Integrated gateways: planning out health & safety risk

Prepared by **Glasgow Caledonian University**
for the Health and Safety Executive 2004

RESEARCH REPORT 263

HSE
Health & Safety Executive

Integrated gateways: planning out health & safety risk

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The following report was prepared by Glasgow Caledonian University, School of the Built and Natural Environment for the Health and Safety Executive (HSE) and describes an investigation into the integration of health and safety planning within construction project management.

It was widely believed that implementation of the CDM Regulations had lead to a bureaucracy, parallel to, but detached from, normal project management practice and adding little value to the management of construction projects. The research team have engaged in extensive industry consultation, including several group meetings and numerous interviews with experienced practitioners. This has resulted in the development of an integrated Gateway model for construction projects, incorporating the management of health and safety risk. Supporting the model are several tools, designed to be used as levers for the detailed requirements of project planning, communication and control.

Health and safety risk is part of overall project risk and the use of Gateways can:

provide the mechanism to manage the risk of cost and time overruns; and

also provide the mechanism to manage health and safety risks.

Lack of planning leads to project uncertainties, such as late changes being realised at construction stage, incurring extra time and cost. Front End Loading of project management effort:

minimises potential for late changes through increased planning; and

also reduces the likelihood of accidents.

The tools are designed to support the Gateway model; however, they are also implements that can be used independently of the model. Every tool achieves two goals:

firstly, the tool aids general project planning; and

secondly, it integrates health and safety planning.

The outcome of this research illustrates that general planning tools that incorporate health and safety planning will make health and safety management easier and more effective, becoming a natural part of the day to day activities of those planning and managing construction projects.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

HSE BOOKS

First published 2004

ISBN 0 7176 2889 2

ACKNOWLEDGEMENTS

The authors would like to take this opportunity to particularly thank the following individuals for their participation, enthusiasm, help and assistance throughout this research:

Steering Group

Ed Bale,	BP Plc
Nick Balsdon,	Environment Agency
Tom Cairney,	Bovis Lend Lease
Dave Devey,	Skanska UK Building
George Inglis,	Capita Health and Safety
Brian Law,	Association of Planning Supervisors
Jim MacKay,	Serco Services Ireland Ltd
Norman Price,	Essempy & A.P.M. H&S Special Interest Group
Stan Purdy,	Turner & Townsend Health, Safety & Environment
Mark Ritchie,	Glasgow City Council
Darrell Scott,	Scottish Widows
John Tetley,	Environment Agency
Martin Worthington,	AMEC Infrastructure

Expert panel members and interviewees

Susan Calderwood,	Thus Plc
Glenn Christiansen,	Vauxhall Motors Ltd
Archie Clark,	Reiach & Hall Architects
Stephen Coppin,	DWP Jobcentre Plus Estates Core Team
Hedley Horsler,	HSE
Brian Hume,	Balfour Beattie Construction Ltd
Thouria Istephan,	Foster & Partners Architects
Peter Mather,	Mitie Plc
John Marsh,	Kirk & Marsh Ltd
Fraser McCaskill,	Thus Plc
Trevor Pavitt,	Loughborough University
Rory Reed,	Serco Services Ltd
Scott Steven,	Halcrow Group Ltd
Mike Thompson,	HSE
David Ward,	Tweeds Project Services
Richard Wilks,	Abco Management Consulting Safety Engineers

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ABBREVIATIONS

Abbreviations used in this report:

ACoP:	Approved Code of Practice
CDM:	Construction (Design and Management) Regulations 1994
DRA:	Design Risk Assessment
Env.:	Environment
FM:	Facilities Management
H&S:	Health and Safety
HS&W:	Health, Safety & Welfare
HSE:	Health and Safety Executive
KPI:	Key Performance Indicator
M&E:	Mechanical and Electrical
O&M:	Operation and Maintenance
OGC:	Office of Government Commerce
PS:	Planning Supervisor
SHE:	Safety Health and Environment
SHEQ:	Safety Health Environment and Quality
SME:	Small to Medium Enterprise
SMS:	Safety Management System

EXECUTIVE SUMMARY

INTRODUCTION

This report was prepared by Glasgow Caledonian University, School of the Built and Natural Environment for the Health and Safety Executive and describes an investigation into the integration of health and safety planning within construction project management and resulting proposals for improving this process.

Effective planning for health and safety is essential if projects are to be delivered on time, without cost overrun, and without experiencing accidents or damaging the health of site personnel. It is estimated that up to 90% of accidents could be prevented through better planning and recent studies have found that designers could have prevented up to 47% of accidents.

AIMS AND OBJECTIVES

This research aimed to investigate how best to promote the effective integration of health and safety management into project planning, communication and control to achieve improvements in both general project management and health and safety management.

To achieve this, the following objectives were set:

1. Consult experienced practitioners to ascertain current practice and improved methods of integrating health and safety within construction project management.
2. Produce a model of construction project management, integrating health and safety.
3. Produce a set of tools to support the model.
4. Field test the model and tools in order to improve them.
5. Produce a guide to best practice, including a set of 'Key Integrated Safety Management Planning Procedures'.

DATA COLLECTION AND ANALYSIS

The research programme was carried out in five overlapping phases:

Literature search – Initially this covered guidance on construction project management; health and safety management, including safety management systems; and the Construction Design and Management Regulations (CDM). As the research developed information on Gateways was also investigated.

Steering Groups – A steering group of senior industry stakeholders was formed to advise on the strategic direction of the research, review progress and outcomes and assist in obtaining access to construction sites and personnel. Several "virtual" steering groups were also formed. This approach allowed individuals to contribute knowledge via email and telephone when geographical location would have otherwise precluded them.

Expert Panels – Expert panels were formed to conduct a series of brainstorming meetings; covering maintenance; construction; and planning and design. These were held to investigate Critical Success Factors, which were subsequently categorised as critical "Events" that had to take place at a macro level, or issues requiring "Tools" at a micro level.

Interviews – Interviews were held with leading industry practitioners, recommended by the Steering Group, to assist in directing the research focus on critical aspects of the development and validation of the model.

Validation interviews – A series of visits to practitioners' offices and sites were made to test each tool by performing simulated demonstrations and gaining detailed feedback on how each tool would perform in real-life situations.

CONCLUSIONS AND RECOMMENDATIONS

Gateway model

A gateway process, that facilitates consideration of the critical aspects of a project at key points through its life, is recommended. This provides assurance that everything is in place prior to progressing to the next stage and assists in setting more realistic targets through the management of risk. Health and safety reviews should become part of these gateway reviews. This approach of allocating considerable resources to the planning stages of projects is termed Front End Loading.

Health and Safety risk is part of overall project risk and the use of **Gateways** can**:**

- provide the mechanism to manage the risk of cost and time overruns; and
- also provide the mechanism to manage health and safety risks.

Lack of planning leads to project uncertainties, such as late changes being realised at construction stage, incurring extra time and cost; but **Front End Loading:**

- minimises potential for late changes through increased planning; and
- also reduces the likelihood of accidents.

The Gateway model is structured, systematic, logical, rigorous and transparent. It moves ownership for health and safety risks upstream, to duty holders identified by the CDM Regulations, particularly the designer and client or project manager. This helps to promote integrated teams and is conducive to collaborative working.

Good leadership will prevent the process becoming bureaucratic; therefore, efforts should be concentrated on managing people rather than managing paperwork. Furthermore, continuous development and refinement of the model is required to ensure that it is relevant and appropriate for current practices.

Smaller Projects

The Gateway principle need not be confined to large projects, where economies of scale allow more scope for funding. It is possible to collapse the existing gateway model to accommodate smaller projects whilst still providing enough Front End Loading to ensure project success. "Consolidated Gateway Reviews" in the collapsed model combine several critical success factors within one gateway review since less time will be needed to review these items for smaller projects.

The Tool Box

The tools contained in the Tool Box chapter are designed to support the Gateway model. However, they can also be used independently of the model. It is not essential that every tool will be used for every project; however, this *is* possible, and would constitute an excellent declaration of the project team's commitment to the management of health and safety risk, as an integral part of project management.

Every tool achieves two goals:

- firstly, the tool aids general project planning; and
- secondly, it integrates health and safety planning.

Responsibility Chart

The responsibility chart is used to show **who** does **what** during a project and **when** it is to be done, which defines interfaces between disciplines and avoids possible conflicts or misunderstandings. Integration of CDM responsibilities is achieved by including tasks specific to the management of health and safety risk.

The greatest benefit of the chart lies in the process of developing it. Tabulating this information on a chart creates a structured approach that can be communicated easily, in a transparent and robust manner. It is also conducive to developing integrated teams, managing people and allocating resources. In terms of the management of health and safety risk, it can bring together the various activities shown separately in the CDM ACoP (HSG224) – Appendix 7 to show what every duty holder has to do in relation to the task *and* each other.

Option Evaluation Chart

An option evaluation chart is a useful tool to summarise what factors need to be considered when making decisions. Alternatives can be investigated in terms of how they impact on predetermined factors, including health and safety risk.

All meetings, formal or informal, involve sketching out the tasks, options, pros and cons, etc. to aid discussion and capture conclusions. The option evaluation chart facilitates this process in a convenient and more standardised way. In auditing, it can be used to demonstrate that a balanced decision was reached, recording what was *reasonably practicable.* It also shows the rationale for the decision, which may be communicated to others to strengthen support and prevent it from being inappropriately challenged.

Hazard ID Workshops

This is a process of group discussion, drawing extended knowledge and experience from several group members regarding issues affecting health and safety instead of individuals, working separately.

Major decisions will be affected by risk identification and management. The early identification of risks will help focus attention on policies and strategies for control and management of risks. The workshops highlight those areas where further design, development work, investigation or clarification is most needed. Group workshops facilitate the development of an integrated team and a collaborative risk management culture, which will achieve a more efficiently managed project.

SHE Information on Drawings

Drawings are used extensively on site and have great potential for communicating residual health and safety risks. SHE information on drawings is of most use at the detailed design stage, although consultation with the contractor, via hazard ID workshops, will help designers understand what information will be useful to include in concept design drawings.

The tool can also be used to explain the rationale behind the design solution, possibly preventing it being changed subsequently to a design that is inherently unsafe or unhealthy. An additional benefit is its ability to trigger further investigation, should a design change be considered, prompting the designer to re-assess the hazards and whether any new risks have been introduced. Providing the information on the design drawing or construction detail itself is generally the preferred option.

Use of the drawing in site inductions, tool box talks and short-term planning makes it easy to refer to areas of high, project specific risk such as interaction with plant, public or transport. This makes risks highly visible to the workforce.

Red Amber Green Lists

Traffic light colours to communicate safety information is well grounded in the UK with Red for warning, Amber for proceed with care, and Green for safe to go. Red items should not be accepted by the client or designer, Amber items will have to be justified, and green items represent good practice that the client or designer would like to see implemented.

Successful application of the RAG Lists will depend on the length of the lists and the time that will be taken in implementing them. The lists need to be short, but cover those items that have the widest opportunity to mitigate health and safety risks, similar to the Pareto or 80/20 rule.

RAG Lists focus attention on the most important health and safety issues in design choices; they can also help designers to become more pro-active. Design and build contractors may be in a position to influence the design, by using thier experience to develop practical, project specific RAG Lists for the designer to follow. Initially project specific items should, where appropriate, be added to generic RAG lists for future use.

As RAG Lists develop, existing items become embedded in the underlying design culture, and new issues can take their place as new materials, technologies and construction techniques are used. This process constitutes a *step change* towards continuous improvement for the industry.

Risk Register

The process for managing commercial risks is similar to the assessment process for health and safety risk, therefore the two can be integrated. Risk sources, or health and safety hazards, the potential impact of each risk , the risk owner, action to be taken and “date to be done by” are essential requirements of any risk register. After initial completion it becomes a control tool, which can be used to check performance with corrective actions taken, if necessary.

The risk register’s main benefit is that it formalises the risk management process and communicates the most important information in a structured manner. A combined risk register can easily be adapted to show how existing commercial risks have a health and safety impact as well as the interdependency of health and safety risks with cost and programme issues. The risk register also provides an audit trail of the risk management process for future reference which can be measured to evaluate performance, or consulted as part of an investigation.

Health and Safety Milestones

A linked bar chart, or network, concentrates on the duration of activities, their position on the timescale and the identification of broadly defined work sequences with their dependencies. Activities required for the management of health and safety risk can be included within this process, assuming what gets measured gets done and what gets measured gets managed.

Strategic programmes can easily incorporate CDM milestones; however, more detailed items fit better on short term programmes. An item on the programme is accepted as another task to be done rather than being an optional extra. This can be used to highlight major risks, e.g. commencement of work at height or moving into an area containing asbestos. It can also be used to show outputs, such as the completion of the Construction Phase Health and Safety Plan. By including this on the programme, along with a realistic duration, it can be ring fenced as a critical project, and health and safety, task.

Gateways are a particular form of milestone and the use of milestones in programmes fits very well with the gateway concept.

Design Change Control

Late changes often occur during construction, and frequently cause serious disruption to the project. In these circumstances, decisions are being made under pressure and cost and time invariably dominate the decision making process. Including health and safety checkboxes on the change management documents and following a set protocol which integrates health and safety issues can ensure that they are not overlooked.

Integrating the management of health and safety risks into change management allows proper health and safety planning when changes are necessary. Improvements in health and safety performance may also lead to improvements in productivity. For example recent innovations in mechanical pile-top break out methods have reduced health and safety risks in this area but have also seen increased use due to excellent improvements in productivity.

Recommendations

The outcomes of the research described in this report should prove extremely useful for those following OGC Gateway methods, but also for those wishing to implement new concepts of integrated teams and collaborative planning. Therefore, publication of a more succinct, user-friendly guide, based predominantly on these outcomes and suitable for the wider construction community is recommended. The layout of the model is ideal for electronic presentation as a CD ROM or similar electronic format with hyperlinks.

Gateways are still relatively new to the wider construction industry. Further longitudinal studies need to be conducted, covering the full life-cycle of Gateway projects to extend and refine the process.

There is also scope to extend and develop all the tools. Further, specific recommendations are as follows:

A combined responsibility chart and risk register could become the overall planning and control document for risk management, including health and safety risk. Future research investigating the possible use of this tool as an alternative to the Health and Safety Plan is recommended.

Hazard ID workshops provide an excellent forum for collaborative risk assessment. Comparison of two similar projects in terms of time spent on individual design risk assessments compared to Hazard ID workshops, along with overall cost/benefit analysis is recommended.

Health and safety milestones at a strategic level align well with CDM “milestones” such as completion of the Health and Safety Plan. This concept could be extended to other CDM and health and safety requirements resulting in a generic set of milestones that can be incorporated into project programmes. This would make an excellent inclusion to CDM guidance such as HSG 224, which would especially benefit SME’s.

1.0 INTRODUCTION

1.1 INTRODUCTION

When the Health and Safety Executive (HSE) implemented the Construction Design and Management Regulations (CDM) they intended them to "encourage the integration of health and safety into project management" (HSE, 2001). Almost ten years on these very regulations are under review as the industry still struggles to properly integrate the management of health and safety throughout the lifecycle of construction projects.

In construction, planning can cover a vast number of activities from pre-project planning, through design, to planning specific site activities. It is estimated that up to 90% of accidents could be prevented through better planning. Recent studies have found that planning and control failures were related to 45.4% of accidents (Duff & Suraji, 2000), and designers could have prevented up to 47% of accidents investigated as part of an HSE research project (HSE, 2003c).

Effective management will embrace all project management objectives, including health and safety, and deliver construction which satisfies all these objectives and not one at the expense of the others.

1.2 AIM AND OBJECTIVES

The problem to be investigated is how best to promote the effective integration of health and safety management into project planning, communication and control to achieve improvements.

The recent HSE discussion document "Revitalising health and safety in construction" has acknowledged problems of bureaucracy regarding CDM paperwork, therefore the ethos is: *minimise bureaucracy and maximise performance.* With this in mind, a *Lean Thinking* approach to the problem is required to develop a health and safety model within contracting organisations' existing production management structures and procedures, as any attempt to overlay a safety specific structure is likely to meet resistance and organisational constraints. Therefore *building-in* health and safety rather than attempting to run separate procedures as *bolt-on* extras should be more successful.

In order to address the problem, the following objectives have been set:

1. Consult experienced practitioners to investigate current, improved methods of integrating health and safety within construction project management.
2. Produce a model of construction project management, integrating health and safety.
3. Produce a set of tools to support the model.
4. Field test the model and tools in order to improve them.
5. Produce a guide to best practice, including a set of 'Key Integrated Safety Management Planning Procedures'.

1.3 SCOPE

Glasgow Caledonian University were commissioned by HSE to perform research investigating the integration of health and safety planning within construction project management. In order to achieve this, the research has concentrated on three main areas:

- Guidance on project management for construction projects;
- Health and safety management systems and guidance on applying these to construction; and
- The Construction Design and Management Regulations (1994) and Approved Code of Practice (HSG224).

Other work on *integration* has sought to integrate the various management systems covering safety, quality and environment such as BS 8800 (health and safety), ISO 9001 (quality) and ISO 14001 (environment). Although this research acknowledges this move towards integrated management systems the scope of work does not explore this subject in detail as it is incorporated within the wider issue of construction project management.

The research has used the Office of Government Commerce (OGC) "Gateway" framework to build a model of the construction process. There has been continued reference to the OGC Gateway framework in recent years, including documents such as *Accelerating Change,* in relation to improving the construction process in general, and *Revitalising Health and Safety in Construction,* aimed specifically at improving health and safety performance. The research has sought to take advantage of the principles of this framework and present it to the wider construction population.

1.4 WHO SHOULD READ THIS REPORT?

This report is aimed at all CDM duty holders, including clients; client agents and project managers; planning supervisors; all designers under CDM; contractors; consultants and anyone involved in planning construction projects.

The Gateway model will be of particular interest to those working within existing Gateway frameworks, such as the OGC, however the research reflects modern thinking and those out with Gateway projects can benefit from exploring how this approach works. Indeed, the processes presented can be readily applied to most types of projects regardless of procurement method.

The Tool Box provides examples of methods and tools to manage the micro level of detail within construction projects. As such the tools have been developed to be used in conjunction with the Gateway model or as stand-alone implements for use on any project type. Some tools are clearly intended for group use whereas others are intended for specific duty holders; therefore, the use of each tool will be dependent on the applicant's own role.

2.0 BACKGROUND LITERATURE

2.1 INTRODUCTION

Effective planning for health and safety is essential if projects are to be delivered on time, without cost overrun, and without experiencing accidents or damaging the health of site personnel (CIOB, 2002). These are not easy objectives as construction sites are busy places where time pressures are always present and the work environment ever changing (HSE, 2002).

The construction industry tends to be under resourced and under planned in relation to other industries (Egan, 1998) and this promotes a crisis management approach to all kinds of production risk, a feature of construction culture which can impact on health and safety. However, highly planned works, such as those requiring a temporary rail possession, almost invariably run smoothly. This type of work is managed in a highly focused way and planned in great detail. Even routine work can benefit from more rigorous short-term planning[1]. There is no reason why health and safety performance should not benefit from the same approach and achieve at least as much improvement.

Today's thinking seriously challenges the old triangular model of time/cost/quality trade-off, which suggested that an improvement in one must lead to deterioration in at least one of the others. It now extends the total quality management philosophy that 'quality is free' (Crosby, 1979) and embraces the premise that delivery in one area, safety, can actually lead to benefits in other areas, such as time and cost (Hinze & Parker, 1978). The importance of effective construction planning and control in the communication and avoidance of health and safety risks cannot be overstated but the fundamental premise is that this need not, and should not, be a separate exercise aimed solely at health and safety. Effective management will embrace all production objectives, as an integrated process, and deliver construction which satisfies all these objectives and not one at the expense of the others.

2.2 DRIVERS FOR INTEGRATED PLANNING

Those traditional performance measurements of time, cost and quality are no longer the only benchmarks for construction projects. In recent years think-tanks such as Rethinking Construction, The Construction Best Practice Programme, and The Key Performance Indicators Zone, now combined as Constructing Excellence[2] have set additional targets, challenging construction to plan more thoroughly and improve performance in many areas, including a greatly increased attention to health and safety.

Management of health and safety risk has traditionally been born by the main contractor supervising site activities, as shown as item 1, Figure 2.1. The Health and Safety at Work Act (1974) can readily be applied to the contractor's planning duties. Subsidiary Regulations such as The Construction (Health, Safety, Welfare) Regulations 1996 and The Management of Health and Safety at Work Regulations 1999 have put more specific obligations on contractors to plan for health and safety and assess the risks to those under their control.

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[1] *CIRIA publication "More for Less" (Horner & Duff, 2001) shows 20% improved productivity.*
[2] http://www.constructingexcellence.org.uk

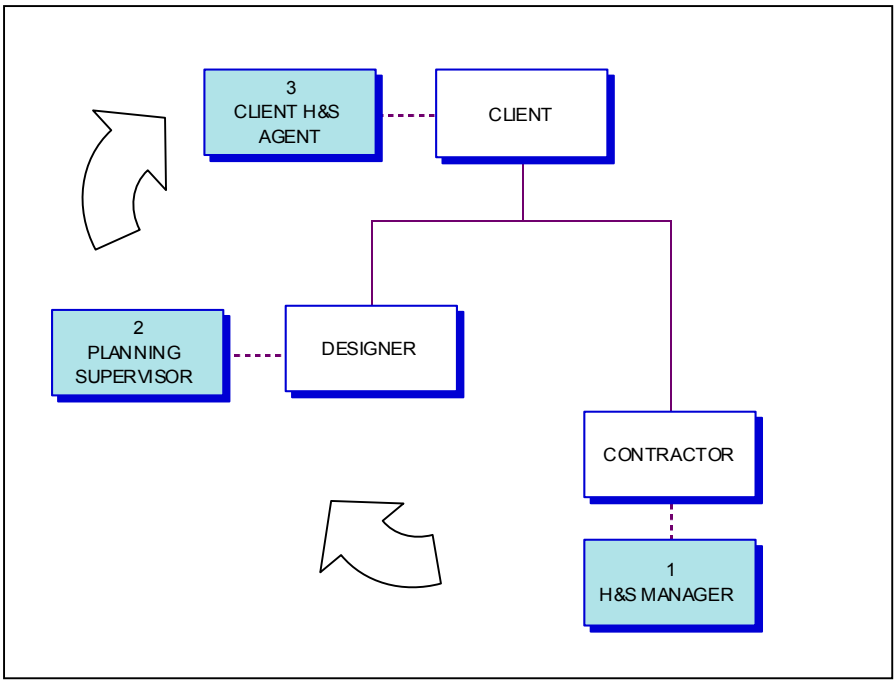


Figure 2.1 Evolution of Health & Safety Risk Management

The introduction of The Construction (Design and Management) Regulations 1994 (CDM) explicitly detailed the requirements of those who indirectly influence site health and safety during the pre-construction, or planning stages. A key introduction was the function of the Planning Supervisor, which concentrated almost exclusively on the design process, as illustrated in item 2, Figure 2.1. This subsequently required designers to manage health and safety risks. The further requirements of CDM, for documents such as the Health and Safety Plan and the Health and Safety File, combined with existing legislation for contractors, has led to the creation of additional processes required to satisfy legislation, running in tandem with existing project planning processes. The result has been described as a paper chase, back-covering exercise and bureaucratic (Baxendale & Jones, 2000) (HSE, 2002).

The application of risk management to construction projects has always had to include some element of health and safety risk (Smith, 1999). But this element now needs to increase in its weighting as the advent of Corporate Governance (Turnbull Report 1999) and the Corporate Killing Bill has forced those at board-room level to engage in the management of health and safety risk. Other initiatives, such as the Corporate Responsibility Index[3], which includes an indicator for Occupational Health and Safety, puts the actions of those distant from the 'coal-face' firmly at the forefront. Therefore, client organisations now see the implications of failing to manage this risk, as shown in item 3, Figure 2.1. The evolution of health and safety risk management has gradually moved the focus more upstream in the project life-cycle, and now encapsulates all of those involved in construction projects.

The statistics for accidents and fatalities in the industry, subsequent to the introduction of CDM, show an initial decline, followed by a sharp increase with fatalities peaking again in the year 2000/2001 (HSE Statistics[4]). This prompted the Deputy Prime Minister John Prescott to call a Construction Health and Safety Summit in February 2001. One of the many actions and initiatives following on from this was "Revitalising Health and Safety in Construction"

[3] *First Corporate Responsibility Index © Business in the Community 2003*
[4] *www.hse.gov.uk/statistics/overall/fatl0203.pdf*

(HSE 2002). This was a discussion document aimed at, amongst other things, reviewing the CDM Regulations. HSE intended CDM to encourage the integration of health and safety into project management (HSE, 2001) but it is clear that industry does not share this view (Baxendale & Jones, 2000) (HSE, 2002).

Revitalising Health and Safety therefore sought to explore various avenues, including the possibility of developing "Gateways" for health and safety. This idea was also discussed in "Accelerating Change" (Egan, 2002), the follow-up to "Rethinking Construction". Both documents make reference to the Office of Government Commerce (OGC), who developed a gateway process for project planning. Figure 1.2 shows the OGC generic project flow chart for construction projects. Gateways are positioned at key decision points throughout the project life cycle; and, passing through each gateway depends on satisfying predetermined "Critical Success Factors" (OGC, 2001). Note that the flow chart shows two "Decision Points" for design, which, by definition make them gateways also.

Responses to the Revitalising Health and Safety[5] consultation process (question 14) on gateways, indicated by a majority of 104 in favour of implementing a gateway process to integrate health and safety risk management, compared to 24 who thought it was not worth while (HSE, 2003b). It must be acknowledged, however, that a client, such as OGC implementing a gateway process is quite different from HSE, possibly, imposing such a process through legislation. If the latter were adopted, and a formal process imposed on construction projects, there may be severe resistance. Any gateway process must be aligned to the individual organisation's own corporate processes (Evans, 2000).

Adoption of a gateway process would provide the framework for integration. Gateways, however are strategic points, where strategic decisions are made, the detailed processes which make up each stage of a project need also to be integrated with the management of health and safety risk. This will now be discussed in more detail.

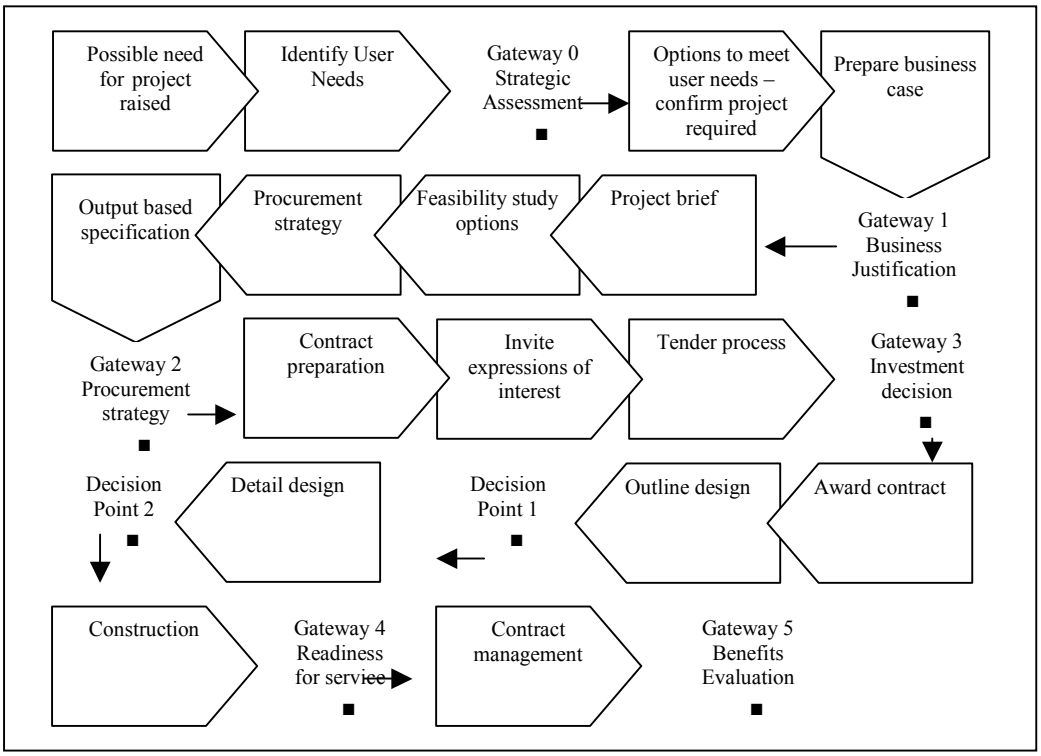


Figure 2.2 Generic project flowchart (OGC Procurement Guidance No03, 2003)

[5] www.hse.gov.uk/consult/disdocs/dde20summary.pdf

2.3 INTEGRATED PLANNING

In construction, planning can cover a vast number of activities from pre-project planning, through design, to planning specific site activities. Anecdotal evidence suggests that up to 90% of accidents could be prevented through better planning. This assumption finds its roots in the HSE publication "Blackspot Construction"[6], in which it was stated that "90% of deaths could have been prevented" (HSE, 1988). More recent studies have found that planning and control failures were related to 45.4% of accidents (Duff & Suraji, 2000), and designers could have prevented 47% of accidents investigated as part of an HSE research project (HSE, 2003c). If improvements are to be made, the management of health and safety risk needs to be integrated with all project planning processes.

Although The Construction (Design and Management) Regulations (CDM) requires integration at a project level, previous work in the UK has mostly concentrated on integrating safety management systems with *other* management systems. The Construction Industry Research & Information Association (CIRIA) report C509, for example, discusses the integration of safety, quality and environmental management systems (CIRIA, 2000). Here BS 8800 (health and safety) is considered with ISO 9001 (quality) and ISO 14001 (environment), with the commonalities of each highlighted to show where consolidation of the management work load could be made. These management systems are, of course, company specific, not project specific. Despite there being an abundant source of literature on CDM (e.g.: HSE CIRIA Summerhayes 2002), there is a lack of information describing how these extra responsibilities should be integrated with general project planning.

Any approach to the integration of project planning with health and safety planning needs to acknowledge that several parties come together to form construction projects, therefore integration at this level needs to concentrate on project processes, such as those shown in Figure 2.2.

Some conceptual work, done in the 1990's focused on integrating health and safety data with Critical Path Method scheduling software (Kartam, 1997). This was based on the MASTERFORMAT classification system used in the United States, which is similar to the United Kingdom's National Building Standard. Classification of work processes, materials and components were linked to safety record sheets relevant to each item. This information was then incorporated into programmes and schedules.

To overcome the problem of information overload those items considered safety critical appeared as an "explicit" item, visible on the network or programme; "implicit" information was indicated with a warning to show further health and safety information existed. This study concentrated on site works but the process could be applied to all project activities. Unfortunately the author has not developed this work.

More recently research was conducted in Brazil where an attempt to integrate safety with project long, medium and short term planning was undertaken (Saurin et al, 2004). This study concentrated on production planning which centred on contractor planning methods. Extensive use of the *Last Planner Method* of production control was used. This consisted of one-week and one-day short-term commitment planning, three-week look-ahead planning, and long-term planning. This was the framework for the integration of the safety planning and emphasises the point that in order to integrate safety planning there needs to be an existing formal planning process already in place.

[6] *Blackspot Construction: 5 year study of 739 deaths in building and civil engineering (1988)*

The Brazilian research considered "long-term planning" to mean each major work package for the project. General activities were planned whilst identifying the risks directly associated with the work package as well as those common to all work packages. This planning stage included the subcontractors who would undertake the work package. Risk management controls were then agreed.

Look-ahead planning incorporated any safety constraints with all other general constraints, therefore responsibility was allocated and safety activities were formally acknowledged as part of the work to be done. The safety constraints consisted of five categories of safety related resources; training; safeguards; PPE; design; and space. Examples of these safety related resources are shown in Table 2.1. It is worth noting that some categories can be termed as "hardware" such as physical safeguards and PPE, whereas others can be described as "software" such as training. Hardware can usually be easily identified, however software requires more thought and effort if it is to be successfully used as it is a more subtle cost and showing the benefits of this is not as straight forward, although it's use is just as necessary as the hardware.

Table 2.1 Examples of safety related resources (source: Table 1, Saurin et al, 2004)

Category	**Examples of Resources**
Training	Passing instructions to new workers, training based on safety plans, training videos.
Safeguards	Hand rails, safety signals, safety nets, fire extinguishers.
PPE	Hard hats, safety shoes, harnesses, hearing protection.
Design	Drawings to assemble scaffolds and handrails systems.
Space	Areas for materials storage, released areas in the industrial building.

It was found that discussion with workers at this level was essential as they would be the ones carrying out the work; therefore they would help identify uncertainties. In addition to this they would actually make the final decisions on the exact method of working. This finding is closely aligned to Maloney's research into operative participation in the planning and conduct of construction work processes (Maloney, 2003), in which he has sought to prove that this can lead to improvements in both productivity and safety performance.

Short term planning in the Saurin et.al. work, included weekly and daily planning. Safety and production indicators were discussed together. A Last Planner tool was utilised, known as *Shielding Production.* This is where certain criteria must be fulfilled before a work package is signed off; and, safety was integrated into this process.

The main safety indicator was "percentage of safe work packages". A work package was considered to be safe when all planned preventative measures have been implemented and no unsafe occurrences have taken place. By checking the planned with the actual another key Last Planner tool can be used. This involves identifying the reasons for not following the plan, recording this, checking trends and taking actions. This is also a perfect representation of the classic Plan Do Check Act model.

This work is similar to Kartam's in that it embraces the philosophy of integrated planning, but concentrates exclusively on planning after design. With the relatively new, and increasing, focus on the health and safety responsibilities of clients and designers, it is essential that this philosophy of integration is extended to all project planning. It has long been acknowledged that the project decisions having the greatest effect on project commercial success are taken early in the project life-cycle and, therefore, must be the subject of careful planning. It should also be acknowledged that health and safety risk is part of the commercial risk portfolio, as well as having serious human consequences, and should, therefore, be an integrated part of this early planning.

3.0 THE GATEWAY MODEL

3.1 INTRODUCTION

The development of the gateway model has been based on the Office of Government Commerce (OGC) framework for construction procurement as shown in Figure 3.2. The decision to use the OGC model has been based on several factors. The flexibility of this gateway model allows various procurement routes to be adopted and acknowledges that no matter which method of procurement is chosen, there are various common processes that need to be fulfilled. Specific guides for the procurement of construction projects proved to be too rigid and prescriptive. The other advantage of the OGC model is that it is primarily for general project management purposes, rather than using health and safety specific gateways.

Although the revised Construction (Design and Management) Regulations (CDM) Approved Code of Practice (ACoP) (2001) lends itself to a gateway approach, it would be counter productive to attempt to structure all other project management processes around CDM. This would surely be rejected by industry, on the grounds that 'the tail was being made to wag the dog'. The gateway model's appearance does resemble CDM phases, as illustrated in the CDM ACoP; however, the various project procedures and gateways have been based on the OGC flow chart shown in figure 2.2 above. An overview of the model is shown in Figure 3.3.

The OGC publication "Gateway Review: Leadership Guide" describes a gateway review as "a review of a procurement project carried out at a key decision point by a team of experienced people, independent of the project team". Although it is debateable whether an independent team, without detailed project knowledge, should carry out gateway reviews, independent facilitators can bring an unprejudiced view to the discussions. This process facilitates consideration of the critical aspects of a project at key points through its life. The system therefore provides assurance that everything is in place prior to progressing to the next stage and assists in developing and achieving more realistic targets. Looking at the wider picture it becomes more obvious why health and safety reviews should follow these gateway stages if true integration is to be achieved.

Having said this, however, there is a distinct possibility that a gateway system could become too bureaucratic. This pitfall was highlighted in the responses to the HSE discussion document "Revitalising Health and Safety in Construction". There is also the issue of applying a gateway system to smaller projects. Both these points are valid and require careful consideration when implementing such a model. This is discussed later.

Rather than being a series of check-lists, each gateway requires the project team to sign-off each item to show that they are satisfied that it has been done to a set standard. This will then constitute success for each item allowing progression with confidence. Figure 3.1 shows an example of a gateway sign-off form. Critical Success Factors (CSF) are reviewed at this point, after which each member of the project team signs off the form. Evidence of the completion of each CSF will need to be presented prior to sign-off by way of reports etc.

Project Name
Gateway Stage Sign-Off

Gateway Stage (Number)

OUTPUTS:

		Comments
Critical Success Factor 1	Yes/No	
Critical Success Factor 2	Yes/No	
Critical Success Factor (H&S)	Yes/No	
Critical Success Factor N	Yes/No	

SIGN-OFF:

Name	**Position**	**Go/No Go/ Conditional**	**Comments**	**Signature**	**Date**

GATEKEEPER'S DECISION:

☐ **Go**
☐ **No Go**
☐ **Conditional Go**

Comments:

GATEKEEPER'S SIGNATURE **DATE**

Figure 3.1 Gateway Sign-Off Form

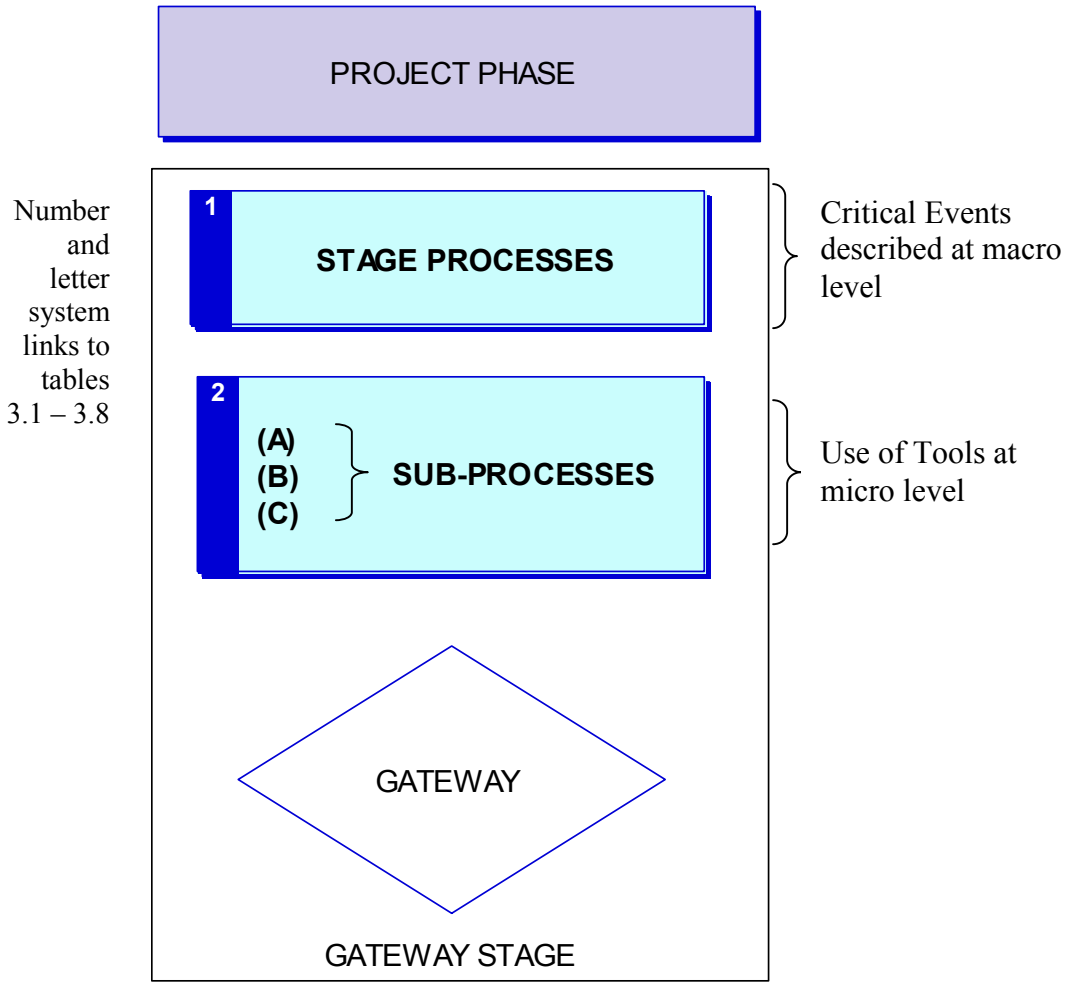


Figure 3.2 Elemental Breakdown of the Gateway Model

Each gateway stage will now be discussed in detail showing how the management of health and safety can be integrated with other project processes. Figure 3.2 explains the breakdown of the model and how it relates to the text boxes which expand each process.

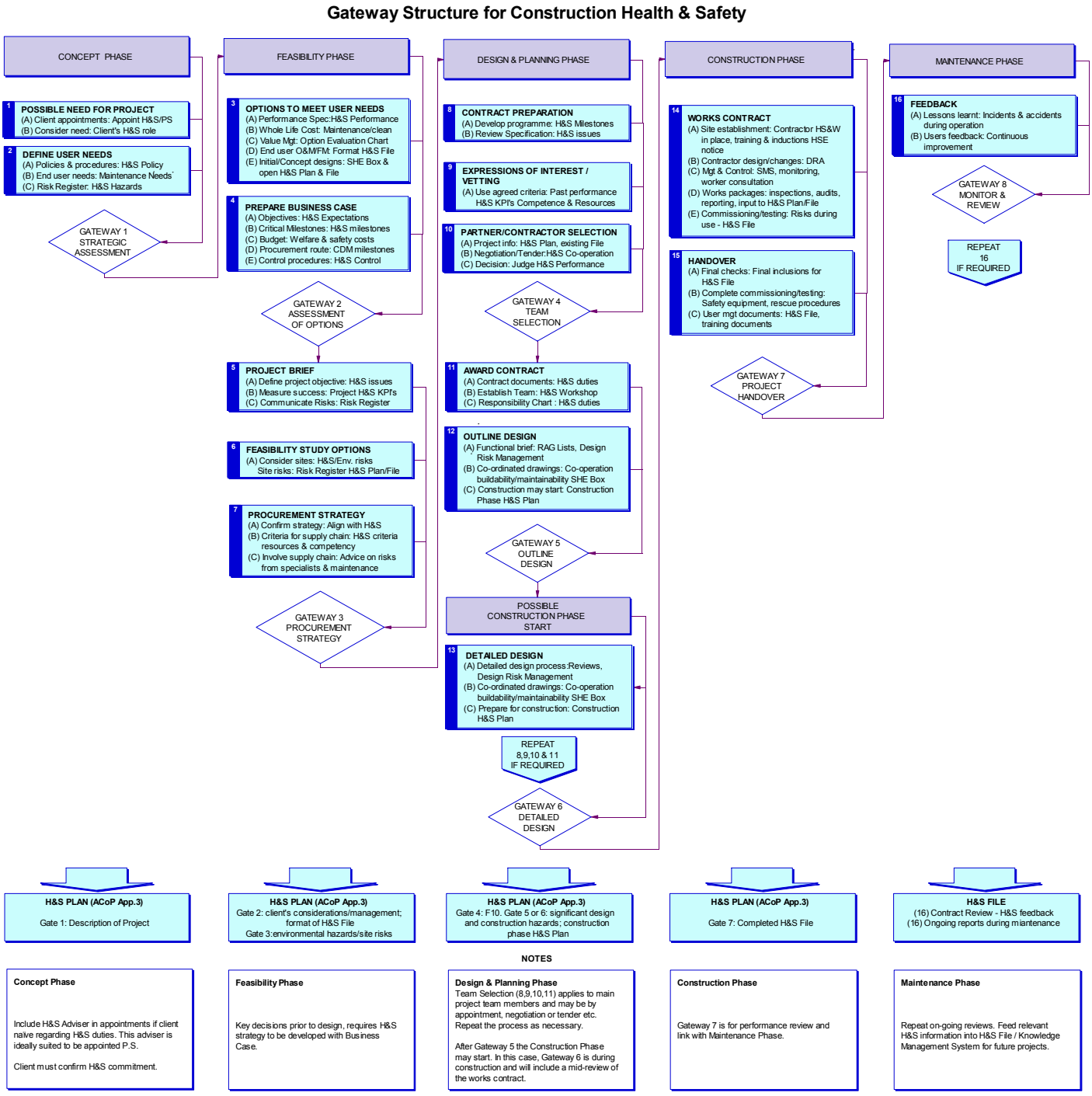


Figure 3.3 Gateway Model for Management of Construction Health & Safety

3.2 GATEWAY 1 STRATEGIC ASSESSMENT

Table 3.1 Gateway 1 – Strategic Assessment

No	P.M. Item	CDM/SMS/H&S
CONCEPT & FEASIBILITY PHASE		
1	**Possible Need for Project**	
A	Initiated by client: "informed" client – appoint owner "naïve" client - appoint consultant.	Appoint a competent Planning Supervisor to assess designers and contractors (CDM Reg 14c ACoP 142 191-200).
B	Consider if construction project is required.	Consider client's role in H&S throughout project: supply of information; time allowed and budget required for project.
2	**Define User Needs**	
A	Policies and procedures	Align Health & Safety (SHEQ) policies for project; how supply chain will be informed of H&S requirements; expertise required; criteria for evaluating competence, resources and commitment; how to measure & monitor performance. Copy to H&S Plan.
B	End users' needs	Issues for safe operation and maintenance. Consult end user/maintenance/FM (if known).
C	Identify threats and opportunities (Risk Register)	Identify S.H.E. hazards (Risk Register)
GATEWAY 1 STRATEGIC ASSESSMENT		
	Purpose of review: ensure support for project; risks are identified; financial provision has been made.	H&S objectives on the agenda for consideration; project risks (Risk Register) include H&S/Environmental (per Turnbull Report); financial provision for CDM/H&S issues (P.S., H&S advice, worker consultation, safe maintenance/cleaning) H&S Plan – Description of Project (ACoP)

CDM: Construction (Design and Management) Regulations
H&S: Health and Safety
SHEQ: Safety Health Environment and Quality
SHE: Safety Health and Environment
FM: Facilities Management
PS: Planning Supervisor
ACoP: Approved Code of Practice

Table 3.1 shows the processes leading to Gateway 1. This is the first of 3 gateways during the concept and feasibility phases prior to design. At this stage it is recommended that the client appoint a competent Planning Supervisor (PS) or health and safety advisor. Indeed, combining both of these functions would give the PS a more integrated role and is a possible future development in the evolution of health and safety risk management, as shown in Figure 2.1. To date, success has been achieved by appointing client health and safety agents who go on to carry out the PS function (BAA) and with integrated health, safety and environmental managers working for the client's team, carrying out both PS roles and site audit checks

(Department for Work & Pentions) Clients clearly require help and robust guidance at this stage, especially naïve, one-off clients . Useful publications include:

- HSE leaflet: Having construction work done? (duties of clients under CDM)
- HSE Publication CDM Role of Client Information Sheet 39

Define User Needs, is a key point when policies for the project should be developed. The integration of Safety, Health, Environmental and Quality (SHEQ) policies has been a recent development for leading construction firms. The Construction Industry Research & Information Association (CIRIA) report C509 explains how integrated SHEQ policies can be developed.

Involving end users at this early stage is highly desirable; however it is acknowledged that in some cases the end user may not be known. In such cases it would be good practice to involve the end user as soon as this information is known. It is assumed that the client commissioning the work has done some investigation into what type of end user the project is aimed at, during preliminary market research if the structure is to be sold on, or by internal consultation if it is for a separate division within the organisation. A consultant could be appointed to input the needs of the end user in their absence.

At gateway 1 it is expected that the strategic objectives have been set and strategic decisions taken. This will include defining outline policies, identifying the main project or programme risks (including health, safety and environmental) on the risk register (see Tool Box), and ensuring that financial provisions have been made for those issues identified for CDM compliance and other health and safety matters. These will include a budget for the Planning Supervisor, provision of adequate communication channels for all stakeholders to communicate views on health and safety matters, and a budget for safe cleaning and maintenance of the finished structure. Initial information for the Health & Safety Plan should be provided by this point.

3.3 GATEWAY 2 PROJECT RISK ASSESSMENT

Table 3.2 Gateway 2 – Project Risk Assessment

No	P.M. Item	CDM/SMS/H&S
3	**Options to Meet User Needs**	
A	Performance Specification to allow flexible approach.	Include H&S performance, materials and components specified by output performance can meet functional and H&S requirements.
B	Whole life Costing	Compare whole life cost of high risk O&M/cleaning, i.e. abseiling to clean glass panels.
C	Value Management	Ensure best choice = safe choice. Option Evaluation Chart to include H&S.
D	End user's operation and maintenance (F.M.).	Input from end user at this stage; include format for H&S File and budget for maintenance strategy.
E	Initial/Concept Designs	Initial S.H.E. Box information e.g. highlight where complicated designs will require extra planning to develop.
4	**Prepare Business Case**	
A	Objectives	H&S Objectives, copy to H&S Plan.
B	Project Critical Milestones	CDM/H&S milestones copy to H&S Plan.
C	Project budget	Evaluate cost of specific CDM/H&S items e.g. P.S., H&S advice, worker participation schemes, safe maintenance.
D	Decide procurement route	Assess procurement route e.g. will it be traditional or combine design and construction in one contract (for CDM milestones).
E	Decide project control procedures	Assess risks. Decide SMS (or SHEQ) control procedures, update Risk Register.
GATEWAY 2 PROJECT RISK ASSESSMENT		
	Purpose of review: ensure business case is robust; previous and new major risks identified have outline risk management plans; objectives are clear; timescales, plans and technical strategies have been properly considered.	Ensure business case has allowed for CDM/H&S issues; major H&S/Environmental risks have been addressed; SMS (or SHEQ) Plan is in place; sufficient time has been allocated for H&S planning at each future stage. H&S Plan – client's considerations/ management; format of H&S File
H&S: Health and Safety O&M: Operation and Maintenance SHE: Safety Health and Environment CDM: Construction (Design and Management) Regulations SMS: Safety Management System SHEQ: Safety Health Environment and Quality		

Table 3.2 shows the processes leading to Gateway 2 - Project Risk Assessment. This stage sees the development of the Business Case. Before this can be done however, all options must be considered. This is when performance specification is now considered better practice over prescriptive specification.

Output performance specifications allow the supply chain to use materials, components and mechanical and electrical plant which meet the functional and health and safety requirements, whereas prescriptive input specifications can lead to unsafe materials being imposed on contractors and suppliers as well as limiting opportunities for innovation and delivering value for money. Output performance specifications are fundamental to "achieving excellence through health and safety" (OGC 2002). This practice has some potential barriers however that need to be addressed. Traditional designers, such as architects cannot pass on their legal responsibilities. Also, there is the danger of contractors becoming inexperienced designers, without proper design competences. An excellent way to overcome these barriers is to have an integrated design process, where everyone who has input to the development of the design works together as a team. A collaborative design team would facilitate this. The Strategic Forum Toolkit[7] is a useful tool to help develop integrated teams and should be consulted by those interested in this approach.

Whole life costing is also seen as best practice when considering options for construction procurement. At this stage the maintenance and cleaning budget should be included in cost analysis. This is clearly an issue for the cost consultants. However, there will need to be an interface with the Planning Supervisor to allow sufficient consideration of the true cost of risk mitigation in dangerous activities during cleaning and maintenance, which may be significant in the overall whole-life cost of the structure. The Royal Academy of Engineers report, entitled "The long term costs of owning and using buildings", crudely defines the ratio of construction cost; maintenance cost; and business operations costs as 1:5:200. This shows the potential significance of maintenance and cleaning costs.

A key issue within Value Management is evaluating and choosing the best option. A tool used for this purpose is the Option Evaluation Chart. This takes the form of a matrix in which various options are compared, applying all the critical factors essential to satisfying the project objectives. Those options that best suit the objectives are chosen. By making health and safety an objective it can be given an appropriate weighting during this decision making process. The related objectives with health and safety dimensions, buildability and maintainability, could also be considered. This is discussed in more detail within the Tool Box.

The end user will be an important stakeholder with useful input at this stage. The importance of the Health and Safety File should also be stressed now. The CDM Approved Code of Practice (ACoP) states that the File's format should be agreed with the client. This assumes that the client will be the end user; however it is obvious that the end user will greatly gain from use of the File if they have input in deciding its format.

Early concept designs will be required at this point for most construction projects, even if there has been no formal design programme put in place. The competence and resources, in health and safety terms, of any designer employed at this point needs to be addressed, possibly via an early appointed PS. Initial SHE box information should be sought, although at this stage it will be limited. Input from construction and maintenance experts will aid identification of relevant SHE information.

The preparation of the business case will require more detailed health and safety input. This is an ideal time to introduce key health and safety objectives. These will serve, during the later project review, to indicate whether the project has been a success in health and safety terms. The relationship of health and safety objectives with the overall project objectives should be made clear in the business case. Measurable objectives will allow linkage to pain/gain share approaches to procurement.

[7] http://www.strategicforum.org.uk/sfctoolkit2/home/home.html

As the business case develops a project programme will evolve, initially with general strategic items but eventually becoming more detailed as the project advances. Key CDM milestones should be integrated into the programme at this point. As the programme develops more health and safety milestones can be added.

The budget items described earlier can now be incorporated into the business case.

The procurement route will have a great bearing on the remainder of the project planning. This is also true for CDM compliance. Traditional forms of procurement can use the outline shown in the CDM ACoP for compliance. However other forms of procurement which rely on early involvement of the contractor and simultaneous design and build processes will require a reassessment of the basic ACoP model. The key points to address are that of the Health and Safety Plan and the appointment and function of the Planning Supervisor (PS). If a client's health and safety advisor is already on board then the continuity of health and safety information can be maintained by them continuing as an integrated PS. The gateway model allows the Plan to be sufficiently developed to suit the form of procurement by reviewing it at each gateway for its suitability.

Some clients or project teams may wish to incorporate a Safety Management System. Assuming that the policy is already in place the next process would be to decide on the system's control procedures. Again this could be part of a SHEQ system and should be incorporated into the overall project controls. For this to work properly one universal system needs to be adopted by every team member organisation. To achieve this, either registration or at least an understanding of formal systems would be required by each party. HSG 65[8] or OHSAS 18001 (BSi, 1999) would provide a suitable framework for all parties to follow. Integration of each phase of the system can easily follow the gateway stages.

At this point the use of a project Risk Register (created at Gateway 1) could help communicate the main risks identified. These would be business risks, which would include SHEQ items. This is discussed in more detail in the Tool Box.

Gateway 2 is a point when the business case is confirmed. It will be successful if it is robust, which will require the team to confirm, based upon early project information, that the project is technically feasible, financially viable, plans are in place to manage the risks identified and the scope of the business case is realistic and timescales and plans are in place. All of these will have an impact on health and safety as shown in Table 3.2.

[8] *Used in the HSE publication "Successful health and safety management" (HSE, 2003d)*

3.4 GATEWAY 3 PROCUREMENT STRATEGY

Table 3.3 Gateway 3 – Procurement Strategy

No	P.M. Item	CDM/SMS/H&S
5	**Project Brief**	
A	Define what the project needs to achieve	CDM/H&S objectives included, update H&S Plan
B	Decide what will be measured to define success	Decide Project H&S Performance Indicators, update H&S Plan, agree format for H&S File.
C	Communicate any known risks	Update Risk Register; new risks.
6	**Feasibility Study Options**	
A	Consider sites and select	Consider H&S/Environmental risks on each site via Option Evaluation Chart. Copy information for site selected to H&S Plan.
7	**Procurement Strategy**	
A	Confirm procurement strategy	Progress H&S Plan in accordance with procurement strategy. Where construction commences prior to completion of design agree "Construction H&S Plan Milestones" also.
B	Agree criteria for selection of supply chain.	Agree H&S criteria for selection of supply chain. (see Appendix 2)
C	Involve supply chain and end users in design options and selection of materials (Design and build options facilitate this)	Seek specialist advice on residual risks (Risk Register). Seek advice on maintenance and access issues during O&M period to prevent H&S problems.
GATEWAY 3 PROCUREMENT STRATEGY		
	Purpose of review: confirm project is fully defined/project plan defined; ensure all controls and performance measurers are in place; confirm funding in place; confirm quality required of supply chain.	CDM/H&S milestones outlined; confirm Risk Register is up to date; confirm funds for CDM/H&S issues are not subject to change; confirm H&S performance measurers required for supply chain H&S Plan – environmental hazards/site risks
CDM: Construction (Design and Management) Regulations H&S: Health and Safety O&M: Operation and Maintenance		

Table 3.3 shows the processes leading to Gateway 3 - Procurement Strategy. Development of the project brief should include CDM outputs such as an updated Health and Safety Plan and an agreed format for the Health and Safety File. Other health and safety objectives need to be included to insure they will not be missed at future reviews. Health and safety Key Performance Indicators (KPI's) for the project can help focus attention. Best practice is now embracing behavioural indicators rather than the usual "zero accidents" type of objective, which is not conducive to understanding and communicating hazards or the goal of continuous improvement. Here concentration on safe acts, such as wearing PPE, following

safe systems of work and reporting minor accidents or near misses will help facilitate continuous improvement. A pro-active Planning Supervisor should be able to advise on suitable KPI's and monitor performance thereafter.

A key function of the brief is to communicate information. In health and safety terms the key issues to communicate are hazards and risks. Reference to the project risk register is therefore vital if the main risks identified are to be communicated to the next stage of the project. In health and safety terms there may be confusion over what a hazard is and what a risk is. The important issue is, however, that these are considered and managed.

When the site is chosen or the construction solution is decided, the existing health, safety and environmental risks will need to be identified, as required by CDM regulation 11. At this stage the Risk Register should be used to communicate this information; however, as more information is gathered the Health and Safety Plan will receive the bulk of this information and the Risk Register should serve as a summary document and show how health and safety is embraced in the overall risk management of the project.

As the procurement strategy develops so must the CDM compliance strategy. Again the H&S Plan should be developed as required and in tandem with procurement planning. Selection of the supply chain requires the definition of health and safety requirements, risks and risk management strategies. These should be agreed at this point. Residual risks that require the input of specialists, to manage safely, may mean their early involvement at this stage.

Gateway 3 marks the end of the concept and feasibility phases. As such a great deal of the initial planning should be completed to such a stage that only design risk needs to be addressed at the next phase.

3.5 GATEWAY 4 PARTNER/CONTRACTOR SELECTION

Table 3.4 Gateway 4 – Partner/Contractor Selection

No	P.M. Item	CDM/SMS/H&S
DESIGN & PLANNING PHASE		
8	**Contract Preparation**	
A	Develop project programme	Develop H&S milestones for project programme.
B	Develop output performance based specifications	Review specifications for prescriptive items that may generate H&S risks during construction/O&M.
9	**Expressions of Interest / Vetting**	
A	Use criteria previously outlined to vet supply chain.	Use H&S criteria previously outlined to confirm individual suitability of members of supply chain. Main CDM requirements are competency and resources (Reg 8 ACoP 191-200).
10	**Partner/Contractor Selection**	
A	Collate and despatch project information/tender documents	Complete and despatch Pre-Construction H&S Plan, including specific feedback requirements regarding residual risks from the site and/or design. Include current H&S File.
B	Negotiation/Tender correspondence.	Co-operation between parties involved in negotiation/tender process with regard to H&S issues.
C	Decide partner/contractor based on cost/performance criteria.	Ensure H&S criteria sufficiently weighted in decision.
GATEWAY 4 TEAM SELECTION		
	Purpose of review: confirm business plan is being followed; controls are being used; risk management / change management plans in place; technical issues relating to construction have been addressed.	Confirm SMS (or SHEQ) policy is being followed; Risk Register is being appropriately used; systems are in place for design hazard identification and risk management; Confirm partner/contractor's competence & resources. Complete F10 for HSE (include PS details).

H&S: Health and Safety
O&M: Operation and Maintenance
CDM: Construction (Design and Management) Regulations
ACoP: Approved Code of Practice
SHEQ: Safety Health Environment and Quality
PS: Planning Supervisor

Table 3.4 shows the processes leading to Gateway 4 - Team Selection. This phase allows various options to be incorporated for the selection of the whole project team, which may include appointments, negotiation or tender processes and can involve designers, consultants and contractors.

Development of the project programme and specifications should follow, and build on the outlines previously mentioned in respect of health and safety milestones on the programme

and output specifications by designers and specifiers. Health and safety milestones at this stage should be more specific and relate to the individual responsibilities of each CDM duty holder.

Regardless of the form of procurement, careful supply chain selection will always be a feature of well-managed construction projects. Health and safety criteria should be seen as a key factor in the selection of the supply chain. The flow chart used in the Office of Government Commerce (OGC) publication "Achieving Excellence Through Health And Safety" is an excellent guide to this process and is reproduced in Appendix 2.

The extent of use of this flow chart will be dependent on the scale and complexity of the project. Also, for repeat work there is no need to revisit the same issues and produce copious amounts of duplicated paperwork. It is recommended that this information is held centrally for repeat contracts and therefore only project specific issues require further investigation.

Communication of the health and safety risks through the risk register and Health and Safety Plan is essential during any negotiation or tender process. Communication of risk is essential to allow properly costed tenders to be developed. Even if a partner or contractor has been appointed based on previous partnering or project collaboration, this information is still essential as it will be required for planning each team member's input to the project. Having said this, if the information is held only by the health and safety officer within the partner/contractor organisation then the benefits will not be realised. The information should be disseminated among the planners, quantity surveyors and other decision makers and this process will probably require interaction between these people and discussion of risks with the health and safety officer. Another added advantage of the Plan is that it can be used to ask questions of partners and contractors regarding specific risks or residual risks and, hence, gauge their competency and culture of their management.

Gateway 4 is a critical point as it marks the move into the main design phase. It's main purpose is to confirm that the earlier plans are being implemented, which should ensure that documents such as policy statements, the Health and Safety Plan and Risk Register have not just been prepared as an action of compliance but are being used to the benefit of the project. This particular gateway can be repeated several times, for example in designer, consultant and contractor selection. The H&S Plan will need to be developed to a suitable degree before this gateway is signed off, depending on which team members it relates to, and sufficient time must be allowed for adequate completion. This gateway should coincide with completion of form F10 to inform HSE of the Project.

3.6 GATEWAY 5 OUTLINE DESIGN

Table 3.5 Gateway 5 – Outline Design

No	P.M. Item	CDM/SMS/H&S
11	**Award Contract**	
A	Issue and complete contract documents. Accept, change or decline contract.	Confirm health and safety duties. Each party may accept or decline contract depending on its commitment to H&S, project risks and contract requirements.
B	Partnering / Team Building Workshop	H&S hazard workshop, action outputs.
C	Confirm Responsibilities	Integrated responsibility chart with H&S included
12	**Outline Design**	
A	Assess functional brief and commence iterative design process.	Initial Red-Amber-Green list analysis. On-going CDM reviews, Buildability, Maintainability.
B	Outline design, co-ordinate services & consultants. Produce drawings, schedules, information.	Co-operation & Co-ordination of design team; Buildability and Maintainability of design challenged; site issues regarding residual risk should have been addressed by the contractor, if appointed, ahead of completing the Construction H&S Plan. Identify H&S hazards/risks on drawings, DRA to Risk Register. Update H&S File
C	Possible construction phase start after this gateway. Detail method of construction. Develop Construction Phase Programme.	Possible Construction Phase H&S Plan; contractor risk assessment; cross reference H&S Plan to programme; H&S milestones on programme.
GATEWAY 5 OUTLINE DESIGN		
	Purpose of review: Design has been progressed enough to allow planning permission / statutory submissions; confirm client freeze (no more major changes). Possible instruction to start on site.	Confirm SMS (or SHEQ) policy is being followed; Risk Register is being used; systems are in place for design changes to assess further risks. H&S Plan – significant design and construction hazards; possible construction phase H&S Plan.

H&S: Health and Safety
CDM: Construction (Design and Management) Regulations
DRA: Design Risk Assessment
SMS: Safety Management System
SHEQ: Safety Health Environment and Quality

Table 3.5 shows the processes for Gateway 5 - Outline Design. On award of the contract there are a series of sub-process which should happen regardless of procurement route as shown below process 11.

Just as the terms of the contract need to be acceptable to all parties concerned, the level of health and safety performance expected from each party to the contract must be considered. This is the time when the decision should be made, by any of the contracting parties, to accept or decline the contract, i.e. walk away if the health and safety risks and requirements are

unacceptable and cannot be resolved. Others may accept the same contract but the decision should be based on the level of risk. The contractor organisation may feel this is too great to accept, for its own integrity and the health and safety of its employees.

If everything is satisfactory, the next step will be to create a climate conducive to co-operation and good communication, along with affirmation of responsibilities. The combination of a team building workshop with a health and safety workshop can both create a team spirit and aid hazard identification. Creating a Responsibility Chart will communicate on one document the roles and responsibilities of each party to the contract, integrating health and safety responsibilities will help show this in a concise and transparent manner. Initial indications show that a short list of responsibility types is easier to manage and will encourage greater acceptance than a long complex list. This is discussed in more detail within the Tool Box.

The design phase is one which, depending on the project, can vary in complexity. Regardless of this, the key CDM functions to consider are design hazard identification and risk management. A useful Construction Industry Research & Information Association (CIRIA) publication to assist designers is Report C604 (previously 166) which outlines the consequences of various design solutions for Buildability and Maintainability, HSE have recently launched a new CDM website for designers[9] which features Red-Amber-Green lists. These can be a useful guide to highlight the main generic hazards to eliminate or avoid, as well as suggest good practice (see Red-Amber-Green Lists in the Tool Box section). Assuming that health and safety issues are written into the brief, then embracing CDM within the design should come naturally. However the Planning Supervisor is still required to coordinate health and safety matters in the design stages. Although the design can be challenged at the next gateway it must be acknowledged that design is an iterative process. The calibre of the Planning Supervisor will therefore heavily influence the quality of design risk management, prior to the final gateway review. It is therefore recommended that several review points are included in the project programme and scheduled with him during this key stage.

Since Gateway 5 may lead into the construction phase the specific issues relating to initial construction activities need to be considered. Analysis of the method of construction goes hand in hand with the contractor's Risk Assessment required by the Management of Health and Safety at Work Regulations (1999). Development of the construction phase programme should include cross references to the Health and Safety Plan and include health and safety milestones (see the Tool Box).

Gateway 5 should therefore confirm that the design has progressed to a pre-specified, acceptable level and no major client changes will be made. Changes are sometimes inevitable but to set a deadline for this goal is better than none at all. This will also aid certainty and reduce the need for lengthy re-assessments. Demonstrable proof that risks have been eliminated or reduced through good design should be sought. This should aim to aid the risk management process rather than be a back covering exercise (although this may be considered a useful consequence). As mentioned previously, this gateway may serve to confirm the start of the construction phase. A key process will be the review of Buildability and Maintainability. Ideally this review will involve both the contractor and end user, or even maintenance contractor, in challenging the design prior to construction. However, in some projects this will not be feasible and, in that case, appropriate expertise from elsewhere in the client or project teams will be required for these reviews.

[9] http://www.hse.gov.uk/construction/designers/index.htm

3.7 GATEWAY 6 DETAILED DESIGN

Table 3.6 Gateway 6 – Detailed Design

No	P.M. Item	CDM/SMS/H&S
13	**Detailed Design**	
A	Detailed design process.	On-going CDM reviews, Buildability, Maintainability.
B	Detailed design, co-ordinate services & consultants. Produce drawings, schedules, information.	Co-operation & Co-ordination of design team; Buildability and Maintainability of design challenged; site issues regarding residual risk have been addressed by the contractor ahead of completing the Construction H&S Plan. Identify H&S hazards/risks on drawings, DRA to Risk Register. Update H&S File
C	Possible construction phase start after this gateway. Detail method of construction. Develop Construction Phase Programme.	Possible Construction Phase H&S Plan; contractor risk assessment; cross reference H&S Plan to programme; H&S milestones on programme.
POSSIBLE CONSTRUCTION PHASE STARTED		
14	**Initial Works Contract**	See process 14 in Table 3.7
GATEWAY 6 DETAILED DESIGN		
	Purpose of review: confirm business plan is being followed; controls are being used; risk management / change management plans in place; technical issues during construction have been addressed. If construction stage has already started: confirm design process is providing adequate and quality information for construction to progress; review performance of contractor during construction.	Confirm SMS (or SHEQ) policy is being followed; Risk Register is being used; systems are in place for design changes to assess further risks; Confirm Pre-Construction H&S Plan done; Buildability and Maintainability of design challenged; site issues regarding residual risk have been addressed by the contractor ahead of completing the Construction H&S Plan. If construction stage has already started: confirm design risk management is adequate; review H&S performance of contractor.

CDM: Construction (Design and Management) Regulations
H&S: Health and Safety
DRA: Design Risk Assessment
SMS: Safety Management System
SHEQ: Safety Health Environment and Quality

Table 3.6 shows the processes leading to Gateway 6 - Detailed Design. The overall design should be well established at this point, therefore the emphasis will be on development of specific details and the co-ordination of specialist contractors will become more relevant. This co-ordination that is necessitated by the design process should also lend itself to a collaborative approach to hazard identification and risk management. Use of the Risk Register as a tool to manage the process will help and provide an audit trail. Continuing review and updating of the Health and Safety Plan and File will also be undertaken.

If the contractor, or even nominated subcontractors, are appointed by this point then their inclusion in the collaborative risk management process will be extremely beneficial in the context of their interest in buildability. This involvement will be conducive to better health and safety planning and risk avoidance, as well as possible productivity improvements during construction.

In many respects Gateway 6 is similar to Gateway 5 applying the same rules for outline design to detailed design, but will yield a greater level of detail. Also, if the construction phase has already started the review should consist of separate design and construction portions. The critical success factors here will be to confirm that the design process is feeding the construction process with sufficient and timely information and the health and safety performance of the contractor on site is satisfactory. This will require a client's health and safety agent to audit the contractor. Examples of this are the Department of Works and Pensions (DWP) Jobcentre plus contracts (DWP, 2004) in which this role is integrated with the Planning Supervisor's function. Guidelines for site audits can be taken from publications such as HSG65 (HSE, 2003d).

3.8 GATEWAY 7 PROJECT HANDOVER

Table 3.7 Gateway 7 – Project Handover

No	P.M. Item	CDM/SMS/H&S
CONSTRUCTION PHASE		
14	**Works Contract**	
A	Site establishment	Display HSE Notice, site inductions – confirm operatives have received and understood method statements, communicate site rules. Confirm contractor's supply chain input to Construction H&S Plan & H&S File.
B	Contractor's own design process. Change management process.	DRA required, P.S. input required – copy residual risk to Risk Register. Update H&S Plan.
C	Site Management & Control – implement management system, monitor progress & resources, report feedback.	Implement SMS, ensure site-specific training, monitor H&S performance & resources, facilitate feedback from operatives and worker consultation.
D	Execute works packages, monitor progress & resources, report feedback.	Safety inspections, continue to monitor H&S performance & resources, report incidents & accidents.
E	Pre-handover meeting agree procedures for commissioning & testing.	Identify potential H&S/Environmental Risks at commissioning and during use. Ensure contractor's supply chain have submitted information for H&S File.
15	**Handover**	
A	Check completed structure with specifications and drawings	Final inclusions and completion of H&S File.
B	Testing and commissioning	Include safety issues in testing of M&E equipment; testing of safety and maintenance equipment, including rescue procedures.
C	User familiarisation, Handover Management Documents	Communicate H&S residual risks (H&S File). Training
GATEWAY 7 PROJECT HANDOVER		
	Purpose of review: confirm contract has been properly completed, necessary testing is done ready for implementation, Management Documents received ensure ongoing risks are being managed, confirm lessons for future projects are identified	Confirm H&S File is completed to client's satisfaction and received; communication processes are available to ensure that users are familiar with residual risks.

HSE: Health and Safety Executive
H&S: Health and Safety
DRA: Design Risk Assessment
PS: Planning Supervisor
SMS: Safety Management System
M&E: Mechanical and Electrical

Table 3.7 shows the processes, during the construction phase, leading to Gateway 7 – Project Handover. At this stage the emphasis will change to short term planning and operational issues. It is important however, that the outcomes of the earlier planning work are communicated and implemented during the construction phase. Communication of the H&S Plan, residual risks and other health and safety issues needs to be part of the ongoing planning of construction work. Although the Principal Contractor is responsible for this the client, or his representative is required to ensure work is being done competently and safely. The contractor's performance will be checked regularly in terms of time, quality and cost. Health and safety is no different and the previously agreed health and safety performance indicators need to be monitored. The client ultimately has this responsibility, but may choose to delegate it to a health and safety advisor.

Again the use of milestones on programmes will help facilitate the inclusion of health and safety issues during the construction phase. Items 14A through to 14E can be included in this way and will show a clear audit trail to confirm compliance.

At handover an important inclusion is the Health and Safety File. Integration of the file with other handover documents is recommended. However, the information still needs to be easily extracted for future use. Other uses, other than CDM compliance, may be for training of end users and maintenance personnel. The safety information held in the File could prove invaluable to users, cleaners and maintenance staff, if appropriately presented.

Gateway 7 marks the end of the construction phase. At this stage contractor and supply chain performance will be reviewed. This in fact can be looked at as a gateway for the supply chain to demonstrate that they have performed well enough to be considered for future projects. Therefore the outputs of the construction phase, including Operation and Maintenance (O&M) manuals and the H&S File, should be reviewed to confirm that they were completed satisfactorily. This can be a good point to review the H&S Plan to see if it has been followed and updated. Following on from this there may be some residual risks in the Plan that need to be transferred to the H&S File. Finally, the handover of the File could be seen as an opportunity for the Principal Contractor to impress the Client with a well presented and useful document to assist in securing future projects. As mentioned previously the integration of the File with other documents can have advantages however it will be the client that determines its format and his requirements should be followed. Specific areas where integration is possible are:

- Cross reference to O&M manuals
- Integral part of training documents for cleaning and maintenance staff

3.9 GATEWAY 8 MONITOR & REVIEW

Table 3.8 Gateway 8 – Monitor & Review

No	P.M. Item	CDM/SMS/H&S
MAINTENANCE PHASE		
16	**Feedback**	
A	Lessons learnt communicated to knowledge management database. Success of project and Performance measurements recorded for future use.	Any incidents and accidents included in lessons learnt along with details of best practice witnessed. H&S performance of supply chain recorded for future tendering purposes.
B	Feedback from users, assess and implement changes	H&S and maintainability issues raised and assessed. Implement changes. Copy to H&S File
GATEWAY 8 MONITOR & REVIEW		
	Purpose of review: assess business case to actual, check that any changes do not compromise the original objectives of the project, check that lessons learnt will be used to improve value for money, confirm the project has concluded or plans are in place to manage it to its conclusion.	Assess H&S Plan to actual, check that changes do not compromise H&S of users, check that lessons learnt will be used to improve H&S, check if H&S/CDM requirements are in place if required to bring the project to completion.
H&S: Health and Safety CDM: Construction (Design and Management) Regulations		

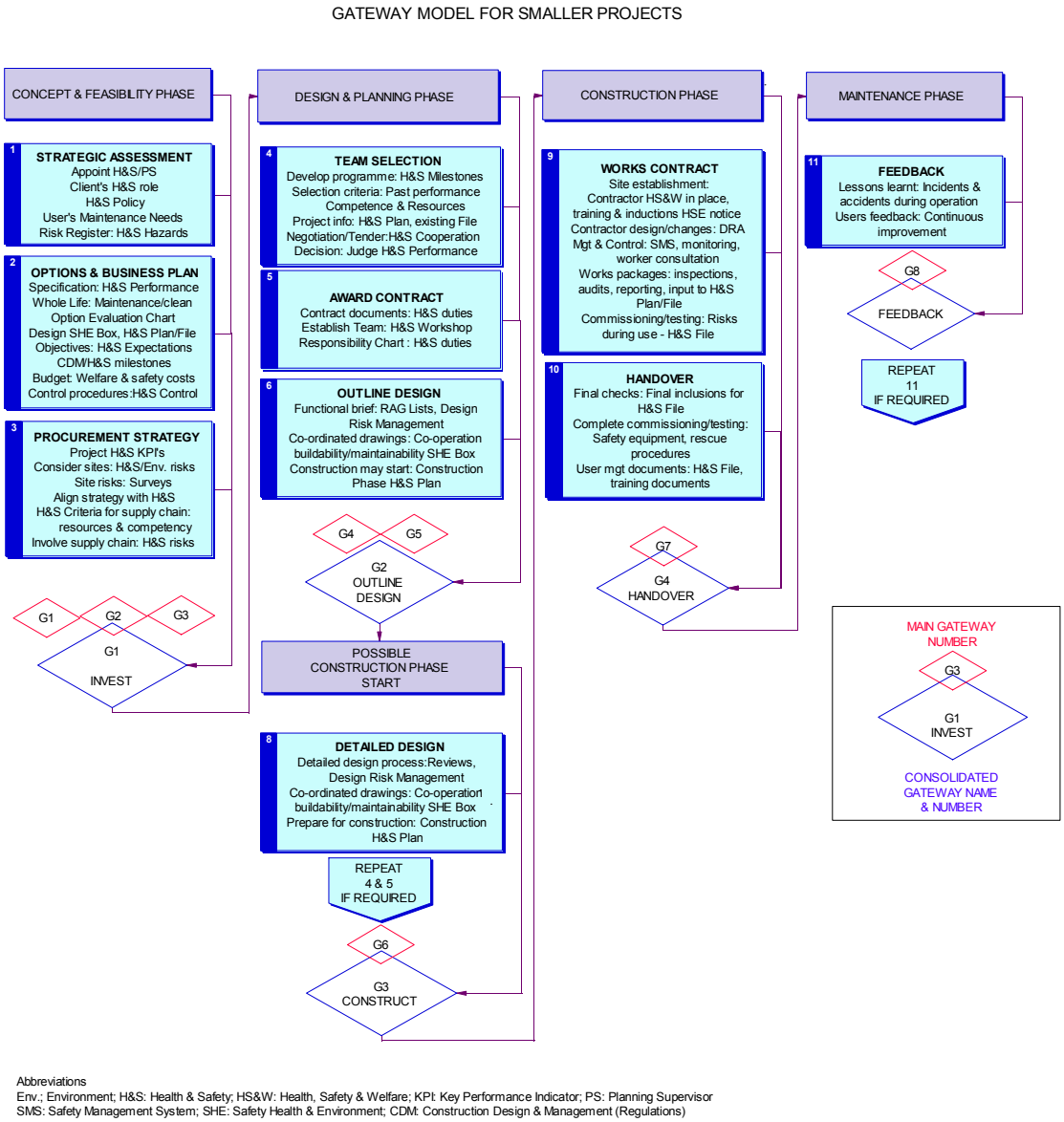
Table 3.8 shows the processes leading to Gateway 8, Monitor and Review. In order to benefit fully from this feedback point it should be carried out during the maintenance phase. This will allow the end users, operating staff and maintenance contractors to evaluate the success of the project in operation and as such is an ongoing process.

It is recommended that the lessons learnt should be recorded in the Health and Safety File. In this way future work can benefit from any mistakes and initiate improvements in project planning, design and construction practice. Some more sophisticated clients may wish to use a knowledge management system for this purpose. This can aid organisational learning.

3.10 COLLAPSING THE MODEL FOR SMALLER PROJECTS

In general, the gateway process has only been applied to major projects over a certain financial size; however, companies such as BP have started to use their own gateway model for smaller projects[10]. This proves that the principle can be applied to all types of projects and need not be confined to the large ones where economies of scale allow more scope for funding of gateways.

With this in mind, it is possible to collapse the existing gateway model to accommodate smaller projects whilst still providing enough Front End Loading to ensure project success. The collapsed model is shown in Figure 3.4.



Abbreviations
Env.; Environment; H&S: Health & Safety; HS&W: Health, Safety & Welfare; KPI: Key Performance Indicator; PS: Planning Supervisor
SMS: Safety Management System; SHE: Safety Health & Environment; CDM: Construction Design & Management (Regulations)

Figure 3.4 Gateway Model Collapsed for Smaller Projects

[10] *CVP Express for smaller projects, developed by BP Grangemouth.*

The Consolidated Gateway Reviews combine the critical success factors discussed at each gateway in the main model within one gateway review. By consolidating these it is assumed that less time will be needed to review these items for smaller projects therefore the outputs can be streamlined. Further information on the processes and each consolidated Gateway is provided in the Gateway tables (Tables 3.1 – 3.8) that correspond to the "Main Gateway Number" shown in Figure 3.4.

Figure 3.5 shows an overview of how the tools previously referred to, relate to the gateway model. This applies whether the main model or collapsed model is used as it relates to the project phases.

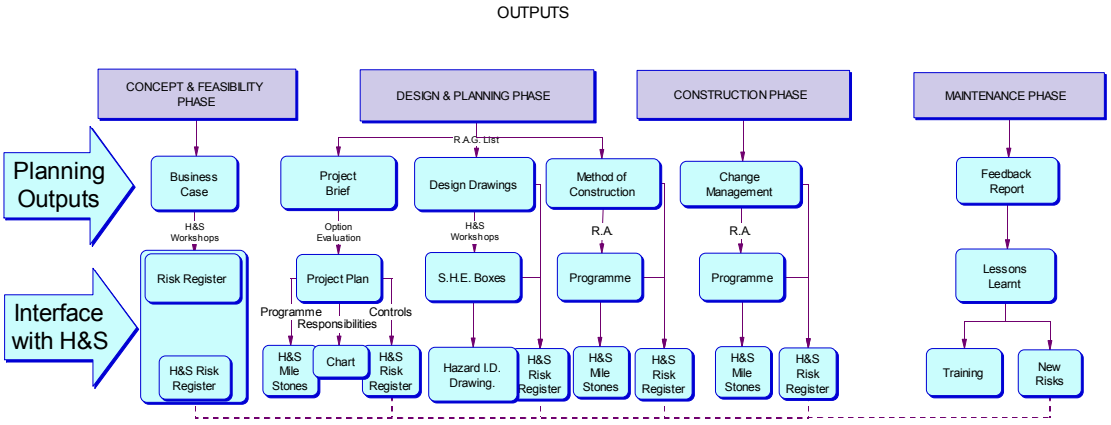


Figure 3.5 Model integrated with Tools

It can be seen that the Risk Register maintains the continuity of health and safety risk information throughout the project lifecycle. Having an integrated Project Risk Register will facilitate the integration of health and safety management achieving what the Health and Safety Plan originally intended. It will also feed into the Health and Safety File at the end of the project. This tool, and the others mentioned above, are discussed in more detail in the Tool Box chapter.

3.11 PRACTICAL USE OF THE MODEL

Views and experience of interviewees and discussion group members were gathered during the course of the research to develop and validate the model. This data has been used to compile the following section discussing the practical use of the Gateway model.

There were three main aspects of the model to consider:

- Its overall application to construction project management;
- The use of Gateways to integrate health and safety planning; and
- Implementing the model effectively and efficiently

3.11.1 Application to construction project management

The Gateway model has been based on the Office of Government Commerce (OGC) framework which has been recommended by *Accelerating Change* and *Revitalising Health and Safety in Construction.* As such, the OGC model has already seen successful use in its application to construction projects. Exploitation of the framework for improvement of health and safety planning has still to be fully realised however, despite a recent review to integrate health and safety management,

> "the OGC framework doesn't properly consider early design development and appointment of the Planning Supervisor is too late, unlike your model [Senior SHE Mgr, 4/3/04] .

The model assumes that construction projects are planned using a linked bar-chart or network to define work sequences and their dependencies. There are tasks that have to be undertaken regardless of the form of procurement used; therefore the model has taken cognisance of this which has met with approval,

> "it offers a good management structure" [Chief Executive, 27/10/03] and;
>
> "I see benefits to some organisations with their own PM /CDM/ procedures" [Architect / Planning Supervisor, 12/3/04].
>
> "It is easy to follow and makes more sense than the OGC version" [Senior SHE Mgr, 13/5/04].

Careful consideration has been given to several factors peculiar to construction. Firstly, the procurement of all the construction services for a project is not usually all done at the same time. The process of appointing project members is more likely to be repeated throughout the life-cycle of the project and several aspects need to be revisited, therefore the model needs to be flexible;

> "Work stages are advanced and it is likely that decision to proceed beyond your suggested gateways would have to be met (a) in the absence of information from outside organisations, e.g. BT, and (b) to meet the clients intended programme. This results in some backtracking" [Architect / Planning Supervisor, 12/3/04].

Secondly, the design process is often described as an iterative one;

> "There are incremental gateways, the design process needs definite points to review and confirm progress e.g. at planning submission but *(the model)* needs to align with iterative process of design" [Planning & Design meeting 18/11/03].

Furthermore, the construction phase almost invariably starts before the completion of the design and to assume that site works only commence after the conclusion of design is unrealistic;

> "The RIBA Plan of Work or similar assumes a logical flow. Life in this day and age is not like that and your model needs to show that" [Architect / Planning Supervisor, 12/3/04].

These factors are now all accommodated within the model which strengthens the case for its application to construction project management.

3.11.2 Gateways to integrate health and safety planning

The gateway process facilitates consideration of the critical aspects of a project at key points through its life. The process therefore provides assurance that everything is in place prior to progressing to the next stage and assists in achieving more realistic targets. This has been proven by a major oil company:

> "It was very difficult for us to adopt this strategy at first, it involved years of resistance to change, but now the improvements to our projects are excellent, we hardly ever have late changes or project overruns as well as increased safety performance." [Project Manager, 16/1/04]

Health and Safety risk is part of overall project risk and the use of Gateways can provide the mechanism to manage health and safety risks along with the risk of cost and time overruns that are usually addressed during project planning.

> *(The Gateways)* "set out what H&S has to be considered" [Chief Executive, 27/10/03]

> "The Gateway is an ideal point to identify unusual and specific risks and deal with residual risks." [Maintenance meeting, 17/6/03]

> "my input at early Gateway reviews have helped address risks that have lead to improvements in health and safety as well as some cost savings, for example, I pointed out a potential slip hazard during use and maintenance, this lead to a re-evaluation of the floor surface, resulting in a better, cheaper alternative." [Senior SHE Mgr, 13/5/04]

Lack of planning leads to project uncertainties, such as late changes being realised at construction stage, incurring extra time and cost, but Front End Loading minimises potential for late changes through increased planning and also reduces the likelihood of accidents. A company implementing Gateways has found that:

> "we can predict the outcome of our projects with Front End Loading, the result of this is a low contingency" [Project Manager, 16/1/04]

Since considerable early planning can be undone with one single change the health and safety benefits of low contingency projects are obvious.

Health and safety reviews should become part of these gateway stages if true integration of health and safety management is to be achieved. Particular attention to Buildability and Maintianability is recommended:

> "Buildability and Maintainability are two key questions to ask of the design."
>
> "The design should be challenged at each gateway. This can be done by contractors and end users to identify constructability and maintainability." [Maintenance meeting, 17/6/03]

Application of Gateways to smaller projects has also been successfully achieved by the oil company mentioned above. Consolidated Gateways can be used to ensure project success:

> "we have successfully implemented a streamlined version of the Gateway model via CD ROM, I even used it to build an extension to my house, it works well regardless of the size of project" [HS&E Senior Manager, 4/2/04]

The potential for Gateways to be used on smaller projects has further advantages:

> "If H&S formally adopted your gateways and set this as a standard to be met on projects, then professionals would have a stronger arm in dealing with smaller clients not versed in H&S." [Architect / Planning Supervisor, 12/3/02]

3.11.3 Implementation of the model

The model is structured, systematic, logical, rigorous and transparent, which is thanks to its use of Gateways;

> "overall in our role as the client the use of gateways is regarded as good … your model's compatibility with APM / RIBA seems fine, well laid out and understandable" [Client H&S Consultant, 6/5/03]
>
> "I am delighted to see that you are working around gateways" [H&S Consultant, 22/8/03]

Since it is based on principles of risk management, it uses the language of project managers and clients.

> *(The model's)* "early interfaces with the Planning Supervisor and the Project Manager addresses health and safety risks with other risks in the business case" [Planning & Design meeting, 18/11/03]
>
> "Having H&S on the Risk Register at your first Gateway is an excellent idea. I have tried to make sure this happens during our own Gateway process". [Senior SHE Mgr, 13/5/04]

Use of the model requires a Gateway sign-off document (Figure 3.1). The use of a *conditional go* option has met with a mixed response. Although the incorporation of this as an option makes the process more flexible, there were concerns that weak managers would abuse it.

> "the Gateway sign-off form needs to be robust, we have a go/no go approach which highlights week points in the management structure" [Senior SHE Mgr, 13/5/04]

Conditional Go options should therefore be monitored to control this problem.

The increasing need for clients to consider the implications of *Corporate Responsibility* and *Corporate Killing* should work as a catalyst for the uptake of such a rigorous and easily auditable method of construction procurement. A key feature of the model is that it moves ownership for health and safety risks upstream, to duty holders identified by the CDM Regulations, particularly the designer and client or project manager. This helps to promote integrated teams and is conducive to collaborative working.

> "your model can be shown to the one-off client, who is generally unaware of his duties under CDM" [Architect / Planning Supervisor, 12/3/04]

> "having the Planning Supervisor and the Quantity Surveyor together at the same time helps to show the cost effectiveness of early surveys and maintenance plans, the Planner can develop H&S issues into the programme after speaking to the PS" [Planning & Design meeting, 18/11/03]

It must be remembered that the model is reduced from reality, and as such, can never be perfect, it is not an exhaustive list of factors to consider. For this reason, continuous development and refinement of the model will be required to ensure it is relevant and appropriate for current practices.

The model requires informed clients to recognise how much project success depends on *Front End Loading* and promotes timely and robust advice to naïve clients on the benefits of good planning (and the cost of poor planning). Without good leadership the process will be in danger of becoming bureaucratic; therefore efforts should be concentrated on managing people rather than managing paperwork. These points need to be clear if the Gateway model is to succeed, as clients will need to be managed by those in the industry rather than being criticised as obstacles to change. There has been some negative attitude regarding clients, such as:

> "I cannot see my clients front loading projects, particularly feasibility studies, if this is merely to establish viability of a site or building which is perhaps up for sale" [Architect / Planning Supervisor, 12/3/04]

> and;

> "I cannot imagine any client/project manager in the current culture allowing H&S matters to bar the Gateway to the next stage of project procurement" [Architect 11/3/04]

This shows that some in the industry perceive the client as an obstacle to improved health and safety planning. However, the Gateway model could be the mechanism to overcome these barriers by using it to educate clients and those unfamiliar with health and safety risks.

4.0 TOOL BOX

4.1 INTRODUCTION

The toolbox chapter contains a more in depth explanation of the tools described in the gateway chapter. The tools are discussed within the following framework:

- Introduction
- Types
- When
- What & How
- Who
- Practicalities
- Benefits
- Limitations

In addition to this, examples are shown to help to understand how each tool could be used. It is not essential that every tool will be used for every project therefore the examples should help the reader decide if, firstly, the tool would aid general project planning, and secondly, if the integration of health and safety planning can be achieved with this tool. The processes of integration described are designed to show how each tool may be implemented.

Views and experience of interviewees and discussion group members are reported in order to give a balanced critique of the pros and cons of each tool and direct quotations are used to emphasise the points being made.

4.2 RESPONSIBILITY CHART

4.2.1 Introduction

A responsibility chart is a matrix or chart that indicates the required actions from each individual or organisation for each task. It is used to show **who** does **what** during a project and **when** it is to be done. Figure 4.1 shows how such a chart can be laid out to define project management participant responsibilities. Integration of Construction (Design and Management) Regulations (CDM) responsibilities is achieved by including tasks specific to the management of health and safety risk. Aligning team members with their CDM duty holder title may also clarify this.

Responsibility charts can be complex or basic:

4.2.2 Types

- Complex: matrix of several layers of responsibilities and numerous types of actions defining interfaces of each person and organisation.
- Basic: table of actions with simple explanations of responsibilities.

It is recommended that a basic format is used. A complex matrix may be difficult to follow and provoke resistance to using such a chart at all. Figure 4.1 is an example of a basic format chart.

4.2.3 When

The responsibility chart is a front end planning tool. It should be developed when setting up the project team. Ideally this will be as early as possible but will depend on the procurement route. The roles and responsibilities of those not yet appointed may be assumed but need to be accepted by each party when they join the team. Discussion and acceptance will be facilitated if it is prepared during an early project meeting of all the main participants.

The chart can be applied to a full project or specific stages, such as each gateway stage. A generic chart can be used for repeat projects and would serve as a useful tool when bringing new individuals or organisations into the project team.

4.2.4 What & How

Lists of possible responsibilities should be kept to a minimum as shown in Figure 4.1 e.g.:

- **L: Lead & co-ordinate**. This person is in charge and makes the final decision.
- **O: Output information received**. This person is informed of decisions made.
- **A: Advise**. This person is consulted and gives advice to be considered.
- **D: Does the work**. This person has to do the task.

A similar version of this chart is currently in use on the Department of Work and Pensions (DWP) Jobcentre Plus projects, known as a RACI chart. This acronym stands for Responsibe, Accountable, Consulted and Informed. DWP use a separate chart for each gateway stage, however it works just as well as one chart, covering all stages of the project.

The process of completing the chart begins with listing the tasks, processes or functions vertically. This information can flow from the same initial list that is used to develop the project programme. Other activities, for example, may come from contractual and legal obligations. Activities specific to the management of health and safety risk may come from existing project procedures contained in a Safety Management System, the CDM Approved Code of Practice (ACoP) (HSG 224) or other guidance.

Secondly, list the organisations, persons or job titles horizontally. The input required for each task is then completed.

4.2.5 Who

The chart should be completed by a person with authority and ultimate responsibility for delivery of the project or stage. This may be the client, agent, project manager or lead consultant. Consultation is essential with those who are implicated in the chart. A competent planning supervisor would be able to advise on the type and level of input required to manage health and safety risks.

L: Lead & co-ordinate **O**: Output, receive info. **A**: Advise **D**: Does the work	**DUTY HOLDER**											
	CLIENT			**P.S.**			**DESIGNER**			**P.C.**		
ACTIVITY	BOARD	P.MGR	USER	EXT. P.S.	CLIENT	LEAD DES/PM	ARCHITECT	ENGINEER	M & E	SNR MGT	P.MGR	F.MAN
Concept Design												
Concept Drawings	O	L	A		O		D					
Design R.A.		O			L		D	D				
Surveys												
Existing Info (H&S File)		L	D		O		O	O	O	O		
Site Investigation		O			O		O	LD	O	O		

Figure 4.1 Responsibility Chart (LOAD Chart)

4.2.6 Practicalities

Initial creation of the chart is a time consuming process. This may hinder its initial development,

> *"the effort would be initially a lot"* [Planner – 13/1/04] and
>
> *"at the end of the day I may not have the time to create it",* [Construction Manager – 13/1/04]

- however, it is the process of developing the chart that is most useful as these issues will be discussed anyway, the chart facilitates this in a structured and orderly manner. The competence and understanding of the author will also affect the usefulness of the chart. There is a danger that it may become a superficial document that does not resemble what actually needs to take place. Therefore, everyone who is referred to in the chart needs to be consulted and they must accept the responsibilities allocated. Once the chart is developed it will be easier to maintain and update. Examples of the chart in use involve senior managers where it relates to strategic issues, however, it is a planning tool and, like networks or bar-charts, can be taken to various levels, from master programme to short-term plan. As mentioned above

its main value is probably in the development, when tasks and responsibilities are identified, discussed and accepted. Thereafter, it will be used for updating plans and auditing delivery.

There may be a need to split the chart into project phases in a similar fashion to the DWP approach,

> *"I would say if you integrate everything then to manage it you may have to split it into sections".* [Project Manager – 15/1/04]

4.2.7 Benefits

The greatest benefit of the chart lies in the process of actually developing it. Deciding what should be done at each stage of the project and who should do it is a fundamental part of project planning. Tabulating this information on such a chart creates a structured approach that can be easily communicated in a transparent and robust manner. It is also conducive to developing integrated teams, managing people and allocating resources, which are fundamental to CDM Regulation 9.

The chart also sits well with other management tools such as bar charts which list activities in the same way. Its universal appeal was recognised,

> *"I would like to see that encompass the other management systems".* [Project Manager – 15/1/04]

The responsibility chart can in fact become an extension of the programme thereby increasing the boundaries of its use.

The chart is intended to help define the interfaces between disciplines and avoid possible conflicts or misunderstandings. In terms of the management of health and safety risk, it can bring together the various activities shown separately in the CDM ACoP (HSG224) – Appendix 7 to show what every duty holder has to do in relation to the task **and** each other.

The interface with the planning supervisor would especially benefit from this tool;

"others would see that the planning supervisor has to be informed or consulted on the main issues relevant to him and act accordingly. The planning supervisor would then become more involved in the project team". [Senior EH&S Manager – 22/1/04]

4.2.8 Limitations

The grouping of CDM-titles format would only work in the simplest of cases. Participants can assume the responsibilities of more than one duty holder, e.g. designer/contractor, lead consultant/PS. In such cases reversing the titles so that the organisation name appears on the top line with their multiple CDM duties below could overcome this problem.

The author of the chart needs to be conversant with the CDM regulations and other regulations relating to the management of health and safety risk. If not, omissions, such as *"failing to involve the planning supervisor with concept drawings"* [Senior EH&S Manager – 22/1/04] may result and integration will not be achieved.

4.3 OPTION EVALUATION CHART

4.3.1 Introduction

The evaluation of options to meet requirements is an iterative process that occurs continuously throughout a project and can relate to strategic decisions, design decisions or even construction methods and sequences. An option evaluation chart is a useful tool to summarise what factors need to be considered. Alternatives can be investigated in terms of how they impact on predetermined factors, as shown in Figure 4.2. This process can be found in Value Management techniques, such as Client Value Systems, which, until recently, had no specific reference to health and safety. In 2002 the Construction Industry Council launched the Design Quality Indicator[11], which includes build quality. This in turn encompasses construction safety issues. The Construction Best Practice Panel (now Constructing Excellence[12]) have included safety as an indicator alongside issues such as cost, time and defects.

Option evaluation charts can be qualitative or quantitative:

4.3.2 Types

- Qualitative: mostly text and short statements indicating a level of acceptability or unacceptability.
- Quantitative: numerical significance attached to each factor

With regard to H&S a qualitative approach is recommended as any assessment will be subjective.

4.3.3 When

Examples reviewed are used for design development when deciding options to meet the clients brief. However the tool could be applied to procurement options at concept and feasibility phase and construction methods prior to site works. The tool can also become an integral part of the change process discussed at section 4.9.

4.3.4 What & How

Health and safety is included with other considerations in a table or chart. Alternative options are compared depending on their overall suitability e.g. in terms of:

- H&S
- Quality
- Programme
- Price
- Performance

(CIRIA C604)

- H&S
- Aesthetics
- Time (initial & Life Cycle)
- Cost (initial & Life Cycle)
- Function
- Engineering
- Environment

(BAA Designer's Manual)

[11] www.cic.org.uk/
[12] www.constructingexcellence.org.uk/

Consideration	Option 1	Option 2	Option 3
Buildability Maintainability Health and Safety	Effect on health and safety risks		
Aesthetics			
Function			
Time			
Cost (initial & life cycle)			
Environment			

Figure 4.2 Option Evaluation Chart

"H&S" may be represented by, and contained within, "Buildability" and "Maintainability" which is a more integrated way of encompassing the risk to health and safety for each alternative. Input to the chart may need to come from several sources. With regard to the effect of each option on health and safety, the author of the chart should have an understanding of the risks involved for each option. If advice is required the planning supervisor or contractor could provide this information.

4.3.5 Who

The selection criteria may change depending on when the chart is used. However, health and safety risks must be included as a factor at all times. The following may use the chart to aid decision making:

- Client/Project Team: strategic decisions
- Designer: design development decisions
- Contractor: assessment of construction methods

4.3.6 Practicalities

Full use of the chart would mostly suit large projects or clients with very structured processes. If a formal decision making process is already in place the integration of the chart will be easier than situations where only an informal decision making process is adopted. Appropriate completion of the H&S section will only be achieved if there is a champion willing to drive this. The planning supervisor is the obvious choice; however, client backing is also required if others are to follow. Qualitative analysis was favoured as opposed to quantitative analysis,

> *"it should be qualitative as this is more amenable and would help buy-in to the tool".* [Geotechnical Engineer – 19/3/04]

One person may not be able to input all of the desired information,

> *"different people would have to input their own specialist information".* [Environmental Engineer – 19/3/04]

Therefore the tool would become a summary document to co-ordinate information for decision making.

4.3.7 Benefits

All meetings, formal or informal, to plan some part of a project will often have someone sketching out the tasks, options, pros and cons, etc. on a board or sheet of paper in a tabular manner, just to aid discussion and capture conclusions. The option evaluation chart can assist this process and capture the results in a convenient and more standardised way.

> *"it brings everything together which helps make better decisions"* [Geotechnical Engineer – 19/3/04]

It also provides an 'aide memoire' or check-list to try to ensure that important issues are not ignored,

> *"It certainly raises the profile of health and safety risks".* [Geotechnical Engineer – 19/3/04]

From an auditing perspective, it can be used to demonstrate that a balanced decision was reached,

> *"it is also a good audit tool, showing why certain decisions were made".* [Environmental Engineer – 19/3/04]

It also shows the rationale for the decision, which may be communicated to others to strengthen support and prevent it from being inappropriately challenged. Completion of the chart can also help identify where more thought is required about health and safety issues, before a decision is reached. If need be, further investigation can be conducted to find an acceptable choice.

4.3.8 Limitations

A problem that is perceived when integrating health and safety with a value management tool such as this arises from the fact that the client team uses the tool to play one factor off against others, to ascertain what they feel is best value. Therefore, in keeping with the original purpose of the tool, they may appear to be planning a lower level of health and safety in favour of some other factor. At first this seems unacceptable, since health and safety measures cannot be sacrificed to increase profit. However, the inclusion of "H&S", as one of the dimensions of evaluation in the chart, does not infer that H&S risk is being traded off against more commercial considerations but that consideration must be given to the level to which each option helps or hinders the management of health and safety risks. This risk management has to be undertaken, legally and morally, and will, of course, have cost implications; which is one of the many reasons why it should be undertaken as an integrated part of value management and all other project planning processes. This evaluation is, in any case, a fundamental part of consideration of what, in risk mitigation, is 'reasonably practicable'.

In general terms the tool can only be limited to high level decisions, day to day decision making may become too cumbersome if this formal process was adopted.

If no formal decision making process is in place at all, the chart may be seen as extra work,

> *"we don't have a formal process like this".* [Architect – 12/2/04]

This may be the case in architectural offices, where there is emphasis on artistic ability and the path from A to B is unclear. In this case the tool can be introduced to help improve the decision making process in overall terms, not just health and safety.

4.4 HEALTH & SAFETY HAZARD WORKSHOPS

4.4.1 Introduction

Hazard workshops are meetings arranged to facilitate the identification and management of health and safety risks. A main feature of this process is that it is done as a group. The purpose is therefore to draw knowledge and experience from each group member in order to achieve a better understanding of the issues than would have been achieved by an individual.

These meetings can be formal or informal. They can also be integrated or separate meetings:

4.4.2 Types

- Formal: Structured, agenda, office environment.
- Informal: Semi-structured, ad-hoc, social or work place environment.
- Integrated: part of wider workshop e.g. partnering, teambuilding, and brainstorming.
- Stand alone: specifically for Health and Safety.

4.4.3 When

These meetings can take place at any stage in the project. During the Concept & Feasibility Phases strategic issues will be discussed. Design and Construction Phases can include workshops also. During design, there is particular benefit to be obtained from workshops involving the contractor, to feed construction knowledge into discussion on buildability, maintainability and health and safety. During construction informal meetings will aid short-term planning. This has been proved to help productivity (Horner & Duff, 2001) and can be incorporated into the "Last Planner" form of short-term planning which involves site management and sub-contractors working together on weekly and four-weekly programmes. Setting targets, planning works and reviewing performance is repeated throughout the construction phase of the project to improve productivity.

4.4.4 What & How

The application of this tool is based on the fundamentals of risk management which can be applied to all risks, including health and safety. Risk managers often rely on workshops to identify and manage risks that will affect the success of the project. There is therefore no reason why the management of health and safety risk cannot be integrated with this process. Significant health and safety risks often have the capacity to impact on project commercial and operational success. The four main stages to manage risk are:

- Identify the risk sources
- Quantify their effects (risk analysis)
- Develop management responses to risk
- Provide for residual risk in the project estimates

Compare this with the HSE guide to risk assessment[13]:

- STEP 1: Look for the hazards
- STEP 2: Decide who might be harmed and how
- STEP 3: Evaluate the risks and decide whether the existing precautions are adequate or whether more should be done
- STEP 4: Record your findings
- STEP 5: Review your assessment and revise it if necessary

[13] *5 Steps to Risk Assessment, HSE (2003a)*

It can be seen that the general process is the same despite slight changes in the wording. The additional HSE step 5 is a feedback loop to ensure the assessment remains valid due to the changing nature of the site.

In general, a risk manager would wish to classify risks, usually within a table. These categories can take the form of global and elemental risks; cover areas of business process such as financial and operational; or even be associated with project phases. Regardless of the classification system used, sources and categories of risk can be aligned with health and safety risk. Therefore categories of risk can be linked to health and safety hazards, which have the ability to cause harm.

Risk managers can use three main techniques to aid the identification of risks:

- Checklists specific to construction projects
- Brainstorming with project participants
- Historic data from similar projects

Information to aid the identification of risks in relation to health and safety can be integrated with general risk management checklists. Examples of general risk categories that have health and safety implications are shown in Table 4.1. This is not a comprehensive list and serves only as an outline guide. In practice existing risk management checklists should be assessed to integrate health and safety risks.

Table 4.1 General Construction Risks and Health & Safety Risks

General Construction Risks	Examples Embracing Health & Safety
Project Team/Organisation	Resources & Competence to manage H&S
Communication Risks	Health & Safety information
Environmental Risks	Contamination of workers or others
Design Risks	H&S due to Buildability & Maintainability
Construction Risks	Contractor's Competence, technology used

Each general category would normally be expanded, with further links defined in more detail. For example, "Design Risks" could include the experience and competence of the design team; novelty of the design; and realism of the design programme. Again, these can all relate to health and safety risks. Here, designer checklists, known as "Red-Amber-Green" lists can be used in the same way. These are discussed in more detail later in the Tool Box.

Brainstorming will be most beneficial if those familiar with construction health and safety risks are involved. Aide memoires can help stimulate the team members; but the real purpose of this exercise is to identify project specific hazards that are out with the aid memoir.

Historical data can come from previous Health and Safety Plans for similar projects. If a Health and Safety File exists this can also be a source of knowledge. End of Project Reviews, from projects with similar features, can also help, if health and safety performance has been reviewed.

Evaluating the effects of health and safety risks and quantifying them is a subjective process. Commercial risk assessment usually comes down to the monetary value of the risk. Recent publications on risk management acknowledge non-monetary appraisals for health and safety (Smith, 2003); however, identifying a specific health and safety implication for a risk could

result in it receiving a higher significance at the monetary appraisal stage. Therefore, the magnitude and likelihood of the risk is important. Quantified risk assessments have been criticised for being easily manipulated. If this is done as a group then group dynamics should help to prevent this. Qualitative risk assessment can be used to focus on the practicalities of managing the risk.

The allocation and management of the risk should be agreed by the group. Further actions will then flow from the workshop. Outputs will include the generation and maintenance of a Risk Register (discussed separately in the tool box). New Red-Amber-Green lists may be developed as a result. Significant information for the Health and Safety Plan should be recorded for design and construction, as well as information for the Health and Safety File.

If workshops are conducted during construction, the "Last Planner" process of weekly meetings could incorporate the hazard workshops. A key factor in this process is the constant checking of planned with actual (Plan, Do, Check, Act). Therefore the hazards identified can be confirmed and the controlling measures checked as an integral part of the process.

4.4.5 Who

The planning supervisor should take part in workshops during the planning and design stages, along with the contractor (if appointed) or consultant with similar experience.

The key personnel at each stage are summarised in Table 4.2.

Table 4.2 Participants for Hazard ID Workshops

	Client/ Agent/PM	P.S. /H&S Consultant	Design Team	Contractor	Specialist Contractor	End user/ F.M.
Concept	✓	✓	✓	*	*	*
Feasibility	✓	✓	✓	*	*	*
Design	✓	✓	✓	*	*	*
Construction	✓$^{+}$	✓$^{+}$	✓$^{+}$	✓	✓	✓$^{+}$
Handover	✓	✓	✓$^{+}$	✓	✓	✓

✓ Expected, ✓$^{+}$ Desired, * If known

Formal workshops are recommended for the initial stages, to coincide with risk management workshops. During construction the same process can be used, in a less formal manner, as part of the agenda of progress and planning meetings between contractor and sub-contractors. Group meetings rather than individual sub-contractors would be more useful as interfaces and interdependencies can be discussed. At handover the emphasis will be on residual risks for maintenance.

4.4.6 Practicalities

Incorporation of hazard workshops, particularly in the early stages, requires client involvement,

> *"the client will drive what should be discussed at meetings".* [Project Manager – 15/1/04]

Indeed, commitment is required from all team members for it to be a success, especially if the client is "naive" and requires robust guidance. In these cases, the client needs to be lead and managed accordingly, rather than being allowed to make erroneous decisions The level of integration may be a problem as it relies, in the early stages, on the existing risk management process and, during construction, on regular, rigorous short-term planning. If these processes are unfamiliar to anyone in the team, training will be required; which may be the case for smaller projects. For larger projects these processes will probably exist and be understood; however the scale and complexity of the project may cause problems when trying to bring everyone together for meetings.

4.4.7 Benefits

Major decisions will be affected by risk identification and management. The early identification of risks will help focus attention on policies and strategies for control and management of risks. In particular, the workshops highlight those areas where further design, development work, investigation or clarification is most needed.

Utilising group workshops, rather than individual risk assessment, facilitates a collaborative risk management culture. Therefore a more comprehensive and realistic output can be achieved,

> *"The existing set up leaves a lot to the designer".* [Electrical Engineer 19/3/04]

This is not to say individual risk assessments have no value. They are a fundamental requirement of the Management of Health and Safety at Work Regulations (1999) and should be conducted by employers for the work their employees undertake. The point is that they are not conducive to project management where co-ordination of interfaces requires collaborative thinking. Input from contractors and maintenance teams should also improve Buildability and Maintainability

> *"the group effect of hazard ID means that there is less chance of things being missed".* [Electrical Engineer 19/3/04]

Another benefit is that holding the workshops should increase team building and help with co-operation. Integrated teams create a collaborative culture which will achieve more.

> *"it was a good team building exercise".* [Geotechnical Engineer 19/3/04]

4.4.8 Limitations

The allocation and management of the risks identified at the workshops needs to be accepted by those affected by them, it must also be within their power to manage them. Therefore if a risk is being passed on to someone who is not present at the workshop there may be problems with it being managed properly. The extent to which individuals participate may be limited by fees or the price tendered/negotiated for the project,

> *"A common problem with all meetings involving designers and other specialists is trying to get them to attend when their fees run out".* [Architect – 12/2/04]

Therefore initial cost calculations need to account for these workshops. If they are requested as an afterthought then this will be at extra cost. Integrating the meetings with existing ones may cost less than holding them separately.

4.5 S.H.E. INFORMATION ON DRAWINGS

4.5.1 Introduction

Drawings are used extensively on site and their great potential in communicating residual health and safety risks is highlighted in the HSE CDM Approved Code of Practice (ACoP) (HSG 224). Information on drawings, to aid communication of project specific hazards or advice on health and safety risks during construction, occupation, maintenance and demolition, can be split into two types:

4.5.2 Types

- Hazard Identification (Hazard ID)Drawing
- Safety Health and Environmental (SHE) Box on drawings

A hazard ID drawing is usually used to highlight hazards that are present in the existing environment. They usually communicate the findings of some form of site survey and may relate, for example, to the presence of contaminated land or asbestos. SHE boxes, on the other hand are used to communicate residual risks from the design of structures or components. The hazard ID drawing is usually a dedicated drawing based on the main site layouts. SHE boxes can be either placed on a dedicated drawing or be housed within other drawings. Providing it does not create information overload or congestion, inclusion of the information in other drawings might be preferred as it will come, more readily, to the attention of the construction team in the normal course of searching for construction data.

4.5.3 When

Presentation of this information can be integrated with all design work. There is some scope for including it with concept designs, however its use will be during the main design phase and when detail design is being done which, in many cases, will be well into the construction phase. Component designers, suppliers and specialist subcontractors can be encouraged to apply the same principle.

It is vitally important that the information in Hazard ID drawings and SHE boxes, relating to risks during occupation, operation, maintenance and demolition, is transmitted to those at risk in these activities. The drawings themselves, or at least the information contained in them, must be included in the Health and Safety File and form part of the handover package at completion of the construction project. The Planning Supervisor should be responsible for ensuring that this happens.

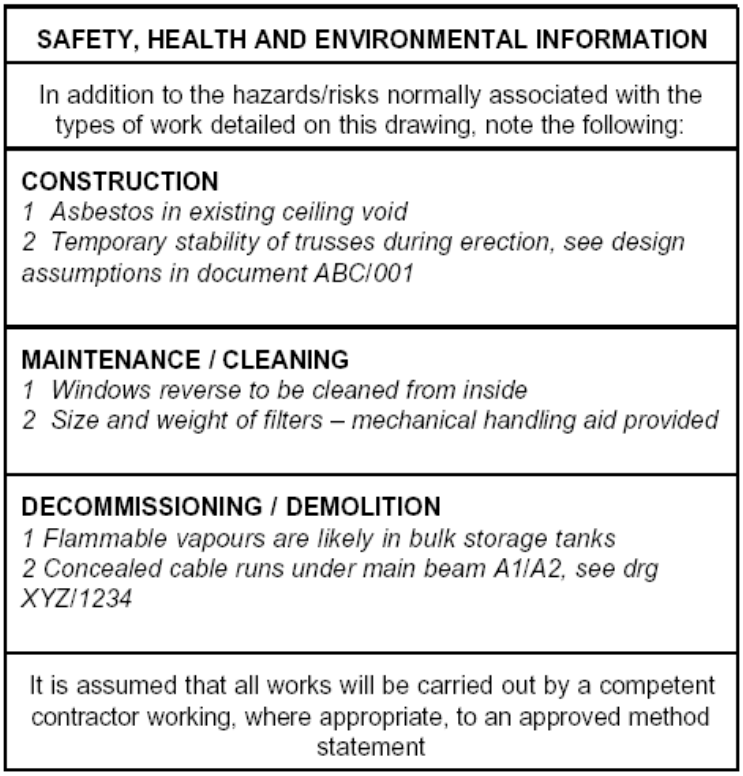


Figure 4.3 SHE Box Example (source: BAA Design for H&S in Construction)

4.5.4 What & How

Safety, Health and Environmental information on drawings and schedules can relate to risks to personnel during construction, occupation, maintenance and even demolition. An example of the presentation of the information is shown in Figure 4.3

The Construction Industry Research & Information Association (CIRIA) publication C604[14] (previously 166) is an excellent source of guidance, describing what information is useful to contractors and other workers. Guides are also available on the Construction Industry Council website "Safety in Design"[15]. Project specific information can be derived from initial surveys and outputs of Hazard ID Workshops, discussed elsewhere in the Tool Box section of the report.

SHE boxes and hazard ID drawings are communication tools. They are the result of previous work to identify, remove or reduce risks to the end users. As such they must relate to the risk management process adopted by the designer. Items may be cross-referenced to other documents e.g. drawings; H&S Plan; and Method Statements.

Computer Aided Design (CAD) allows links to be inserted into drawings which will allow the viewer to go directly to the source document if necessary. Conversely, information held in Microsoft Word or Excel can be easily imported into CAD. Hand written notes can be made at site level and may represent the method by which the contractor relates the controls required by risk assessment as an alternative to separate safety method statements. This

[14] *CDM Regulations – work sector guidance for designers, Second Edition (2003)*
[15] www.safetyindesign.org

recommendation relates to the on-site practice of photocopying drawings, or sections of drawings, in order to convey what is required to the sub-contractor or trade operative.

4.5.5 Who

Anyone involved in design can integrate health and safety information with their designs. In terms of CDM, those who specify can also be designers and anyone producing drawings and schedules may have cause to use this tool. Designers can include lead designer; architect, civil/structural engineer; M&E engineer; contractor's designers; and specialist contractor's designers.

4.5.6 Practicalities

It has already been recognised that providing the information on the design drawing or construction detail itself is generally the preferred option,

> *"The benefit is the information is all on that one drawing".* [Construction Manager – 13/1/04]

- compared to referencing information elsewhere which assumes that the person viewing the drawing knows where to get, and will look for, this information.

In most cases, use of SHE information on drawings was recommended at the detailed design stage of the process,

> *"Working drawings or Shop Drawings which are more detailed"* [Architect – 8/12/03] and *"it may be better for site operations".* [H&S Manager$_1$ – 22/1/04]

Concept designs can potentially cover everything and lead to long lists of, at that time, superfluous information in SHE boxes. This is not to say their use is to be discouraged at concept design stages, but consultation with the contractor, via hazard ID workshops, will help concept designers understand what information will be useful.

Early inclusion of the contractor will also help with the management and co-ordination of this information. Design and build type contracts will give contractors the leverage to educate designers in terms of what is useful for site operations.

4.5.7 Benefits

Hazard ID drawings can bring together a summary of hazards identified from different surveys, some of which may be years old, and present it to the contractor, where previously this information may have been lost or not communicated.

> *"Well by the time the contractor comes on site the original survey drawings may be difficult to trace".* [Geotechnical Engineer – 22/1/04]

Even if there have been no formal surveys, a site walk over would be expected. Detailing basic hazard information in the existing environment presents little in terms of extra work and will help to communicate the information in a visual manner that has a better chance of being referred to on site. Repeating the site walkover with the contractor can be an extremely useful exercise and, again, should be part of natural project procedures,

> *"A site walk over would always be required".* [Construction Manager – 13/1/04]

This will help to clarify what is required to manage the risks.

Not only does this tool communicate useful health and safety information, but it can explain the rationale behind the design solution and possibly prevent it being changed, subsequently,

to a design that is inherently unsafe or unhealthy. An additional benefit of a SHE box or Hazard ID drawing is its ability to prompt further investigation should a design change be considered. When considering the possible effect of design revisions it was pointed out on several occasions that a SHE box being added to a drawing could in fact *"trigger the designer to re-assess the hazards"* [H&S Manager$_3$ – 22/1/04] and assess whether any new risks were introduced,

> *"I would probably recommend a check box to note whether any new risk assessment is required or if new information needs to go in the box"*. [H&S Manager$_1$ – 22/1/04]

Use of the hazard ID drawing can extend to induction training, tool-box training and short-term or daily activity planning. Pinning the drawing on the wall of the area where such meetings are conducted makes it easy to refer to, indicating areas of high, project specific risk such as interaction with plant, public or transport. This makes risks highly visible to the workforce,

> *"the hazard ID drawing will be the one that is up on the wall in the safety induction room"*. [Project Manager – 12/1/04]

4.5.8 Limitations

Information overload and duplication is the main danger to address with this tool. Dedicated drawings allow the dissemination of more information devoted to health and safety issues, but it may be overlooked on site if separated from construction data. Alternatively, including the information on other drawings that are actually used may clutter the page,

> *"The other drawings have an awful lot of information on them, it would be too cluttered"* [Construction Manager – 13/1/04] and *"The drawing may become too cluttered, it would have to be a stand alone drawing"*. [Geotechnical Manager – 22/1/04]

Referencing information to avoid duplication of information contained elsewhere in the contract documents is a possibility; however, as mentioned previously the person on site has a better chance of reading information already there rather than locating another source document. Both of these challenges can be overcome through the use of electronic file management. Information can be easily cut and pasted, or automatically linked to streamline duplication time and layers on CAD drawings can be switched on and off to view information without losing it. This shows how integration can have a strong reliance on I.T. Having said this, those who do not have access to I.T. tools may not encounter the problems described above as they will probably be working on smaller, less complex projects.

The other danger is that the SHE information becomes too superficial. Again, communicating with the contractor before design can help determine what will be useful and what information is obvious and superficial. When developing the Hazard ID Drawing *"meeting the contractor and discussing at that stage what is relevant"* [Planner – 13/1/04] helps significantly.

Finally it needs to be acknowledged that the SHE information is not intended to dictate management controls on site. This will be for the contractor to decide,

> *"I can't control the risks once the contractor is on site"*. [Planner – 13/1/04]

The SHE information is merely an input to the contractor's risk assessment process and the designer is not expected to do the contractor's job.

4.6 RED, AMBER, GREEN LISTS

4.6.1 Introduction

The use of checklists to aid rigour in the management of a process is common practice. In construction projects checklists can be used as an aide memoire at client briefing meetings, design development meetings and to aid site managers with site set-up. In terms of health and safety, HSE guidance often provides examples such as the CDM Approved Code of Practice (HSG224) paragraph 127 which lists construction hazards to consider in design.

The notion of traffic light colours to communicate safety information is well grounded in the UK and can easily be recognised as Red for warning, Amber for proceed with care, and Green for safe to go.

HSE have combined these two ideas to form Red-Amber-Green (RAG) Lists which can be viewed on their website[16]. The initial concept was developed by BAA and is used in conjunction with their Risk Register.

4.6.2 Types

The basic principle is that Red items should not be accepted by the client or designer, Amber items will have to be justified, and green items represent good practice that the client or designer would like to see implemented. The concept is illustrated in Figure 4.4. It can be seen from the examples that issues covered by both design and construction decisions can be influenced by the lists.

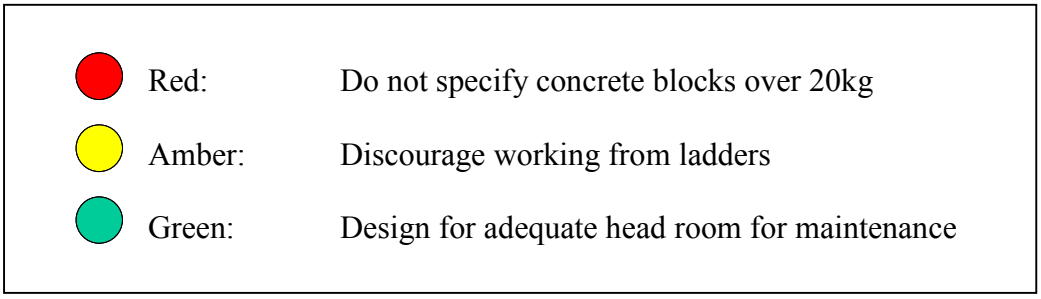


Figure 4.4 Red Amber Green List

4.6.3 When

The RAG List may be a pre-prepared document which is included with client objectives or the brief and fed into the Risk Register. The List may then be customised by the design team during the design phase or presented by the contractor prior to the construction phase as a guide for sub-contractors. They will be used in, and further developed during Hazard ID Workshops or as part of design or construction planning meetings.

4.6.4 What & How

The source of information is an important factor to consider when developing RAG Lists. The HSE website for designers gives examples of RAG issues to consider, however companies should be encouraged to develop their own. Other sources recommended include codes of practice, insurance companies' advice, and experiences from other projects. Existing

[16] http://www.hse.gov.uk/construction/designers/index.htm

in-house guides for hazard identification and risk assessment will also contain information on issues to consider. There is, in addition to this, the need for site specific issues. Outputs from surveys and project hazard ID meetings will cover this.

How the RAG Lists are actually used can vary. As mentioned previously, BAA include the RAG List at the front of their Risk Register to act as a constant reminder of the health and safety risks requiring to be addressed. The key factor is that they influence the designer's decisions during design development rather than being an afterthought. Designers will often refer to a guide or framework to build up their designs. The RAG List can be used as an integral part of this process.

Items considered for the Red List may derive from some legal influence. The magnitude of a particular risk could also merit its inclusion in a Red List. When considering Amber List items the approach should be to assume it is as critical as a Red item and only after compelling justification can it be allowed. Even then this should trigger an investigation into the hierarchy of controls to mitigate and manage the risk. Green Lists are a useful way of disseminating good practice, as shown in Figure 4.4.

4.6.5 Who

RAG Lists need to be championed by those wishing to integrate the management of health and safety. As such a client health and safety advisor or planning supervisor should take the lead in implementing them. Development of the content of the list needs to be done as a team and this requires all stakeholders to participate in hazard ID workshops.

4.6.6 Practicalities

Successful application of the RAG Lists will depend on the length of the lists and the time that will be taken implementing them. The lists need to be short, but cover those items that have the widest opportunity to mitigate health and safety risks. This rationale is similar to the Pareto or 80/20 rule that assumes 80% of outcomes can be attributed to 20% of sources. It therefore follows that the lists should not cover every risk,

> *"the list needs to be short and contain those issues that have the widest opportunity to mitigate health and safety risks".* [H&S Director – 26/1/04]

Keeping the list simple will streamline the process and limit the development time and cost of implementing it.

Design and build forms of procurement may lend themselves to successful implementation of the lists as the contractor may be in a position to influence the design, by using his experience to develop practical RAG Lists for the designer to follow. Often what is practical, effective and efficient is also what is safe "safety goes hand in hand with practicality".

Designers themselves believe in working to guides or frameworks and dislike the term "checklist". This should be acknowledged if the tool is to be adopted by the design community. "Checklist" is a useful shorthand way of describing a tool of this type but its real purpose is to communicate strategic objectives for the management of health and safety risk. As long as this is achieved then the terminology can be flexible.

4.6.7 Benefits

It was acknowledged that the RAG Lists have the ability to focus the designer on the most important health and safety risks,

> *"prioritise health and safety issues"* [Architect – 8/12/03], *"help you concentrate"* [Bridge Engineer – 22/1/04]

they can also help *"designers to become more pro-active"* [H&S Manager$_1$ – 22/1/04] in aiding the management of health and safety risk. Often a guide will actually save time, eliminating the need to 'reinvent the wheel'.

As the RAG Lists develop, keeping them to a minimum should facilitate their acceptance and application. As it becomes standard practice to avoid the more dangerous items, it may be assumed, temporarily at least, that the problem has been dealt with. The lists can then begin to focus on the somewhat less dangerous items, so that avoidance strategies for them are developed. Thus, incremental steps can be made towards safer and healthier designs taking advantage of new materials technologies and construction techniques.

Additional benefits include using the list as a learning tool. It will communicate good and bad practice; new and young members of staff can easily assimilate this information and it will also be transferred across projects and organisations,

> *"It is also a good learning tool, to take from project to project and learn from mistakes".* [H&S Manager$_2$ – 22/1/04]

4.6.8 Limitations

There is the possibility that those using the lists may become so dependent upon them that they fail to look beyond them, thereby missing some other significant risk. This is particularly true of project specific risks. Regular design risk assessment meetings should facilitate reassessment of the lists so that this does not become a problem.

Time is obviously a key limitation. As mentioned previously, short lists covering the widest range of influence will help. However, the designer's time is precious and implementation of the tool will need to be monitored to ensure its success. Engaging the planning supervisor or an independent health and safety advisor to do this may be required.

4.7 RISK REGISTER

4.7.1 Introduction

The use of a risk register or log is well established in the field of risk management. Here the aim is to determine the most cost-effective risk management strategy. More recently those involved in the design of construction projects have started to use the same tool to manage health and safety risks. Since the process for managing commercial risks is similar to the assessment process for health and safety risk there is scope for consolidation and indeed, integration of the two.

4.7.2 Types

The two types of risk register are identified as follows:

- Risk Management Log/Register – For recording strategic risks that may impact budget, programme and quality/performance.

- Design Risk Assessment Register – Records Design Risk Assessment (DRA) and residual risks that directly affect health and safety during construction, maintenance and demolition.

A combined risk register, or linked registers would aid integration; however, the parameters of each need to be clear.

4.7.3 When

The commercial risk register is usually developed early in the project and is one of the first documents produced. Obviously health and safety risks, with the ability to disrupt the project, should be included in the commercial register. From here the register will be used throughout the project's life. This means it becomes a constantly used tool which is dynamic, changing as uncertainties change through each phase.

4.7.4 What & How

It is recommended that an integrated risk register is developed, initially at least. Depending on the size and complexity of the project, it may be necessary to group risks thereby separating health and safety risks as the register grows. If this is the case then links between the two need to remain strong.

The commercial risk register is usually formed using three sources:

- Checklists specific to construction projects
- Brainstorming with project participants
- Historic data from similar projects

In terms of health and safety risks the three sources listed above can be aligned with health and safety documents as shown in Table 4.3. These are discussed in more detail within the hazard ID workshop section. The source of a risk is usually termed a "hazard" in health and safety language, this being something that has the potential to cause harm to something or someone. After the hazard is assessed for severity and likelihood the resultant combination, or multiple, is termed the "risk".

Table 4.3 Sources of Health and Safety Risks (Hazards)

Risk Management	Health & Safety
Checklists	Red Amber Green Lists
Brainstorming	Hazard ID Workshops
Historic data	Previous Health & Safety Plans & Files

Within general risk management, authors on the subject include categories with obvious CDM/S.H.E. implications[17], these include:

- Project management team experience and availability (competence & resources)
- Site-specific safety procedures
- Ground conditions
- Temporary works
- Preventative measures to protect staff, labour and surrounding areas

These categories can be used as a guide; however, the detailed information will come from the project stakeholders, which usually happens during meetings such as hazard ID workshops. Project meetings of any sort will invariably lead to identification of risks followed by agreement on how they will be managed. The risk register merely formalises this process in a tabular form. Therefore any meeting that generates the discussion of a risk should use the Risk Register.

Once risk sources, or health and safety hazards are identified, there are other relevant pieces of information required for the risk register. The potential impact of each risk needs to be assessed and recorded. In terms of commercial risk this will relate to size and likelihood of impact on cost and programme. In terms of health and safety hazards this will relate to severity and likelihood of accident. Issues considered commercial, that affect cost and programme, can also be assessed for their impact on health and safety. Likewise the effect of a health and safety risk on cost and programme may be assessed; although, depending on the level of information that can be obtained, this may be purely indicative.

The risk owner, action to be taken and "date to be done by" are other essential requirements of any risk register as shown in Figure 4.5.

After completion of the risk register it becomes a control tool, which can be used to check that the planned actions are being implemented. Performance can therefore be measured and corrective actions taken, if necessary.

[17] *N.J Smith (1999) Managing Risk in Construction Projects*

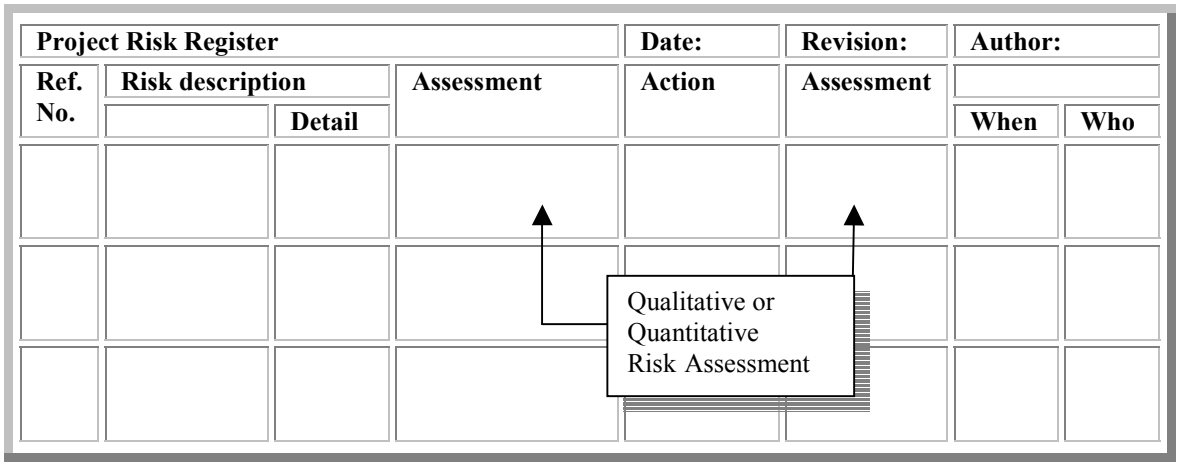


Figure 4.5 Project Risk Register

4.7.5 Who

If an integrated risk register is used it will invariably be managed by someone who has overall control of the project. This may be the client, client's agent, lead consultant or project manager. If a separate design or health and safety risk register is developed then the lead designer or planning supervisor may manage it.

4.7.6 Practicalities

If the project risk register is to successfully integrate health and safety risks the parameters of each need to be clear. One company which had previously tried to combine the two registers found difficulties with designers risk information as it did not sit comfortably with the financial risk register,

> *"Different risks are managed by different levels of management, therefore you have different audiences using the register".* [H&S Director – 26/1/04]

The problem seemed to be that everyday risks were included on the risk register rather than confining it to strategic issues, such as multiple fatalities or high risk innovative designs. One possible solution to this problem is to view the risk register the same way as any other project management tool, i.e. it can operate at a strategic level initially but drill down to specific operational levels as the project develops.

It should be recognised that the health and safety risk register should not, as has become all too common, contain a multitude of generic construction risks, of the kind that standard management and operative training should encompass. It is intended to draw attention to and assist the management of significant, project specific risks; and these are often, if they happen, the sort that can impact on project commercial success.

The magnitude of the risk needs to be known; however, quantified risk assessments seem to be disliked by many people. A qualitative approach may be used as long as high risks are identified. Emphasis should be more on the mitigation actions, as an indication of the quality and robustness of the risk register

> *"Our approach is to actually focus on the risk management controls".* [H&S Director – 26/1/04]

HSE have recently commented on the importance of the ”management controls” column on health and safety risk registers and will be concentrating on this during their current designer interventions as a means of identifying genuine actions taken to manage health and safety risk, as opposed to “contractor to provide method statement” approaches.

4.7.7 Benefits

The risk register’s main benefit is that it formalises the risk management process and communicates the most important information in a structured manner.

A combined risk register can easily be adapted to show how existing commercial risks have a health and safety impact as well as the interdependency of health and safety risks with cost and programme issues. Reviewing the risk register at regular meetings brings the risks to everyone’s attention and requires action to be taken, making them highly visible to the project team,

> *“the risk register would be reviewed at meetings on a regular basis. That would make us consider the issues and think about how to deal with them”.* [Project Manager – 15/01/04]

The risk register also provides an audit trail of the risk management process for future reference which can be measured to evaluate performance, or consulted as part of an investigation.

4.7.8 Limitations

Integrating all project risks in one register requires a great deal of control. Everyone must be made aware of who will use the risk register and for what purpose. If health and safety risk information only makes sense to the author then others using the register will not benefit from it. Day to day risks are controlled by the organisation in control of site activities. Project specific issues of a strategic nature belong on the risk register and detailed control measures should be communicated at the operational level. Applying these principles should help avoid unnecessary paperwork and facilitate concerted effort on strategic issues at the planning and design stages of projects.

It must be acknowledged that once the risk register is up and running circumstances invariably change,

> *“you set out the risks at the beginning of the project, but then the programme may change”.* [Senior Planner – 12/1/04]

There is a very real possibility that, like many construction programmes, the risk register will become obsolete as the project develops, if it is not properly maintained. Specification, programme and time changes are just a few examples of events that will affect risks on projects. This is yet another reason why control of the register is extremely important. For the register to work properly in must be a living document. By doing this it can become the main document that runs through the project from conception to completion maintaining the continuity of risks in much the same way as the Health and Safety Plan should do.

4.8 H&S MILESTONES ON PROGRAMMES

4.8.1 Introduction

During the lifecycle of a project there may be several types of programme produced. They invariably take the form of a linked bar chart, or network, which concentrates on the duration of activities, their position on the timescale and the identification of broadly defined work sequences with their dependencies.

At a strategic level health and safety milestones can be used to show when key events are and how they link to other tasks. At the operational level specific tasks can be detailed to show health and safety activities with durations.

4.8.2 Types

The main types of programmes that can be used are as follows:

- Project Master Programme
- Design Programme
- Outline/Master Construction Programme
- Sectional/Package/Short Term Programme

4.8.3 When

The project master programme is usually the first to be prepared, showing the strategic overview. Further detailed programmes are usually developed in the sequence shown above, along with others having very specific purposes, such as procurement or personnel resource programmes, and not addressed here.

4.8.4 What & How

The four main types of programme shown above can incorporate health and safety related information specific to the level of detail relevant to each.

The Project Master Programme can include strategic & CDM milestones e.g. Health and Safety Objectives; Site Surveys; Health and Safety Plan Completion; Health and Safety File Completion.

Design Programmes can include CDM & Design Risk Assessment (DRA) procedures critical to design e.g. appointment of planning supervisor (P.S.); DRA review meetings; Pre-Construction Health and Safety Plan Completion.

The Outline/Master Construction Programme can include the contractor's strategic milestones and interfaces with other project team members e.g. meeting with P.S./Design regarding the Health & Safety Plan; Construction Phase Health and Safety Plan Completion; Risk Assessments received from Sub-contractors; Health and Safety File information completed.

Sectional/Package/Short Term Programmes may include operational milestones important to the works e.g. site set-up and welfare facilities complete; worker inductions completed; method statement communicated to workers; new scaffold checked prior to use; barrier installed round excavation.

Examples of health and safety milestones on programmes are shown in Figure 4.6.

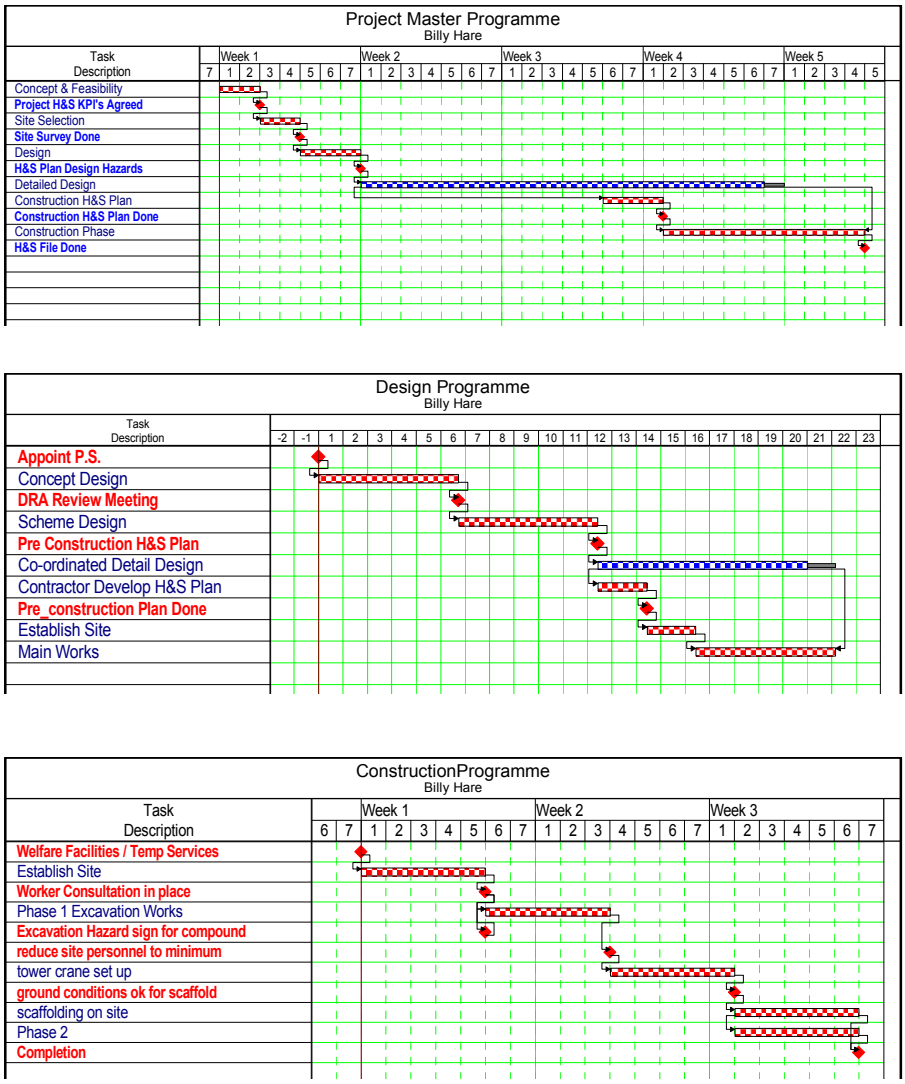


Figure 4.6 Health & Safety Milestones on Programmes

4.8.5 Who

In general terms, the following people may produce each type of programme:

- Project Master Programme: Client/Agent/Project Manager
- Design Programme: Lead Designer/Design & Build Design Manager
- Outline/Master Construction Programme: Main Contractor
- Sectional/Package/Short Term Programme: Main Contractor

These individuals may be knowledgeable enough to incorporate health and safety milestones into each programme. However, consultation with the planning supervisor prior to design and any health and safety manager available from either the client or the contractor during the construction phase planning would help to strengthen the quality of the information used. This is summarised in Table 4.4.

Table 4.4 Health & Safety Input to Programmes

Programme Type	Author	H&S Input
Project Master Programme	Client/Agent/P.M.	P.S.
Design Programme	Lead Designer/Design & Build Design Manager	
Outline/Master Construction Programme	Main Contractor	H&S Manager
Sectional/Package/Short Term Programme	Main Contractor	

4.8.6 Practicalities

Strategic programmes can easily incorporate CDM milestones; however, more detailed items fit better on short term programmes. The Health and Safety Plan will be a good source of information for tasks and milestones, as should be the case anyway, if the quality of the Plan is appropriate. This is also true of any surveys.

Integrating this information with programmes will obviously lead to more information on the programme, which may make it too complex. The use of programme software will allow use of filters to extract specific information, which should help to overcome this problem.

The programme will mostly be used to measure progress against time and to make sure things get done, although it does not guarantee this:

> *"having it on the programme won't control the Planning Supervisor or the designer or the client and make them do it. It just helps identify a problem when it isn't done".* [Project Manager – 12/1/04]

Control of CDM activity and ensuring appropriate output is an important, additional function and preparation of the programme alone must not be relied on to achieve this.

4.8.7 Benefits

A philosophy commonly linked with evaluating output or achievement against programmes is that what gets measured gets done. If an item is on the programme it is accepted as another activity to be completed, rather than being an optional task requiring the conscience and memory of the individual to make it happen.

Milestones can be used to highlight major risks,

> *"showing at what stage in the project they will appear e.g. commencement of work at height or moving into an area where asbestos is".* [Architect – 8/12/03]

Secondly, they can be used to show required outputs. One such item that was mentioned extensively in the research consultation process was completion of the Construction Phase Health and Safety Plan,

> *"I would use a standard template which includes things like the Health and Safety Plan".* [Senior Planner – 15/1/04]

All too often there is not enough time allocated for this task. By including it on the programme, along with a realistic duration, it can be ring fenced as a critical health and safety task. This point was made several times:

> *"It would be good to allocate time against the construction phase plan as time is a big factor that there is very little of",* [Bridge Engineer – 22/1/04]
>
> *"a start date and an end date for the health and safety plan",* [H&S Manager$_2$ – 22/1/04]
>
> *"It could serve as a good tool to ensure we have enough time to complete the Construction Phase Health and Safety Plan".* [Commercial Manager – 21/1/04]

As well as high level tasks, operational tasks can also benefit. Detailed short term planning can lead to substantial improvements in productivity (Horner & Duff, 2001). This concept has been exploited by the "Last Planner" approach which involves site management and sub-contractors working together on weekly and four-weekly programmes. Setting targets, planning works and reviewing performance is repeated throughout the construction phase of the project to improve productivity. One process involves recording sources of failures to meet targets in order to focus on areas needing improvement. Monitoring health and safety tasks through the programme can be done in the same way to improve management safety behaviour, such as completion of tool-box talks to warn of health and safety risks inherent in new activities.

4.8.8 Limitations

Care must be taken to ensure health and safety milestones do not clutter the programme, as mentioned above. Conversely, however, there is the danger that the milestones may become superficial if not enough time and effort is spent developing them "*if it is superficial it has no chance of working".* [Ports & Docks Engineer – 22/1/04]

Simply having the information on the programme does not necessarily mean it will be done. It is used as the input information to the monitoring and control functions and therefore requires the action of those enforcing this to maintain its integrity.

4.9 DESIGN CHANGE CONTROL

4.9.1 Introduction

Most forms of contract for construction projects allow a process for changes and variations. In a perfect world changes will be confined to the planning stages. However, late changes do occur, often during construction, these frequently cause serious disruption to the project. These changes, sometimes referred to as "post fixity" changes because they occur after a design freeze, can impact on cost, time and health and safety risks. Even though there may be a process in place to deal with these late changes, cost and time invariably dominate the decision making process. If the change affects the design, it will impact on the construction process and, quite possibly, operation and maintenance as well. The planning supervisor must be informed and involved. Even if the design is not affected there may still be an impact on health and safety risk to consider.

Including checkboxes on the change management documents and following a set protocol which integrates health and safety measures can address these problems. This is not a new idea but very few projects actually implement such a tool.

4.9.2 When

The tool can be used during design development and any time after then. Changes during design development are expected and the design programme would normally accommodate them. Post design changes are unplanned and are usually urgent.

4.9.3 What & How

Design change requires co-ordination and proper communication. Health and safety issues require consideration and should be included in the decision making process when a change has to be made. The decision process may involve an Option Evaluation Chart as discussed separately in the Tool Box. Communication of change needs to include residual risk, possibly via a risk register, which is also discussed separately.

Most change management model procedures require there to be greater discussion if a change seriously affects cost, time and performance – including its effect on health and safety risks. Figure 4.8 shows a flow chart for the change management process. A key point is the initial review, when it is decided to stop, continue or provide more information. Including prompts on the change order (or similar document) and confirmation document, as shown in Figure 4.7, should provide the initial trigger required to investigate any possible health and safety risk. Following the protocol in Figure 4.8 will then enable proper consideration of any health and safety risk as an integral part of the change process. It also facilitates a team sign-off for the change.

CHANGE REQUEST

Is it likely that the change will impact on design and/or health & safety risk?	YES	NO	If YES, inform the Planning Supervisor / H&S Manager. If NO, justify this choice.

CHANGE CONFIRMATION

Has the change had impact on design and/or health & safety risk?	YES	NO	If YES, reference where information on residual risk and controls can be found.

Figure 4.7 Change Control Check Boxes

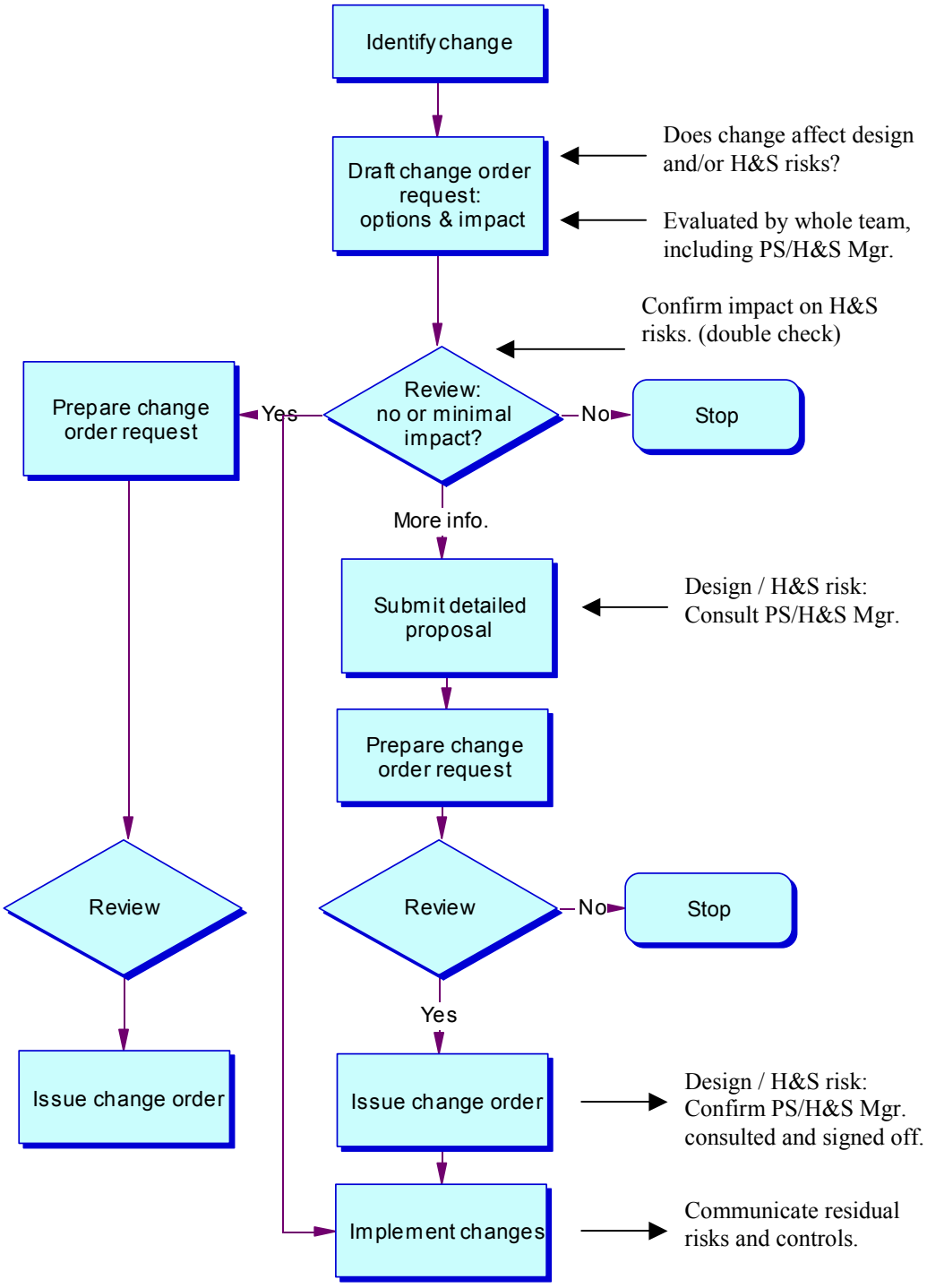


Figure 4.8 Change control process (adapted from model in CIRIA C556)

4.9.4 Who

Design changes usually require input from a lead designer. However, more complex projects, with many specialist designers, will require a more co-ordinated approach. Changes are often instigated, and the design outcome will ultimately be agreed, by the client or his delegated

representative. Other consultants may contribute for specific changes and obviously the planning supervisor or client's health and safety advisor should also be included where health and safety risks need to be considered.

4.9.5 Practicalities

Change documents vary from project to project. Despite this they should all have a common thread of logic that follows the change management protocol in Figure 4.8; therefore the principle of this idea should be applicable to most circumstances.

There may be concerns over increased workload as a result of this tool, however, it must be remembered that if this process, or something similar, is not being followed, then the CDM regulations are being breached. Dealing with changes in this manner can be streamlined through careful consideration of which ones require the input of the health and safety personnel rather than consulting them for every item. Even when they *are* consulted, improvements in health and safety performance may in fact also lead to improvements in productivity. For example recent innovations in mechanical pile-top break out methods have reduced health and safety risks in this area but have also seen excellent improvements in productivity.

The process relies on teamwork, in terms of finding a solution as well as signing off the change. Traditionally the client and lead consultant would decide on changes,

> *"the designer and QS are the only other two consulted"*. [H&S Manager – 19/3/04]

However, involving the planning supervisor in this process may make his input to the project more visible to the client, allowing him see where his money is being spent!

4.9.6 Benefits

The change control document is essentially a planning tool. Therefore, integrating the management of health and safety risks into change management allows proper health and safety planning when changes are necessary. Planning ahead in this manner will reduce the chances of subsequent accidents and ill health, in the way intended by the CDM Regulations.

An added benefit of referring to health and safety measures on change documents is that a cost can be allocated for the new actions required to control the risks. This will help to

> *"show costs up front when changes occur and should reduce potential claims"*. [Environmental Engineer – 19/3/04]

Use of this tool would ensure

> *"including the planning supervisor in the decision making process"*. [Architect – 12/2/04]

This would undoubtedly result in a more pro-active role for the planning supervisor. Subsequently more project-specific risk assessments would result as changes peculiar to the project would prompt this as a necessary action.

In auditing, the tool also provides demonstrable proof that health and safety risks have been considered when changes have occurred.

4.9.7 Limitations

The process relies on executing a certain level of judgement when deciding to alert the Planning Supervisor and/or commence a revised Risk Assessment. Therefore, it is subjective. This may become a problem when:

> *"several small incremental steps mount up to form an eventual change of considerable proportion".* [Electrical Engineer – 19/3/04]

This is the same for all changes, including those that impact cost and time. Regular change management reviews to check the overall effect of changes are a useful way of controlling this. Therefore reviews of this type should obviously include a review of health and safety risks.

The participation of those other than the client and lead consultant may be limited by fixed fees. Unfortunately changes on a project are unpredictable,

> *"there is the problem of covering costs, they are fixed but the number of possible change requests are not".* [H&S Manager 19/3/04]

Therefore some arrangement in the contract for such circumstances needs to be in place.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

5.1.1 Introduction

This research sought to investigate how best to promote the effective integration of health and safety management into project planning, communication and control, in order to achieve improvements in both health and safety management and project management.

To achieve this, the research team have engaged in extensive industry consultation, including several group meetings and numerous interviews with experienced practitioners as detailed in Appendix 1. This has resulted in the development of an integrated Gateway model for construction projects, incorporating the management of health and safety risk. Supporting the model are several tools, designed to be used as levers to satisfy the detailed needs of project planning, communication and control in accommodating the requirements of the CDM Regulations.

The findings of further validation meetings and interviews, as detailed in Appendix 1, has been extremely valuable. This information has been incorporated into the report to show the practicalities, benefits and limitations of the model and tools as well as showing best practice for their implementation.

5.1.2 Gateway model

The gateway process facilitates consideration of the critical aspects of a project at key points through its life. The process therefore provides assurance that everything is in place prior to progressing to the next stage and assists in achieving more realistic targets. It is clear, therefore, that health and safety reviews should become part of these gateway stages if true integration of health and safety management is to be achieved. At each gateway, Critical Success Factors (CSF) are reviewed, after which each member of the project team signs off the gateway form. Evidence of the completion of each CSF must be presented, prior to sign-off, by the provision of appropriate evidence. This approach, consistent with the increasing focus on Front End Loading of projects, involves allocating considerable resources to the planning activities, in order to anticipate and manage both commercial and health and safety risk.

The Gateway model has been based on the Office of Government Commerce (OGC) framework for construction projects. This decision is consistent with the recommendations of *Accelerating Change* and *Revitalising Health and Safety in Construction.* Respondents to the latter discussion document voted for some form of Gateway process to be used in the management of health and safety risk during construction projects.

Health and Safety risk is part of overall project risk and the use of **Gateways** can**:**

- provide the mechanism to manage the risk of cost and time overruns; and
- also provide the mechanism to manage health and safety risks.

Lack of planning leads to project uncertainties, such as late changes being realised at construction stage, incurring extra time and cost, but **Front End Loading:**

- minimises potential for late changes through increased planning; and
- also reduces the likelihood of accidents.

The Gateway model is structured, systematic, logical, rigorous and transparent. Since it is based on principles of risk management, it uses the language of project managers and clients. The increasing need for clients to consider the implications of *Corporate Responsibility* and *Corporate Killing* should work as a catalyst for the uptake of such a rigorous and easily auditable method of construction procurement.

A key feature of the model is that it moves ownership for health and safety risks upstream, to duty holders identified by the CDM Regulations, particularly the designer and client or project manager. This helps to promote integrated teams and is conducive to collaborative working.

It must be remembered that the model is reduced from reality, and as such, can never be perfect, it is not an exhaustive list of factors to consider. For this reason, continuous development and refinement of the model will be required to ensure it is relevant and appropriate for current practices.

The model requires informed clients to recognise how much project success depends on *Front End Loading* and promotes timely and robust advice to naïve clients on the benefits of good planning (and the cost of poor planning). Without good leadership the process will be in danger of becoming bureaucratic; therefore, efforts should be concentrated on managing people rather than managing paperwork.

Smaller Projects

The Gateway principle need not be confined to large projects, where economies of scale allow more scope for funding. Companies, such as BP have started to use their own gateway model for smaller projects and it is possible to collapse the existing gateway model to accommodate smaller projects whilst still providing enough Front End Loading to ensure project success. Some of the "Consolidated Gateway Reviews" in the collapsed model combine the critical success factors discussed at each Gateway in the main model within one gateway review. By consolidating these it is assumed that less time will be needed to review these items for smaller projects therefore the outputs can be streamlined.

5.1.3 Tools

The tools contained in the Tool Box section of the report are designed to support the Gateway model, however, they are also implements that can be used independently of the model. It is not essential that every tool will be used for every project, however, this *is* possible, and would constitute an excellent declaration of the project team's commitment to the management of health and safety risk, as an integral part of project management.

Every tool achieves two goals:

- firstly, the tool aids general project planning; and
- secondly, it integrates health and safety planning.

General planning tools that incorporate health and safety planning will make this function easier, becoming a natural part of the day to day activities of those planning and managing construction projects.

Each tool has its own benefits and limitations, however, if used correctly all of them can improve the management of health and safety risks.

Responsibility Chart

The responsibility chart is a front end planning tool used to show **who** does **what** during a project and **when** it is to be done. Integration of CDM responsibilities is achieved by

including tasks specific to the management of health and safety risk. The chart is intended to help define the interfaces between disciplines and avoid possible conflicts or misunderstandings.

The greatest benefit of the chart lies in the process of developing it. Deciding what should be done at each stage of the project and who should do it is a fundamental part of project planning. Tabulating this information on such a chart creates a structured approach that can be communicated easily in a transparent and robust manner. It is also conducive to developing integrated teams, managing people and allocating resources. In terms of the management of health and safety risk, it can bring together the various activities shown separately in the CDM Approved Code of Practice (ACoP) (HSG224) – Appendix 7 to show what every duty holder has to do in relation to the task *and* each other.

Option Evaluation Chart

An option evaluation chart is a useful tool to summarise what factors need to be considered when making decisions. Alternatives can be investigated in terms of how they impact on predetermined factors, including health and safety risk.

All meetings, formal or informal, to plan some part of a project will often have someone sketching out the tasks, options, pros and cons, etc. on a board or sheet of paper in a tabular manner, to aid discussion and capture conclusions. The option evaluation chart can assist this process and capture the results in a convenient and more standardised way. In auditing, it can be used to demonstrate that a balanced decision was reached, recording what was *reasonably practicable.* It also shows the rationale for the decision, which may be communicated to others to strengthen support and prevent it from being inappropriately challenged.

If no formal decision making process is in place at all, the chart may be seen as extra work. In this case the tool can be introduced to help improve the decision making process in overall terms, not just health and safety.

Hazard ID Workshops

This is a process of group discussion, the purpose of which is to draw knowledge and experience from each group member in order to achieve a better understanding of issues affecting both health and safety and the smooth progress of the project than would have been achieved by individuals, separately.

Major decisions will be affected by risk identification and management. The early identification of risks will help focus attention on policies and strategies for control and management of risks. In particular, the workshops highlight those areas where further design, development work, investigation or clarification is most needed. Utilising group workshops, rather than individual risk assessment, facilitates the development of an integrated team and a collaborative risk management culture, which will achieve a more efficiently managed project. Therefore a more comprehensive and realistic output can be achieved. Another benefit is that holding the workshops will increase team building and help with co-operation. Integrated teams create a collaborative culture which will achieve more.

The extent to which individuals participate may be limited by fees or the price tendered/negotiated; therefore the requirements of participation need to be an integral part of contractual arrangements.

SHE Information on Drawings

Drawings are used extensively on site and their great potential in communicating health and safety residual risks is highlighted in the HSE ACoP (HSG 224). In most cases, use of SHE information on drawings was recommended at the detailed design stage, although

consultation with the contractor, via hazard ID workshops, will help concept designers understand what information will be useful to include, even in concept design drawings.

Not only does this tool communicate useful health and safety information, but it can explain the rationale behind the design solution and possibly prevent it being changed subsequently to a design that is inherently unsafe or unhealthy. An additional benefit of a SHE box or Hazard ID drawing is its ability to prompt further investigation should a design change be considered and trigger the designer to re-assess the hazards and whether any new risks have been introduced. Providing the information on the design drawing or construction detail itself is generally the preferred option.

Pinning the drawing on the wall of the area where inductions are conducted makes it easy to refer to, indicating areas of high, project specific risk such as interaction with plant, public or transport. This makes risks highly visible to the workforce.

Information overload and duplication can be overcome through the use of electronic file management. This will allow easy manipulation of the information without unnecessary extra work. Communicating with the contractor before design can help determine what will be useful and what information is obvious and superficial.

Red Amber Green Lists

The notion of traffic light colours to communicate safety information is well grounded in the UK and can easily be recognised as Red for warning, Amber for proceed with care, and Green for safe to go. Red items should not be accepted by the client or designer, Amber items will have to be justified, and green items represent good practice that the client or designer would like to see implemented.

Successful application of the RAG Lists will depend on the length of the lists and the time that will be taken in implementing them. The lists need to be short, but cover those items that have the widest opportunity to mitigate health and safety risks. This rationale is similar to the Pareto or 80/20 rule that assumes 80% of outcomes can be attributed to 20% of sources.

RAG Lists focus attention on the most important health and safety issues in design choices; they can also help designers to become more pro-active. Design and build forms of procurement lend themselves to development of the lists as the contractor may be in a position to influence the design, by using his experience to develop practical, project specific RAG Lists for the designer to follow. Initially project specific items should, where appropriate, be added to generic RAG lists for future use.

As RAG Lists develop, existing items become embedded in the underlying culture, and new issues can take their place as new materials, technologies and construction techniques are used. This process constitutes a *step change* towards continuous improvement for the industry. Additional benefits include using the list as a learning tool to communicate good and bad practice, however, designers may fail to look beyond them. Regular design risk assessment meetings should facilitate reassessment of the lists so that this does not become a problem.

Designers themselves believe in working to guides or frameworks and dislike the term “checklist”. This should be acknowledged if the tool is to be adopted by the design community. “Checklist” is a useful shorthand way of describing a tool of this type but its real purpose is to communicate strategic objectives for the management of health and safety risk. As long as this is achieved then the terminology can be flexible.

Risk Register

Since the process for managing commercial risks is similar to the assessment process for health and safety risk there is scope for consolidation and indeed, integration of the two. Once risk sources, or health and safety hazards are identified, there are other relevant pieces of information required for the risk register. The potential impact of each risk needs to be assessed and recorded, the risk owner, action to be taken and "date to be done by" are other essential requirements of any risk register. After completion of the risk register it becomes a control tool, which can be used to check that the planned actions are being implemented. Performance can therefore be measured and corrective actions taken, if necessary.

The risk register's main benefit is that it formalises the risk management process and communicates the most important information in a structured manner. A combined risk register can easily be adapted to show how existing commercial risks have a health and safety impact as well as the interdependency of health and safety risks with cost and programme issues. The risk register also provides an audit trail of the risk management process for future reference which can be measured to evaluate performance, or consulted as part of an investigation.

It should be recognised that the integrated risk register should not, as has become all too common with health and safety, contain a multitude of generic construction risks, of the kind that standard management and operative training should encompass. It is intended to draw attention to and assist the management of significant, project specific risks; and these are often, if they happen, the sort that can impact on project commercial success. It can operate at a strategic level initially but drill down to specific operational levels as the project develops.

Although the risk assessment process requires some form of measurement or hierarchy of risk to be developed, a pre-occupation with numbers to justify decisions is not seen as a productive use of time. Emphasis should be more on the mitigation actions as an indication of the quality and robustness of the risk register. The magnitude of the risk is obviously important and should be apparent regardless of the assessment process used.

There is a very real possibility that, like many construction programmes, the risk register will become obsolete as the project develops, if it is not properly maintained. Specification, programme and time changes are just a few examples of events that will affect risks on projects. This is why control of the register is extremely important. For the register to work properly in must be a living document. By doing this it can become the main document that runs through the project from conception to completion maintaining the continuity of risks in much the same way as the Health and Safety Plan should do.

Health and Safety Milestones

A linked bar chart, or network, concentrates on the duration of activities, their position on the timescale and the identification of broadly defined work sequences with their dependencies. Activities required for the management of health and safety risk can be included within this process. At a strategic level, health and safety milestones can be used to show when key events are and how they link to other tasks. At the operational level specific tasks can be detailed to show health and safety activities with durations.

A feature commonly linked with programmes is the notion that what gets measured gets done. It can also be said that what gets measured gets managed. Strategic programmes can easily incorporate CDM milestones; however, more detailed items fit better on short term programmes. If an item is on the programme it is accepted as another task to be done rather than being an optional extra requiring the conscience and memory of the individual to make it happen. They can be used to highlight major risks, e.g. commencement of work at height or moving into an area containing asbestos. They can also be used to show outputs, such as the

completion of the Construction Phase Health and Safety Plan. All too often there is not enough time allocated for this task. By including it on the programme, along with a realistic duration, it can be ring fenced as a critical project, and health and safety, task.

As well as high level tasks, operational tasks can also benefit. Detailed short term planning can lead to substantial improvements in productivity. Monitoring health and safety tasks through the programme can be done in the same way to improve safety behaviour through regular meetings to report feedback and actions required.

Care must be taken to ensure health and safety milestones do not clutter the programme. Conversely, there is the danger that the milestones may become superficial if not enough time and effort is spent developing them. Therefore, as with all programmes, the experience of the planner and the type of project will affect the usefulness of the tool.

Gateways are a particular form of milestone and the use of milestones in programmes fits very well with the gateway concept.

Design Change Control

Late changes often occur during construction, and frequently cause serious disruption to the project. In these circumstances, decisions are being made under pressure and cost and time invariably dominate the decision making process. If the change affects the design, it will impact on the construction process and, quite possibly, operation and maintenance as well. Even if the design is not affected there may still be an impact on health and safety risk to consider.

Including checkboxes on the change management documents and following a set protocol which integrates health and safety issues can ensure that they are not overlooked. This is not a new idea but very few projects actually implement such a tool.

The change control document is essentially a planning tool. Therefore, integrating the management of health and safety risks into change management allows proper health and safety planning when changes are necessary. Improvements in health and safety performance may in fact also lead to improvements in productivity. For example recent innovations in mechanical pile-top break out methods have reduced health and safety risks in this area but have also seen increased use due to excellent improvements in productivity.

The process relies on teamwork, in terms of finding a solution as well as signing off the change. Involving the planning supervisor in this process makes his input to the project more visible to the client. Subsequently more project-specific risk assessments would result. An added benefit of referring to health and safety measures on change documents is that a cost can be allocated for the new actions required to control the risks. In terms of auditing, the tool also provides demonstrable proof that health and safety risks have been considered when changes have occurred.

Regular change management reviews to check the overall effect of changes are a useful way of controlling the possibility of small incremental changes mounting up to one significant change. Therefore reviews of this type should obviously include a review of health and safety risks. The participation of those out with the client and lead consultant may be limited by fixed fees. Therefore some agreement in the contract for such circumstances needs to be in place.

5.2 RECOMMENDATIONS

This report constitutes one of the first investigations into the possible use of Gateways to integrate health and safety risk management, as recommended by *Revitalising Health and Safety in Construction.* As such, the outcomes of the research described in this report should prove to be extremely useful to those following OGC Gateway methods, but also for those wishing to implement new concepts of integrated teams and collaborative planning. Therefore, publication of a more succinct, user-friendly guide, based predominantly on these outcomes and suitable for the wider construction community is recommended. The layout of the model, with its direct links to the Gateway tables and tools makes it ideal for electronic presentation with hyperlinks flowing from the model to more detailed information in the report. Therefore a CD ROM or similar electronic format would be an ideal future development to guide project planners through the Gateway process. Promoting Gateways within a guidance document would be the preferred option, as opposed to imposing prescriptive legal requirements on the industry, since this would probably be met with resistance.

The Gateway process is well established in companies such as BP, but is still relatively new to the wider construction industry. Further longitudinal studies need to be conducted, covering the full life-cycle of Gateway projects to extend and refine the process. Early consideration of this recommendation could result in the implementation of research covering the current DWP Jobcentre Plus programme.

During the research investigations, some tools were found to be used more than others. There is scope to further test and develop all the tools regardless of the extent of previous use. In addition to this, further recommendations are as follows:

The responsibility chart and risk register have clear overlaps and similarities that could allow the development of a single tool for the identification and management of risks, including health and safety risks. Leading on from this, an integrated risk register can potentially provide continuity for the risk management process, from conception to completion. This could make it the overall planning and control document for risk management, in many aspects replacing several sections of the Health and Safety Plan, as a more user-friendly, practical tool. Future research investigating the possible use of this tool as an alternative to the Health and Safety Plan is recommended.

The option evaluation chart was originally developed for design decisions; however, it can also be applied to project wide decisions due to its logical approach and systematic presentation of information. Future research investigating this possibility is recommended.

Hazard ID workshops provide an excellent forum for collaborative planning. The benefit of bringing different stakeholders together to identify hazards and discuss how to address them was seen as an invaluable process assisting design risk assessment (DRA). Indeed, it may be possible to take this notion a stage further and test the hypothesis that this process could actually replace individual design risk assessments. Individual designer risk assessments are almost looked upon with contempt, being required by law, but adding no value to the construction process and basically imposing on the designer's productive time. Possible future research could seek to compare two similar projects' cost in terms of time spent on DRA for one and Hazard ID workshops for the other, along with overall cost/benefit analysis.

Health and safety milestones at a strategic level align well with CDM "milestones" such as completion of the Health and Safety Plan. The benefits of this inclusion have been discussed in detail within the relevant Tool Box section of the report. This concept could be extended to other CDM and health and safety requirements resulting in a generic set of milestones that

can be incorporated into project programmes. This would make an excellent inclusion to CDM guidance such as HSG 224, which would especially benefit smaller organisations (SME's).

Further to the previous recommendation, the current review of CDM may include the evaluation of all the tools. Therefore the report should be made available to those reviewing the CDM Regulations.

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APPENDIX1 PROJECT RESEARCH METHODOLOGY

INTRODUCTION

The research programme was carried out in five overlapping phases:

Literature search – Initially this covered guidance on construction project management; health and safety management, including safety management systems; and CDM. As the research developed information on Gateways was also investigated.

Steering Groups – A steering group of senior industry stakeholders was formed to advise on the strategic direction of the research, review progress and outcomes and assist in obtaining access to construction sites and personnel. Several "virtual" steering groups were also formed. This approach allowed individuals to contribute knowledge via email and telephone when geographical location would have otherwise precluded them.

Expert Panels – Expert panels were formed to conduct a series of brainstorming meetings; covering maintenance; construction; and planning and design. These were held to investigate Critical Success Factors, which were subsequently categorised as "Events" that had to take place at a macro level, or issues requiring "Tools" at a micro level.

Interviews – Interviews were held with industry practitioners, recommended by the Steering Group, to assist in directing the research focus on the development and validation of the model.

Validation interviews – A series of visits to practitioners' offices and sites were made to test each tool by performing mock demonstrations and gaining detailed feedback on how each tool would perform in real-life situations.

The method of research is illustrated in Figure A1.1.

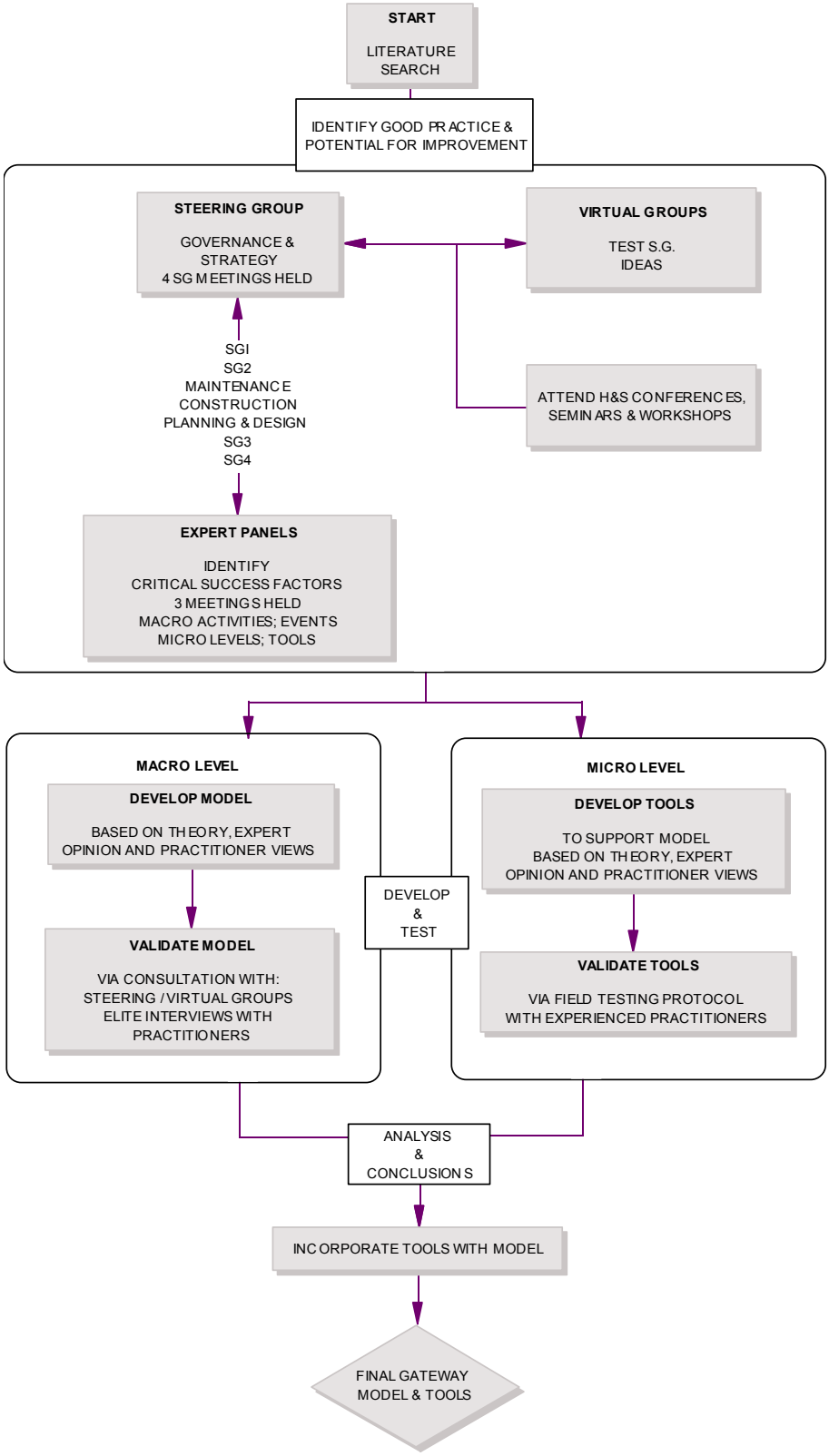


Figure A1.1 Research Method

LITERATURE SEARCH

In general, literature referred to during the research has included textbooks, institutional and statutory publications, periodicals and academic/trade journals, seminar and conference papers as well as an extensive computer search utilising the various databases available to the research team. In addition to this, several conferences, seminars and workshops have been attended to gain further insight into current trends in the management of construction health and safety.

The research has concentrated on three main areas:

- Guidance on project management for construction projects;
- Health and safety management systems and guidance on applying these to construction; and
- The Construction Design and Management Regulations (1994) and Approved Code of Practice (HSG224).

Figure A1.2 lists the main sources of literature consulted during the research.

In addition to this, information on Gateway frameworks has been collected. The main source of literature for this information has been the OGC; however, other sources such as the DWP Jobcentre Plus projects, the Salford "Process Protocol" and BP's CVP model also use gateways and have been referred to during the course of the research.

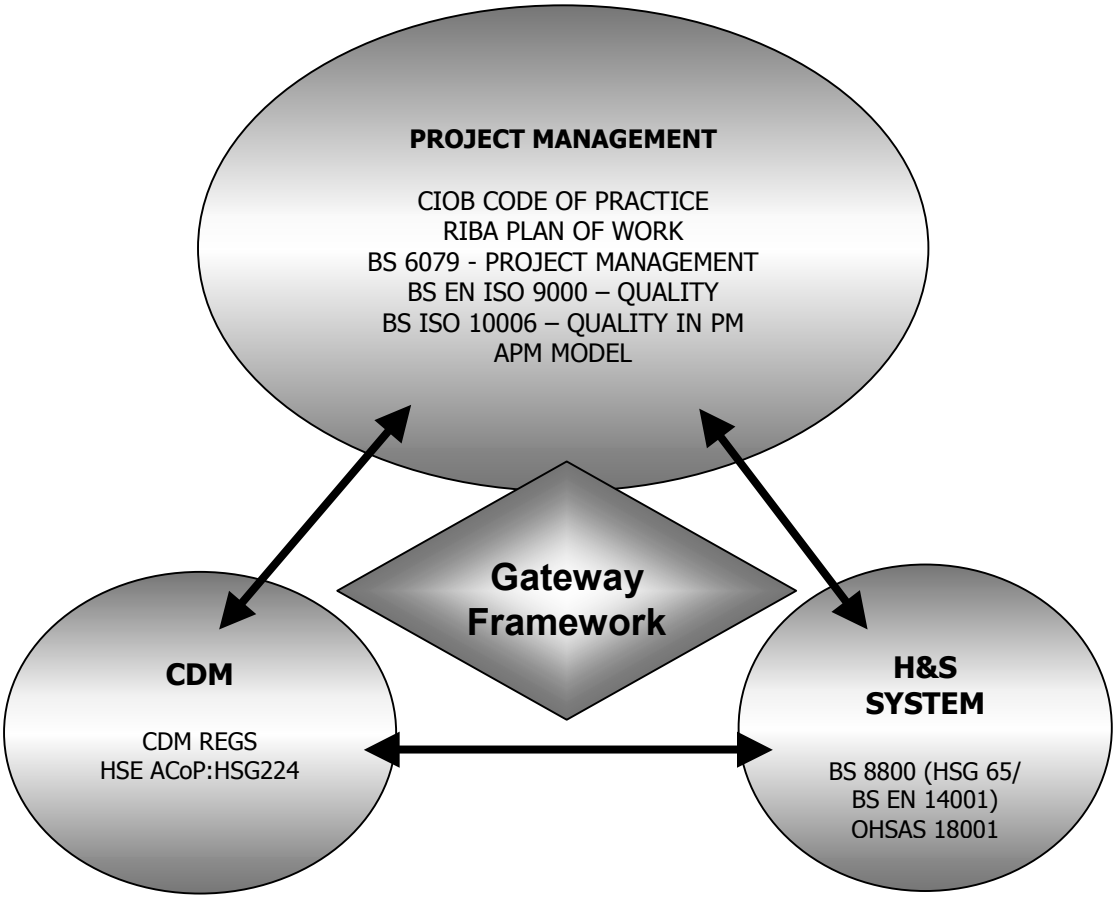


Figure A1.2 Literature search

RESEARCH GOVERNANCE

A Steering Group was formed to oversee the research programme. The remit of the group was to:

- Provide strategic direction to the research
- Give specialist advice on behalf of industry
- Facilitate access to suitable construction sites to view the systems in operation and interview appropriate personnel, and
- Suggest further contacts within the industry who could contribute to the research

Table A1.1 Steering Group

Ed Bale,	BP Plc
Nick Balsdon,	Environment Agency
Tom Cairney,	Bovis Lend Lease
Dave Devey,	Skanska UK Building
George Inglis,	Capita Health and Safety
Brian Law,	Association of Planning Supervisors
Jim MacKay,	Serco Services Ireland Ltd
Norman Price,	Essempy & A.P.M. H&S Special Interest Group
Stan Purdy,	Turner & Townsend Health, Safety & Environment
Mark Ritchie,	Glasgow City Council
Darrell Scott,	Scottish Widows
John Tetley,	Environment Agency
Martin Worthington,	AMEC Infrastructure

The steering group membership is shown in Table A1.1, which met throughout the research, allowing feedback to be delivered on progress:

9th January 2003
8th April 2003
10th September 2003
11th February 2003

Virtual steering group membership was determined according to the members' CDM duty holder title, $V_1 - V_4$, and other consultants under V_5, as shown in Figure A1.3. This facilitated rapid responses to specific questions or clarification on points, related to current or best practice, by each specialist virtual group.

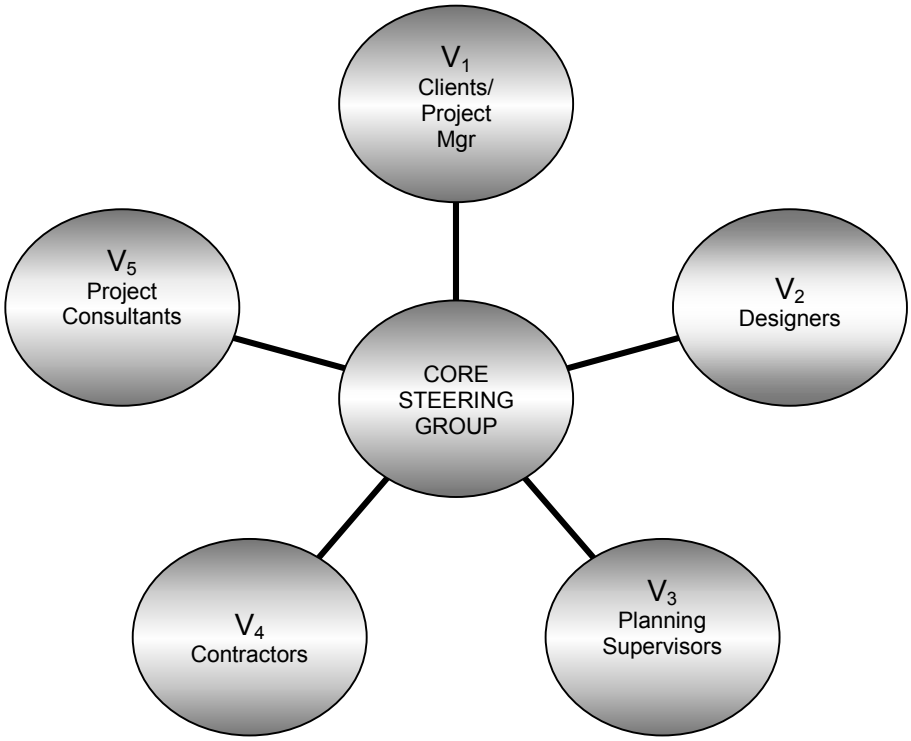


Figure A1.3 Steering groups: overview

EXPERT PANELS

Early in the research, it was decided to form Expert Panels of industry specialists and deep topic experts. These panels covered the following project life-cycle areas:

- Maintenance phase
- Construction phase
- Planning and design phase

The members of these panels are shown in Tables A1.2, A1.3 and A1.4 respectively. The meetings were held in reverse order rather than their logical, project life-cycle sequence. This method was adopted in order to feed the outputs of the previous meeting into the discussion of the succeeding one, as in many cases these outputs were perceived requirements of the management of earlier phases of the project. Hence the aggregated outputs of the planning and design meeting, and both previous meetings, fed into discussions by the Steering Group and, thence, into the gateway model. This process and the relationship between the expert panel groups and steering group is illustrated in Figure A1.1.

Table A1.2 Maintenance expert panel

Brian Law	Association of Planning Supervisors
Glenn Christiansen	Vauxhall Motors Ltd
Rory Reed	Serco Services Ltd
Norman Price	Essempy & A.P.M. H&S Special Interest Group
Peter Mather	Mitie Plc
Scott Steven	Halcrow Group Ltd
Worthington, Martin	AMEC Infrastructure
Hedley Horsler	HSE

Table A1.3 Construction expert panel

Fraser McCaskill	Thus Plc
Susan Calderwood	Thus Plc
Richard Wilks	Abco Management Consulting Safety Engineers
John Marsh	Kirk & Marsh Ltd
Brian Hume	Balfour Beattie Construction Ltd
Peter Mather	Mitie Plc
Norman Price	Essempy & A.P.M. H&S Special Interest Group
Scott Steven	Halcrow Group Ltd

Table A1.4 Planning & design expert panel

Susan Calderwood	Thus Plc
Richard Wilks	Abco Management Consulting Safety Engineers
Thouria Istephan	Foster & Partners Architects
David Ward	Tweeds Project Services
Trevor Pavitt	Loughborough University
Archie Clark	Reiach & Hall Architects
Mike Thompson	HSE

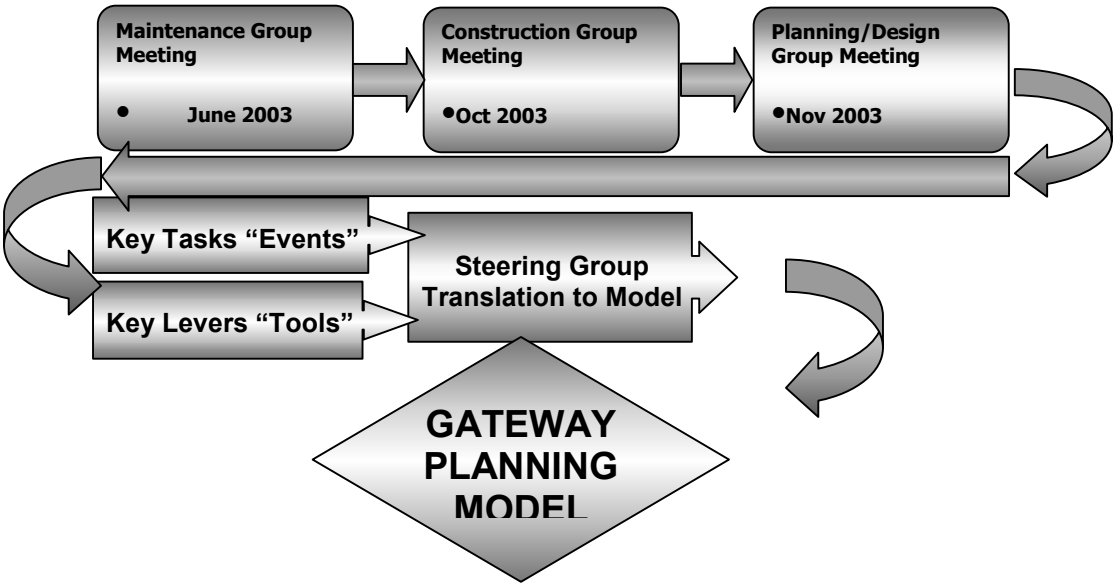


Figure A1.4 Expert Panels: Overview

These outputs were categorised as either "Events" that had to take place at a macro level, or issues requiring "Tools" at a micro level. The meetings were audio-recorded and transcribed for evidence purposes. These transcriptions are held privately by the research team and are not publicly available, in order to comply with the essence of Data Protection, good research etiquette, and assurances given by the research team.

INTERVIEWS

In order to supplement information collected at the expert panels, several visits were made to practitioners' offices and construction sites to interview people with experience of integrating health and safety within planning, designing and managing construction projects. A summary schedule of the interviews is shown in Table A1.5.

Table A1.5 Interview Schedule

DATE	NAME & COMPANY
10/2/03	Norman Price, APM H&S Special Interest Group
17/2/03	Jim MacKay, H&S Director, Serco Ireland
20/2/03	Stan Purdy, Senior H&S Mgr, Turner Townsend (G)
25/2/03	Ed Bale, Asset Mgr, BP Grangemouth (G)
3/3/03	Brian Law, Chief Executive, APS
5/3/03	Martin Worthington, SHE Mgr AMEC Infrastructure
7/3/03	Thouria Istephan, Foster & Partners
14/3/03	Richard Thorpe, Project Manager MACE, RBoS H/O
7/4/03	Allan Ritchie, UCATT
14/4/03	George Ingles, Senior Project Manager CAPITA
2/7/03 & 13/5/04	Stephen Coppin, Senior SHE Mgr, DWP Jobcentre + (G)

(G): Those directly involved with Gateway projects

The objectives of these interviews were to resolve any unresolved issues remaining from the expert panel meetings, to confirm opinions expressed in these meetings and to observe health and safety management systems in use. These interviews were semi-structured, due to their exploratory nature, allowing the interviewee to relate their opinions, experience and perceptions. This in turn led to the development and refinement of the Gateway model. Validation feedback was also collected from those directly involved with Gateway projects, as shown in Table A1.5. This allowed direct comparison with existing practices regarding the running of such projects and provided rich data for analysis.

VALIDATION INTERVIEWS

Although the Gateway model provides guidance at a macro level, it was recognised by the steering group that the "devil was in the detail" and the tools were the critical elements of the research requiring further validation. It was also acknowledged that the Gateway model was too large in its scope to be tested within the timeframe of the research project. Since the model essentially provides the framework to hang the tools on, a programme of validation interviews was carried out to test each tool.

The purpose of these validation interviews was to gain detailed feedback on how each tool would perform in real-life situations. This was achieved by presenting mock demonstrations of each tool before undertaking rigorous interrogation of the tool, inviting the interviewee to critically analyse it in detail. To gain real-life candid responses most interviewees were chosen from professions outwith those specifically related to health and safety such as planning supervisors and health and safety managers. The interview strategy specifically asked questions of each tool as a data-processing system, with input data/information, a transformation process and outputs as illustrated in Figure A1.5.

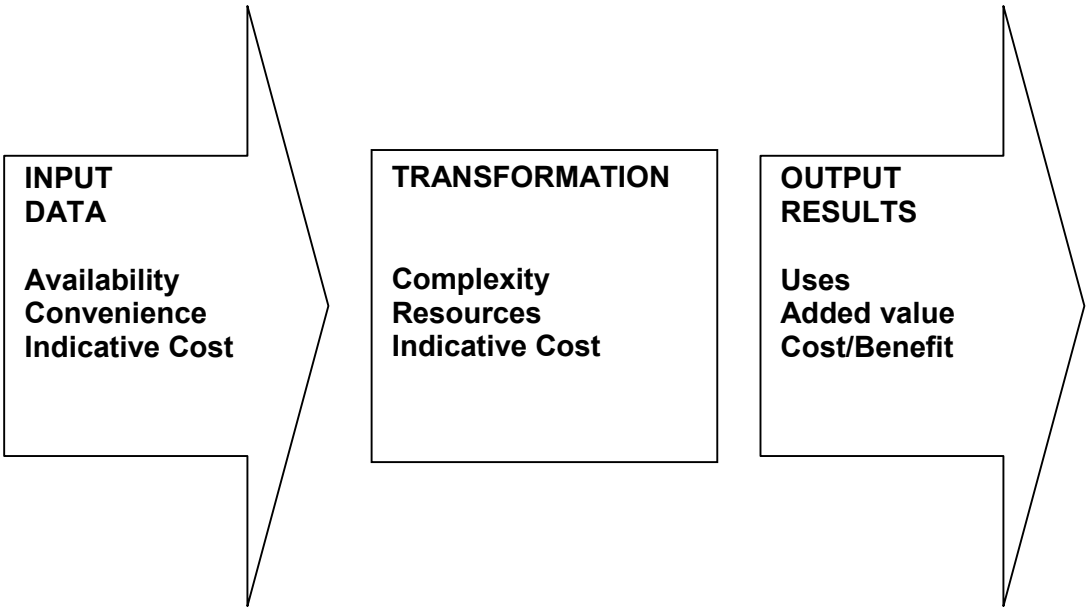


Figure A1.5 Validation interview strategy

A total of 28 validation interviews were carried out, as shown in Table A1.6. Each interviewee was questioned on the tool(s) regarded most relevant to them, based on their particular profession, background and experience. This lead to some tools being reviewed more times than others, however no individual tool received less than six reviews.

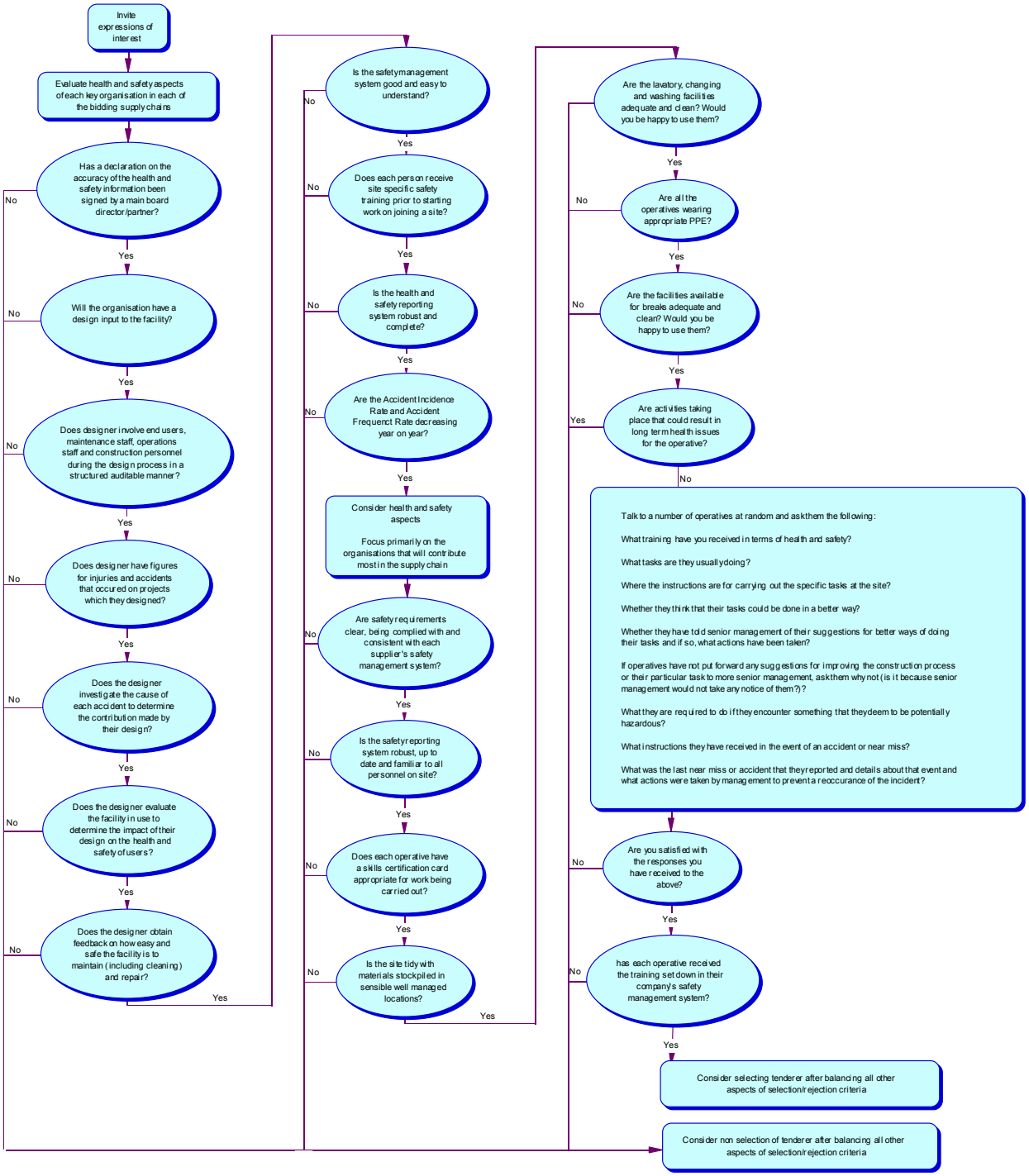
The validation interviews were audio-recorded, where possible, and transcribed for evidence purposes. These transcriptions are held privately by the research team and are not publicly available in order to comply with the essence of Data Protection, good research etiquette, and assurances given by the research team. The interviewees have also been kept anonymous, as shown in Table A1.6.

The results of the validation interviews were synthesised with the Tool Box sections of the report, with quotes presented where necessary to convey specific aspects of each tool in use. These are found under the headings of Practicalities; Benefits; and Limitations within the Tool Box section of the report.

Table A1.6 Validation interview schedule

DATE	NAME	DATE	NAME
8/12/03	Architect, Foster & Partners	22/1/04	H&S Mgr, Halcrow
12/1/04	Project Manager, AMEC	22/1/04	Water Ways Engineer, Halcrow
12/1/04	Senior Planner, MACE	22/1/04	Ports & Docs Engineer, Halcrow
13/1/04	Construction Mgr, THUS	22/1/04	Environmental Engineer, Halcrow
13/1/04	Planner, THUS	22/1/04	H&S Mgr, Halcrow
13/1/04	CAD Specialist, THUS	22/1/04	Geotechnical Engineer, Halcrow
15/1/04	Senior Planner, Kier	22/1/04	Snr. HS&E Mgr DWP Jobcentre +
15/1/04	Project Manager, Kier	26/1/04	H&S Director, BAA – T5
16/1/04	Project Manager, BP	12/2/04	Architect, Reiach & Hall
21/1/04	Commercial Mgr, Balfour Beattie	19/2/04	Environmental Engineer, Halcrow
22/1/04	H&S Mgr, Halcrow	19/2/04	Bridge Engineer, Halcrow
22/1/04	Bridge Engineer, Halcrow	19/2/04	H&S Mgr, Halcrow
22/1/04	Electrical Engineer, Halcrow	19/2/04	Geotechnical Engineer, Halcrow
22/1/04	Civil Engineer, Halcrow	19/2/04	Electrical Engineer, Halcrow

APPENDIX 2 OGC VETTING FLOW-CHART



Source: Achieving Excellence Through Health And Safety (OGC, 2003)

APPENDIX 3 NEWS RELEASES & DISSEMINATION

News Releases – Notification of Project

The Caledonian (GCU News), BNE safety research success, June 2002

> *Dr Iain Cameron, Lecturer in Construction Management within the school of the built and natural environment, has been awarded an 18 month research to investigate ways in which construction organisations can better plan for safety on site.*

Construction Manager, "Research weaves safety into management", November 2002

> *A new study on how to build health and safety into construction management is about to start, but researchers need your help. The team will investigate how to properly integrate health and safety planning, to stop it being a bolt-on extra to the overall planning process. Iain Cameron said "Those who manage safety best don't necessarily care more about health and safety, they're just better managers".*

Project Scotland, "Second safety award for university experts", November 2002

> *A Scots university has won a second contract to help make construction sites safer. Dr Iain Cameron, a Senior Lecturer in Construction Management within the School of the Built Environment, will lead the team, assisted by Dr Roy Duff, a specialist in behavioural safety and improving productivity. Billy Hare, who comes from a management contracting background, joins them to liaise with industry.*

Safety & Health Practitioner, "Getting construction planning right", December 2002

> *SHP readers' opinions are being eagerly sought to help develop methods to ensure that construction projects build in safety planning and control as a core aspect of normal time and resource management, rather than running separate safety procedures as bolt-on extras. The research team says it will need industry help to identify best practice ideas.*

IOSH Construction News, "HSE research at GCU", Issue 1 2003

> *"Investigation into the integration of health and safety planning in construction" will focus on how best to promote the effective integration of health and safety management into project planning, communication and control in all construction activity.*

Construction News, "Planning is key to safer workplaces", 3/4/2003

> *Iain Cameron asks for the industry's help with a new health and safety research initiative. The research will use lean thinking to develop a health and safety model within contracting organisations' existing production management structures and procedures. The research aims to deliver a best practice guide on planning and control in construction management for the integrated management of health and safety risks.*

Site Safe News, "Help needed", Issue 5 May 2003

> *Researchers from Glasgow Caledonian University are carrying out a project entitled Integration of Health and Safety Planning in Construction. Representatives form disciplines including clients, project managers, designers, management contractors, consultants and union representatives are required.*

WWT News, "Your chance to get involved in HSE-backed project",
Issue 12, spring 2003

> *Caledonian's research team are welcoming input from people already working in the field. Specific areas where the research team would welcome input are; "steering" the research; analysis of the best practice model; provide interviews of knowledge and current practice; field testing of the model.*

Dissemination

15/7/03 Chartered Institute of Building (CIOB) Health & Safety Committee, London, presentation of research work done to date.

> *The CIOB Health and Safety Caucus has several senior Health and Safety professionals within its membership (of which Dr Iain Cameron is one) and provided an excellent venue to disseminate the initial findings of the research.*

19/11/03 Postgraduate Researchers of the Built and Natural Environment, First Scottish Conference, GCU, presentation of findings of research to date.

> *The project's research assistant, Billy Hare is developing his contribution to the research within his PhD thesis. Therefore he was able to present some intermediate findings of the research to the academic community at this conference, organised by post graduate researchers of Glasgow Caledonian University, which included many international delegates.*

9/12/03 Construction News Seminar, Achieving Effective Health & Safety in Construction, London, presentation of findings of research to date.

> *The research team were invited by Construction News to present the findings of the research at a prestigious Seminar in London. This provided an excellent platform for disseminating the work to the wider construction community. Over 80 delegates attended the event.*

11/3/04 Centre for Built Environment (CBE), Seminar: Integration of Health & Safety Planning using Gateways, presentation of findings of research to date.

> *The research team organised this event through CBE, a commercial knowledge transfer organisation who partner with Glasgow Caledonian University (GCU). This event was primarily aimed at SME's and was held in Glasgow. Due to the success of this event a future workshop is planned to showcase all the research work done by GCU for the Health and safety Executive, to be held on 24th June 2004.*

16/3/04 North West Safety Initiative, Construction Safety Seminar, Runcorn, presentation of findings of research to date.

> *The research team were invited by the committee of the North West Safety Initiative to present the findings of the research at the 2004 event of their well established health and safety seminar in Runcorn. This provided an excellent opportunity to further disseminate the research findings to the wider construction community. Over 250 delegates attended this event.*

21/4/04 IOSH Annual Conference, Douglas Short Memorial Lecture, Harrogate, presentation of findings of research.

> *Dr Iain Cameron's membership of IOSH allowed the research team to submit a paper for consideration at their annual conference. This was subsequently recommended by the organising committee to be presented as "The Douglas Short Memorial Lecture". This not only allowed the research work to be showcased as a prestigious lecture presentation but also allowed it to be disseminated to the construction health and safety community of IOSH members and will subsequently be printed in the members' publication Safety & Health Practitioner.*

18/5/04 AMEC Health & Safety Seminar, Manchester, presentation of findings of research.

> *One of the steering group members, Martin Worthington, of AMEC, invited the research team to present the findings of the research at their annual SHE conference in Manchester. This was an international event with over 120 delegates from the worldwide AMEC Group.*

Planned

24/6/04 GCU HSE Research Seminar, Glasgow, presentation of findings of research.

June 04 Safety & Health Practitioner, journal paper on research findings.

Printed and published by the Health and Safety Executive
C1.10 09/04

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