whose back was broken as a consequence of a fall, declining to assign responsibility saying it was just one of those things. Similarly in a case of asbestos related mesothelioma, the AP felt no particular person was responsible and viewed it as a lack of knowledge at the time. Another AP with the same condition felt past and current employers were responsible. A man suffering chronic silicosis attributed responsibly to himself (for not complaining about inadequate ventilation) and his employer (for not addressing the risks). Where Employer / Main Contractor failings where cited, these included provision of incorrect or insufficient PPE (in one case lead poisoning, for example).

The observations are anecdotal and from a specific perspective but give some insight to the expectations workers have about where responsibility for a safe work environment lies.

A final point derives from the information about the economic situation of the 94 construction respondents to the telephone survey. Two-thirds were on less than full pay, most notably 48% reliant on statutory sick pay or other benefits and 15% with no form of financial support. Other economic factors in the industry included limited job security, non-transferable skills with limited scope for returning to light duties and the small size of many employed companies. Together these factors were seen to drive workers to seek financial compensation. Conversely recognition of these factors should be a powerful incentive to avoid unacceptable risks which might lead to serious injury.

The full scope of the research was used by HSE to provide more comprehensive support and guidance for inspectors when interviewing those affected by workplace trauma.

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*a The attribution of responsibility for accidents before or after they happen is an area with substantial underpinning literature beyond that which it is appropriate to include in this Inquiry summary. This research does however demonstrate the breadth of HSE investigation in relation to the causes and consequences of accidents.*
2.3 STRUCTURING UNDERLYING CAUSES

2.3.1 Derivation of combined model structures

In the foregoing discussion of investigation methods, it was noted (HRA, 2001) that “a causal model that represents a system-based approach to incident investigation” is the necessary first stage. A number of models were then presented in relation to HSE’s own and recommended approaches (e.g. HFACS-C - Walker, 2007; ECFA+, etc) and within the commissioned research into underlying causes (Loughborough and UMIST, 2003; BOMEL 2001, 2004 etc). The plethora of underlying causes revealed by the many other studies of construction safety and accidents, bring attention full circle back to the need for a unifying system-based model to provide a basis for interpreting the evidence.

The Inquiry has been conducted with the oversight of three academic peer reviewers, with particular input from Professor Andrew Hale (Professor of Safety Science at the Delft University of Technology, The Netherlands), principal author of the ARAMIS\(^a\) safety management system structure. As part of the Phase 2 case study work, a mapping was performed between the HFACS-C model used in Phase 2 (and developed from Figure 2-4), the Influence Network (e.g. Figure 2-6), and Loughborough (Figure 2-10) and ARAMIS models alongside the requirements for management of construction and design enshrined in the CDM 2007 regulations and ACOP (HSC, 2007) and the HSG65 principles of safety management (HSE, 2003a). The resulting ‘combined’ model and mapping is reproduced in Annex 2-3. The underlying considerations, derivation and use will form the subject a future paper as detailed methodological coverage would be out of balance here. However, the combined model was used extensively in interpreting the Phase 2 case studies (HSE, 2009b) and the same model provides a meaningful basis for consolidating the Phase 1 review findings.

Importantly the resulting ‘combined’ model, shown in Figure 2-27:

- Retains the coverage of direct and underlying organisational, policy and environmental influences of the IN system, enabling not only factors but their inter-relation and paths of influence to be analysed
- Is comprehensive in the treatment of human, hardware and external influences
- Reflects the recognised elements of safety management good practice
- Retains the flexibility to group or subdivide factors as may be appropriate to the sector / scenario circumstances
- Provides transparent linkage to the explicit requirements in CDM 2007
- Offers the potential for strategic use in designing and prioritising alternative interventions based not only on the rating of factors but also on the weighting of influences between them.

Figure 2-27 Combined model of direct and underlying factors relating the causes and control of fatal accident risks

The combined model is shown in layers with the general commercial and regulatory ‘Environment’ (at the bottom), most distant from the fatal accident circumstances (at the top). The ‘Corporate systems’ in terms of contracting strategy, leadership and culture, for example, are shown together influenced by the wider industry environment but also influencing the ‘Delivery systems’ at the site management level. The array of delivery system factors reflect recognised elements of safety management such as resource planning, communication and cooperation, planning and risk assessment, etc etc. Most of these elements are mirrored at the ‘Output’ level, on the ground, on site where construction activity take place and the immediate control of the risks is required.

2.3.2 Mapping diverse research finding to a single combined model

An exercise was undertaken to map the underlying causes revealed in the different studies and listed in this report onto the combined model simply in terms of the frequency with which relevant matters were identified. Although the structuring is helpful in identifying recurring themes, some caution is needed for the reasons set out below:

- A number of different taxonomies and investigation models (and none) have been used by the original researchers.
- Lack of clarity in the source material and the absence as yet of precise definitions for the new combined model leaves some uncertainty in the mapping accuracy.
- Where the studies have had different foci, and / or were not necessarily undertaken from a system perspective, this may mean particularly strong or negligible attention may have been given variously to certain factors
- The studies have drawn on different evidence sources (data, industry / HSE focus groups, investigation reports etc) as illustrated in Table 2-1 which could have different inherent bias or emphasis.
The studies have sought underlying causes of different accident types and / or solutions to bring improvement (tackle underlying causes) and not all will be equally relevant or applicable to fatalities.

Despite these apparent ‘reservations’, the balancing strengths of the prior work undertaken should also be acknowledged:

- The different approaches have been well suited to exploring the causation and meaningful controls for certain types of fatal accidents in specific sub-sectors.
- Furthermore, there is strength in involving different research teams with complementary expertise in accident investigation / human factors / technical design / construction management etc and often this is embedded in preferred modelling approaches.
- The academic literature does not include a universally agreed system model of accident causation (nor especially one suited to construction) and it would be unwise to shut out new thinking and alternative approaches.
- Some continuity in methodology has been achieved with use of the IN to structure, for example:
  - Accident attribute data
  - Evidence form specialist reports
  - Learning from fatal accident files
  - Industry and HSE focus groups to rate and weight factors in specific areas
  - Recommendations for preventing major and over-3-day injury incidents
  - Baseline reviews against which to monitor the concerns and extent of CDM 2007 impact
  - The likely impact and effectiveness of proposed interventions.

### 2.3.3 Principal underlying causes

These reservations notwithstanding, the mapping of underlying causes emerging from the research reviews was conducted to measure the relative dominance of factors. The mapping was undertaken without reference to Phase 2 case study findings (HSE, 2009b) and furthermore without any moderation to attempt to control for any of the noted inconsistencies. Whilst the uncertainty should be recognised, the degree of impact could not sensibly be quantified. Figure 2-28 highlights the principal areas associated with the underlying causes of construction fatal accidents.

In the event, the correlation between the findings from this Phase 1 review and the 28 accident cases analysed thoroughly in Phase 2 is remarkable. The dominant four of the eight ‘output’ factors corresponded as did the dominant four of the 11 ‘delivery’ system elements. Similarly of the seven corporate level factors the principal two agreed, in all other cases the remaining factors were relatively rare contributors. This provides some confidence that these underlying causes of construction (fatal) accidents revealed by the research warrant continued attention.
Specifically, at the output (direct) level issues with the hardware - equipment suitability and usability combined with general workplace conditions were a dominant factor. Deficiencies in competence and suitability of the personnel for the specific work and the problems with planning, risk assessment and risk control selection on the job were identified to a significant extent. The fourth factor emerging from the research in this report concerned participation, motivation and conflict resolution within which concerns about compliance, complacency and over-confidence reside. It did not, however, come through as strongly as in the Phase 2 fatal accident cases. The explanation is likely to lie in the different nature of the evidence sources and the significant impact of such individual characteristics in the instances where they arise.

At the delivery system (site management) level the correlation is even closer. Planning and risk assessment and risk control selection (pre-planning); competence, selection & training and information; hardware (equipment) design, selection, availability, and use; and monitoring & correction and supervision being key factors emerging from the research studies based variously on focus groups, investigation files. These correspond to the leading issues from the Phase 2 fatal accident cases.

Other factors have been shown to play a part in fatal accident causation within the specific research studies, just as they contributed to some fatal accident cases in Phase 2. However, the principal focus is on those factors listed. Whilst the quantification is instructive, it is important that the qualitative insight from the research is also kept in focus as improvement measures are designed as detailed in the body of this report.
2.4 CONCLUDING SUMMARY

The foregoing sections have demonstrated a range of studies by HSE in relation to underlying causes of construction fatalities and/or the barriers good practice in these areas can present. The factors can be underlying causes of accidents when poor but equally can be barriers or risk controls when implemented well and studies have examined the factors from complementary angles. The available data on fatal accident causation have been worked hard as sources of evidence for underlying causes. Techniques which triangulate data with expert judgement aim to maximise the available insight and understanding.

Some illustrations have been given in terms of the way supporting information about specific factors is gathered in order to drive improvement. Some significant successes in identifying the causes of accidents and eradicating their source have also been demonstrated.

Although an aim has been to draw together conclusions about the underlying causes of construction fatalities, some caution is needed:

- Different underlying causes are pertinent only to certain sectors of the industry, types of activity – their significance also depends on the inter-related business practices and priorities that prevail.
- The focus of the studies differ – not all look in a balanced way across all possible causes – some are confined to specific types of accident, look beyond fatalities and/or deal with particular aspects of causation.
- The studies cover a wide time-span through a period of considerable change and demonstrable improvement in aspects of HSE and industry regulation and practice.

The HSE investigations and research, individually, have tried to reflect these considerations providing recommendations and solutions appropriate to the context.

On one level this report has demonstrated an inherent challenge in tackling the underlying causes of construction fatal accidents. There are so many (inter-related) factors and taxonomies for their interpretation that a coherent basis for prioritising action is also needed. The Influence Network was adopted in ConD research and wider intervention planning, specifically to provide such a strategic framework, not only to identify related areas with repeated deficiencies but also to identify those where the standards were most significant for safety. This approach enables risk control interventions to be prioritised based on impact on safety outcomes.

The combined model developed here, essentially ties that approach back more formally into the theories of safety management systems whilst retaining the essential strategic elements of the structuring.

Significantly the dominant factors within the research studies have together confirmed the particular significance of the following factors as underlying causes of construction fatal accidents:

- At the Corporate level:
  - Ownership of safety and leadership
  - Contracting strategy and controls
• At the Delivery system (site management) level:
  o Competence, selection, training and information
  o Planning, risk assessment and risk control selection (pre-planning)
  o Hardware (equipment) design, selection, availability, and use
  o Monitoring, correction and supervision
• At the Output (direct) level:
  o Competence and suitability
  o Hardware, workplace ergonomics, usability and workplace hazards
  o Planning, risk assessment and risk control selection (on the job)
  o Participation, motivation and conflict resolution (managing competing demands).

These themes mirror those found from the Phase 2 case studies so together the evidence sources point powerfully to areas for increased attention and action.

2.5 LITERATURE PREVIEW
Although the main thrust of this report is on the work with which HSE has been involved, HSL were asked to perform an abstract trawl for related references in the open literature. An outline review of the findings is presented in Annex 2-1. The trawl brought back many of the HSE references included in the body of this report confirming the suitability of the search terms. More importantly from a preliminary scan the HSE work would appear to be more comprehensive, providing more detailed attention to underlying causes than many of the international references.

The review is not presented as being comprehensive or sufficient but it provided a basis for peer reviews to direct more detailed scrutiny in the Phase 2 external review.
2.6 PART 2 - REFERENCES


BOMEL Ltd. ‘Sample analysis of construction accidents reported to HSE’, HSE Research Report RR139, 2003b.


HSE. ‘Working Well Together’ (http://www.wwt.uk.com/)


HSE. ‘Booster survey’ reported in Construction Intelligence reports as results become available (see HSE above), 2008a.


HSE. ‘The health and safety of Great Britain \ Be part of the Solution’, HSE Strategy, June 2009a.

HSE. ‘Inquiry into the Underlying causes of construction fatal accidents – Review and sample analysis of recent construction fatal accidents’ Phase 2 Inquiry report, 2009b


Mullins, P. ‘Would HSE investigations benefit from the use of analytical investigation methods?’, MSc of Science in Health Ergonomics, University of Surrey, 2006.


Walker, D. ‘Applying the Human Factors Analysis and Classification System (HFACS) to incidents in the UK Construction industry’, MSc Thesis, Cranfield University, School of Engineering Human Factors Department, 2007.

ANNEX 2-1 – ACCIDENT CAUSATION IN CONSTRUCTION – ABSTRACT REVIEW

Introduction
In building the evidence base, HSL Information Services were engaged to trawl abstract directories for related information from the international literature covering academic conferences and journals such as Safety Science, the Journal of Construction Engineering & Management, Accident Analysis and Prevention and the Journal of Safety Research amongst many others. The databases available were:

- Oshrom CDROM (5 OHS databases, HSELINE, CISDOC, RILOSH, NIOSHTIC, OSHLINE)
- Web of Science (Science Citation Index, Social Sciences Citation Index, Medline)
- OEM Medline (OHS refs from Medline)
- PsycINFO
- Compendex
- Healsafe

The searches had an intentionally narrow focus matched to the terms of reference for the Inquiry and were based on:

- (accident or accidents) appearing within 5 words of caus* within the title
- (accident or accidents) appearing within 5 words of caus*) as well as construction anywhere within the title or abstract

The HSL researcher also added a further filter to the results based on one of the following terms being present in the text

- (work* or employ* or occupation*).

Alternative search terms such as ‘safety’ or ‘prevention’ would undoubtedly have brought back a more comprehensive dataset from which information about construction accident causation could be sifted or inferred. However, this was intended to be no more than an initial scan in the limited time available as an addendum to the main focus of the Phase 1 report to help inform the design of the more comprehensive Phase 2 external research planned.

The trawl brought back 178 abstracts / references. From these it was noted that:

- The principal HSE research by Atkins on models of accident causation and construction specific work by BOMEL, Habilis, Loughborough University and UMIST was highlighted by the searches, confirming the relevance of the terms and completeness of the approach.
- The results brought back research into accident causes from diverse locations including Australia, Brazil, China, Finland, Greece, Hong Kong, Israel, Italy, Kuwait, The Netherlands, New Zealand, Singapore, Spain, Taiwan, Uganda and the USA as well as the UK. Whilst indicating the search has been wide ranging and confirming the universality of the construction safety challenge, it cannot be concluded that all aspects are directly transferable to British construction practices in 2009. However, the papers offer the opportunity to identify material worthy of consideration in the British context.
• Not all research is specific to construction and the trawl brought in major hazards studies as well as work on occupational accident causation in industries such as manufacturing.

• The research itself is diverse relating, for example, to:
  o Techniques for accident investigation & analysis (e.g. use of a ‘storybuilder’, reliance on accident narratives, enhancing company investigations, statistical methods)
  o Studies of specific human factors aspects (e.g. linkage between accident experience, causal attribution and behaviour; safety climate; sleep deprivation effects)
  o Studies of particular accident / activity types (e.g. highways, struck by, manual handling, trenching operations, and (most frequently) falls).

These broad categories are used to structure the review of relevant literature in the next section.

• There was considerable duplication within and between the returns from the abstract databases.

• There is negligible coverage of the success or otherwise of measures to reduce in the incidence of (fatal construction) accidents based on insight to causation – although this may, in part, be influence by the narrow search terms.

In screening out generic references, for example related to the role of fatigue in accident causation, the inference should not be that they are considered irrelevant. However, the focus is at a higher level on identifying those factors significant to the causation of fatal construction accidents at this stage, not the more detailed examination of specific aspects.

A short-list of the references most relevant to the current work was developed. These relate to methods for investigating underlying causes, analysis of the construction problem, and specific aspects of potential causative factors. The source papers have been published over the last fifteen years (~1993-2008) although the time for undertaking research and the duration of the publication processes, mean that the underpinning data in some cases go back as far as the mid to late 1980s. The short-list excludes papers drawn from HSE research which is covered more fully elsewhere in this report. It should be noted that, depending on timing, those HSE funded studies will have accounted for some of the research developments listed below so the sources are not necessarily mutually exclusive. Where appropriate, the short summaries below indicate the timing of the work, the country and any construction focus.

Modelling accident causation
Considering accident causation and risk control in general, Svedung and Rasmussen (2002) developed the graphic representation of the causal flow of accidents. Traditionally these focused on technical faults and human errors (causal trees, event trees etc) and were then adapted to encompass organisational and social factors (using tools like MORT – the Management Oversight and Risk Tree). The authors argue that due to the fast pace of change of technology and financial conditions, emphasis is increasingly on proactive risk management strategies replacing reactive methods based on analysis of accidents in the past. They therefore present a set of graphic representations
to structure analyses of hazardous work system, and to identify the interactions in a socio-technical system shaping the landscape in which accidents may unfold themselves. Although not specifically related to construction, the dynamic characteristics can be recognised to be particularly relevant and the broad context of influencing factors is mirrored in some of the HSE funded research by BOMEL and Loughborough University, for example. MORT, however, places greater emphasis on the sequencing of influences.

Elsewhere in this report, the appropriate basis for determining underlying causes of fatal accidents is discussed. Research by Williamson et al (2001) tested the validity of narrative analysis using data on work-related fatalities across a range of industries from New Zealand, Australia and the USA through the period 1985-1994. Based on comparisons for 200 cases from each country, the authors concluded that narrative analysis showed promise as an alternative to the more conventional coding of mechanisms as a basis for investigating the causes of fatalities. This approach features in much of the HSE funded research (BOMEL 2003a, HSE 2008f, for example) and is advocated for Phase 2.

On behalf of the Ministry of Social Affairs and Employment of The Netherlands, an international consortium (Bellamy et al (2006) et al) recently constructed a causal model for the most commonly occurring scenarios related to occupational risk. It provides quantitative insight to the causes and consequences with the results aimed at helping select optimal strategies to reduce risks. The model includes a ‘Storybuilder’ bow-tie tool to classify systematically and analyse past accidents. An application of the Storybuilder approach is presented based on accidents in the construction industry in the Netherlands by Ale et al (2008). Causation is examined to the extent revealed by narrative reports of some 3000 fatal and non-fatal cases allow. Analyses are grouped by type of accident revealing comparable causes to the findings from the BOMEL Influence Network research reported in the main part of this Phase 1 report (BOMEL, 2001). Contrary to popular beliefs in the industry, their analysis leads the authors to conclude that the underlying causes are motivational with a lack of attention to the dangers and insufficient procedures for implementing the prevention measures. Further links with this work are developed in the Phase 2 external research.

Chua and Goh (2004) focused in on the feedback mechanisms necessary for learning from incident investigations to be utilised in safety planning in the Singaporean construction industry. They determine that feedback should be at two levels: first, feedback to the safety management system that had failed, and second, feedback to the safety planning of future projects. The first level of feedback can be achieved by basing the investigation on an incident investigation model that explicitly identifies system failure. The second level of feedback can be achieved if both incident investigation and safety planning share the same incident causation model, such that the information from each process can be retrieved and utilised in the other process smoothly. The modified loss causation model (MLCM) they developed to deliver this two-level feedback was applied to 140 actual accident cases.
Subsequent research by the same authors, Chua and Goh (2005), took a completely different approach and considered construction incidents to be essentially random events with a probabilistic component that causes their occurrence to be indeterministic [indeterminate]. On that basis they argue one of the best ways to understand and analyse construction incidents is to apply statistical methods and tools. The statistical model they present is a development of the earlier MLCM with two basic components: random and systematic [systemic]. The random component is represented by a probability density function assumed to be represented by a Poisson distribution. The systematic component is represented by the situational variables and quality of the safety management system. Incident records from 14 major projects were used to test the suitability of the modelling. The approach is highly mathematical and the paper also presents some applications of the proposed Poisson model to improve construction safety management, focusing on two specific components: the Bayesian approach [for updated learning] and the partitioned Poisson.

Abdelhamid and Everett (2000) based in the US, point out limitations of accident investigation techniques and reporting systems which identify what type of accidents occurred and ‘how’ but do not properly address ‘why’ as the identification of root causes is only possible by complementing conventional techniques with theories of accident causation and human error. They also argue that the uniqueness of the construction industry requires contemporary accident causation models and human error theories to be tailored to the application. An accident root causes tracing model (ARCTM) is proposed with three root causes: (1) failing to identify an unsafe condition that existed before an activity was started or that developed after an activity was started; (2) deciding to proceed with a work activity after the worker identifies an existing unsafe condition; and (3) deciding to act unsafe regardless of initial conditions of the work environment. They further suggest that unsafe conditions are due to four causes: (1) management actions / inactions; (2) unsafe acts of worker or co-worker; (3) non-human related event(s); (4) an unsafe condition that is a natural part of the initial construction site conditions. Thus ARCTM is said to acknowledge the possible contribution of both management and labour to the accident process.

The work of this research team was continued and Mitropoulos et al (2005) look at different systems models of construction accident causation pointing out the limitations of approaches which focus on prescribing and enforcing ‘defences’ – physical and procedural barriers that reduce the workers’ exposure to hazards. In this view accidents occur because the prescribed defences are violated due to lack of safety knowledge and / or commitments. However, the authors argue this ignores the underlying causes, namely the work system factors and their interactions that generate the hazardous situations and shape the work behaviours. The model they present takes an alternative systems view of accidents and analyses the conditions that trigger the release of the hazards. The model is said to be based on descriptive rather than prescriptive models accounting for actual behaviours as opposed to normative behaviours and procedures that workers ‘should’ follow. The model identifies the critical role of task unpredictability in generating unexpected hazardous situations and acknowledges the inevitability of exposures and errors. The model identifies the need for two accident prevention strategies: (1) reliable production planning to
reduce task unpredictability; and (2) error management to increase the workers’ ability to avoid, trap and mitigate errors.

Human & organisational underlying causes of construction accidents
This section demonstrates the recurrence of comparable human and organisational factors across the construction industry worldwide. This in itself presents a number of troubling possibilities, for example, that: (i) construction has inherent problems which cannot be overcome; (ii) local measures have had negligible impact and any improvements form part of general progress in construction; or (iii) the powerful solutions have yet to be identified.

One research team examined the government statistics and confirmed the construction industry has ‘a poor safety record’. They go on to describe ‘causes of accidents which appear to be peculiar’ to the country as ‘difficulties in adaptation for new immigrant workers, employment of unskilled workers, overtime work, lack of leadership from top management, poor working attitudes, shortage of factory inspectors, low penalties for breaches of the safety law, inadequate safety education courses, inadequate authority of the Labour Department, and poor site supervision’. Despite resonances with the UK construction industry variously in the past and present, the research was performed by Lam and Rowlinson (1997) in Hong Kong.

Another group of researchers identify major causes of accidents associated with construction projects to include inadequate supervision, use of incompetent personnel and use of inappropriate construction techniques. Among the recommendations made for minimising and / or avoiding re-occurrence of accidents are review of the existing regulations, enforcement, sensitisation and training. The paper was presented by Lubega et al in 2000 at a conference entitled Challenges facing the construction industry in developing countries and is based on research in five districts of Uganda. It is noted that construction is one of the high-risk industries in the country.

Examining key factors influencing 784 occupational fatalities across all industries in Taiwan in 1999 and 2000, Chi et al (2003) concluded that a high risk [group was] construction workers with less than one year of experience who were employed by small companies with less than 30 workers’.

The role of design in construction accident causality and prevention was explored by Gambatese et al (2008) as part of a US drive to design for construction safety, paralleling the work by Habilis for HSE reported earlier. Initial work suggested 42% of 224 fatalities examined could be linked to the design for safety concept. This paper reports work to validate the model by subjecting a sample of the cases to scrutiny by an expert panel who endorsed the findings about the role of design in 71% of cases. The authors conclude if safety performance in the construction industry is to improve, design professionals need to play a role in addressing safety in their designs.

A paper by Vedder and Siemers carried in the proceedings of an International Ergonomics Association Conference in Korea 2003 examined accidents and safety in the construction industry. The significantly higher rate of accidents (fatal
and non-fatal) and occupational diseases than other industries is noted. The authors go on to state: ‘The main causes are low awareness among workers and management, as well as time and cost pressure on construction sites. Two key preventive measures are the introduction of a safety management system and the use of personal protective equipment (PPE). However, for the majority of construction markets, both of these measures have not reached the reduction in injuries and accidents as was hoped for. The pivot point again is low awareness of the issues. It can be clearly stated that changing awareness needs a top-down approach, starting with the management. Construction sites with an increased management awareness of safety and health issues, from both the injury and cost aspects, have a significantly better record in all accident and occupation disease statistics’. Information on the scale and location of evidence should be obtained from the full paper.

One of the oldest papers in the trawl by Paul (1993) looks at the causes of accidents in the New Zealand construction industry. The findings are high level and descriptive commenting that the construction industry contains hazards peculiar to the industry because of the nature of building work. Although a high physical effort of the workers is required, the cognitive skills required are rather low. The fact that each new project means a new workplace and labour force is usually casually recruited means that the chances of accidents are higher. It is suggested ergonomics interventions should relate to people, machines and the work environment.

Work from Japan by Egawa and Nakamura (2000) examined accident reports in construction work and identify communication errors between workers to be responsible for a large number of accidents. Where work involves two people they conclude that communication was effective when the workers were face to face but ineffective when back to face.

Gheradi et al (1999) from Italy address conflicting perspectives on accident causation and safety management in a construction firm. The paper is based on the assumption that people in organisations do not learn ‘safety’; rather they learn safe working practices. On that basis there are as many safety cultures as there are communities of practice inside an organisation contributing to the safety performance. They suggest ambiguity plays a central role in this process as opinions on safety and danger are issue-specific and constantly fluctuating. They analyse the explanations of the cause of accidents held by engineers and site managers as two communities of practice to shed light on the processes by which safety is understood and safer practices can be developed.

The role of individual characteristics on construction industry accidents (non fatal) was examined by Chau et al (2002) in a large case-control study where circumstances for 880 male construction labourers who had experienced an accident were compared with 880 who had not. Statistical analysis was used to identify strong associations, the most significant relationship being observed between the severity of sleep disorders and accidents, particularly falls and accidents leading to lengthy absences from work. Being a current smoker, being less than 30 years old, and not taking part in sport all slightly increased the likelihood of suffering an accident or injury. Overall, the authors conclude that
occupational accidents are mainly due to work conditions, but note that certain individual characteristics such as these may play a part.

Choudhry and Fang (2007) present an investigation of why operatives engage in unsafe work behaviour based on structured interviews with Chinese and non-Chinese construction workers who had been accident victims. Emerging themes from the data analysis suggest workers were involved in unsafe behaviour because of: a lack of safety awareness; a macho ‘tough guy’ culture; work pressure; co-workers’ attitudes; and other organizational, economic and psychological factors. Despite being based on only seven cases so far, the authors conclude that the findings substantiate the significant role of: management; safety procedures; psychological and economic factors; self-esteem; experience; performance pressures job security and education as well as safety orientation and training.

**Underlying causes of specific aspects / areas of construction work**

Early research into fatalities and injuries in the Kuwaiti construction industry by Kartam and Bouz (1998) identified falls from height to be the major cause. They also note that poor accident records and reporting system hide the extent of the construction safety problem in Kuwait. In addition, many people at management level are unaware of accident-related costs and the effectiveness of a safety programme in reducing project costs.

Papaioannou et al (2003) present one of several studies looking at falls from height on construction sites. Based on experience in Greece the authors conclude human error seems to be the immediate cause of accidents albeit with other factors contributing significantly. They use this to support the principal objective of the paper which was to demonstrate the importance of human factors in accident prevention.

Progressing from recognition of human factors, Nakamura et al (2006) looked at 191 construction accidents in Japan in 2000 and looked at the relationship between the state of the victim’s psychological condition and the processes of the accident occurrence and human errors. The authors argue that the propensity for human error is not an inherent characteristic of the individual but is influenced by circumstance.

Kines (2003) from Denmark undertook 26 semi-structured interviews and on-site investigation with 24-65 year old male workers who reported to an emergency department for treatment of injuries due to falls from heights. They were not necessarily construction related but the results showed that a greater number of workers carrying out non-routine compared to routine tasks perceived, identified, interpreted and attempted to control a fall hazard. The paper also presents two case studies to illustrate how cognition and behaviour in context progressed from a lesser to a greater active role in the incident processes. The author argues that investigations of how and why workers thought and behaved the way they did in a
particular situation can give important clues as to whether preventive measures will be effective in a similar situation in the future.\textsuperscript{a}

Huang and Hinze (2003) tried to identify the root cause of fall accidents in US construction based on OSHA data from 1990 to 2001 (and in particular the most recent five years). They found that fall accidents occur primarily on new construction projects of commercial buildings and residential projects of relatively low construction cost. Results also suggested experience does not seem to diminish accident occurrence and hazards are often misjudged by workers. An earlier paper by Hinze et al (1998) is entitled ‘identifying root causes of construction injuries’ but no details are given.

Hinze et al (2005) further looked at the nature of struck-by accidents in the US construction industry which accounted for 22\% of the fatalities in the late 1980s. Although not presented in the abstract it is indicated that study of OSHA data from 1997 to 2001 revealed some new insight to the underlying causes which are generally difficult to identify due to the broad categories utilised in the accident coding system.

Perttula et al (2003) from Finland gathered complementary data about materials handling accidents from a large construction company and from the database of reported serious accidents (Sammio). The data encompassed injuries due to over-exertion in materials handling and more serious accidents due to falling from height or being struck by falling objects in the handling process. The authors conclude by addressing one of the risk transfer themes explored in HSE research. They conclude that over-exertion can be decreased by reducing manual materials handling [but] replacing manual transfers with mechanical transfers means that there arises a risk of serious accidents.

Arboleda and Abraham (2004) from the US applied two models to understand the underlying causes of the 65 fatalities typically associated with trenching operations each year. Based on data from OSHA (the Occupational Safety and Health Administration) from 1997 to 2001 the ‘how’ and ‘why’ of trenching fatalities were considered. The two models considered the causes related to physical process and those associated with human behaviour and the work set out to explore the linkage between these factors.

Work by Burstyn et al (2004) studied asphalt workers in terms of the risk of fatal industrial accidents and of death from other external causes. Mortality rates for

\textsuperscript{a} Further work by Sangenberg et al (‘Factors contributing to the differences in work related injury rates between Danish and Swedish construction workers’, Safety Science, Vol. 41, 2003) considered the differing safety records for Danish and Swedish workers constructing either end of the Oresund bridge with the Danes experiencing four times as many lost time incidents than their Swedish counterparts. Covered in some detail in the ConD research exploring the potential for different Scottish and wider GB performance (BOMEL et al, 2006), that work concluded that the more formal education and training regime in Sweden gave the workers a greater focus on regulation and procedures that the Danes who tended to learn through informal on-site training. The origins appear therefore to lie in deep underlying factors in the educational and societal systems needing work control approaches to reflect this. It also implies some caution is needed before transferring measures from one international context to another and / or assuming there are universal answers to the challenges of construction safety.
asphalt workers from seven European countries and Israel were examined but no evidence was found supporting the hypothesis that asphalt workers are at increased risk of fatal industrial or road accidents.

Chi et al (2005) went on to examine 621 occupational fatal falls in construction categorising the factors associated with the many different types of falls e.g. falls from scaffold staging were associated with a lack of complying scaffolds and bodily action. The authors conclude primary and secondary measures can be used to prevent falls or to mitigate the consequences. Primary prevention measure would include fixed barriers, such as handrails, guardrails, surface opening protections, crawling boards / planks and strong roofing materials. Secondary protection measures would include travel restraint systems (belts), fall arrest systems (harnesses) and fall containment systems (nets). Such a hierarchy is embedded in UK legislation, preceded by a requirement to first try and eliminate the work at height risk.

**Conclusions**

Based on this limited trawl and basic scrutiny of abstracts, there is nothing to suggest the international literature contains more advanced insight to or definitive conclusions about the underlying causes of fatal accidents in construction or practical solutions to the problems. However, the limitations of the trawl underline the need for a more thorough literature survey in Phase 2 before firm conclusions can be drawn. Nevertheless, the industry based ‘system’ models, within which HSE has researched causation, take a more holistic approach than much of the literature glimpsed at here. Furthermore, the detailed aspects scrutinised in the literature are fully reflected in the HSE research.

Care is needed in translating research from different periods and different international regulatory and operational regimes to today’s construction industry in the UK, nevertheless the resonances with experience in this country are striking.

In order to ensure the profile of the underlying causes of fatal construction accidents is comprehensive, examination of some of the reference papers is warranted. In addition, it is essential to draw in complementary work undertaken by the industry which is not captured in the academic literature but which may offer more contemporary and practical insight. This is beyond the scope of the present review of the work HSE has done simply reinforced the need for Phase 2 to pursue industry sources such as construction companies, trade bodies, training organisations, professional institutions, insurers and other interested parties to complement a more comprehensive international literature review.

**Annex 2-1 References**


Ale, BJM, Bellamy, LJ, Baksteen, H, Dame, M, Goossens, LHJ, Hale, AR, Mud, M, Oh, J, Papazoglou, IA and Whiston, JY. ‘Accidents in the construction


Kartam, NA and Bouz, RG. ‘Fatalities and injuries in the Kuwaiti construction industry’, Accident Analysis & Prevention, 30 (6) 1998.


ANNEX 2-2 – COMPLEMENTARY HSE RESEARCH ON IMPACT

Introduction
HSE’s research spans the spectrum from analysis through to impact evaluation as described in the Part 2 Introduction. To complement the Inquiry focus was principally on identification of the underlying causes of construction fatal accidents, HSE central research procurement team was asked by the peer reviewers to provide examples of the wider consideration given by HSE to the overall success of its strategies and the interventions it adopts. The main body of the text mentions examples of the follow through from problem analysis to intervention and impact in construction, and the examples here illustrate the approach more widely.

HSE Strategy
Formal stock takes of what works in delivering health and safety outcomes have been undertaken by, for example, the Institute of Employment Studies (IES, 2001 and 2008). These both identify successes (e.g. regulation, tools like SHADs etc), limitations (e.g. knowledge of the combined effects of interventions, effects of sanctions etc) and opportunities to improve (e.g. organisationally, process wise, etc). On a continuing basis, in-house analysis provides a current picture on risks and trends in health and safety\(^a\) which is considered alongside a current economic perspective\(^b\) to inform targeting. This is complemented, for example, with survey evidence gathered to inform directly the recent strategy review (KRC Research, 2009).

In areas of regulation, impact assessments are conducted to a timetable as the CDM evaluation process described in Part 2 (Section 2.2.4.8) illustrates (BOMEL, 2007). The impact of key guidance is also evaluated. The work by IES (2004) to evaluate ‘Reducing Risks, Protecting People’ (R2P2)\(^c\), which explains HSE’s decision making processes, provides an example as does the HSE Board’s commitment to review the impact of the 2007 joint HSC/IoD guidance for directors as described in Part 1\(^d\).

Inspection
Understanding the role of inspection and the success of different approaches for targeting inspection has encompassed LA partners (University of Wales, 2000). Work by Amey VECTRA (2002) specifically looked at how inspection success could be measured over time and a suite of indicators was proposed (linked to HSG65 elements – HSE, 2003a) to score performance against an anchored set of objective descriptors. These went on to form the basis of the risk control indicator scheme used to rate standards found in industry across the Fit3 prioritised themes. In 2005 Risk Solutions evaluated the benefits of directing inspections to focus on prescribed topics but although standards had not fallen the impact was difficult to distinguish and the evaluation highlighted other process factors to be addressed if impact were to be increased. Recognising the breadth

\(^a\) www.hse.gov.uk/strategy/researchfindings.pdf
\(^b\) www.hse.gov.uk/strategy/economicbackgroundmay09.pdf
\(^c\) www.hse.gov.uk/risk/theory/r2p2.htm
\(^d\) www.hse.gov.uk/aboutus/meetings/hseboard/2008/261108/b80.pdf
of stakeholders, work by Kings College London (2005) for example, illustrates the specific attention to the needs of SMEs as part of cross-cutting support work.

**Fit3 Programme**

In terms of the impact of the Fit3 programme through the period 2004-8 described in Part 1, papers to the (then) HSC provide a public record of progress and impact\(^a\), with independent measures from both worker and separate employer surveys\(^b\).

**Fit 3 Intervention evaluation research**

Arising from the programme approach, specific interventions have been evaluated (many covered in the aforementioned IES research (IES, 2008)). Again, different techniques are used with, for example, interviews being used to understand and detect the impact of slips and trip roadshows in raising awareness and changing behaviour (HSL, 2007). Quantitative surveys were used by BMRB (2007) to evaluate the falls campaign, whereas HSE and Synovate (2007) together looked at the campaign process (Watch Your Step) as well as the impact. Greenstreet Berman (2008) provided a round up of complementary interventions across the manufacturing sector, finding significant improvements beyond the overall average but noted that success needed long term commitment and continuity. Having identified that more than 40% of transport related accidents were associated with workers being ‘struck by’ a moving object (not a vehicle), audit style interventions in high risk areas such as waste were carried out and these were followed up with case study evaluations (HSL, 2008).

All these are complemented by internal HSE work and technical support by HSL and framework providers in addition to the commissioned research. It is beyond the scope here to describe each intervention and assimilate the impact evaluation findings, but the above illustrates the ongoing attention paid to this important aspect of research.

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\(^a\) HSC paper: Fit3 - progress with implementation (HSC/05/96): www.hse.gov.uk/aboutus/meetings/hscarchive/2005/260705/c96.pdf


\(^b\) Fit3 survey results - www. hse.gov.uk/statistics/fit3/surveyfindings.pdf
Annex 2-2 references


University of Wales Institute, Cardiff University, School of Applied Sciences. ‘Investigation and evaluation of the application of HELA’s risk rating and priority inspection regime for H&S inspections by LA’, HSE Contract Research Report, CRR297, 2000.
ANNEX 2-3 – MAPPING BETWEEN INVESTIGATION AND CAUSAL FACTOR MODELS

This annex contains the mapping between principal direct and underlying influences on safety and fatal accident causation between different research models, investigation tools and the regulations that relate to construction industry practice (CDM 2007)

The resultant ‘combined’ model draws on the best elements of all the models. It provides a framework for collating the findings from this Phase 1 review and for categorising the deficiencies revealed in the Phase 2 cases studies. Importantly it also offers a coherent structured approach for assimilating the findings from ongoing work into the underlying causes of construction fatal accidents.
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