

INTEGRATION OF HEALTH AND SAFETY PLANNING IN CONSTRUCTION PROJECT MANAGEMENT THROUGH A BEST PRACTICE “GATEWAY” MODEL

B. Hare¹ A.R. Duff¹ and I. Cameron¹

¹ *School of the Built and Natural Environment, Glasgow Caledonian University,
Cowcaddens Road, Glasgow, G4 0BA, UK*

E-mail: B.Hare@gcal.ac.uk

Abstract: 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 authors have engaged in extensive industry consultation, including several group meetings and a number of 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. 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 as well as health and safety risks. If the model is to be implemented issues such as iterative design processes and construction beginning before completion of design needs consideration.

Keywords: Gateway, Health, Integration, Planning, Safety.

1. INTRODUCTION

When the UK's Health and Safety Executive (HSE) implemented the Construction Design and Management Regulations 1994 (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 many in the industry still struggle to properly integrate the management of health and safety throughout the planning 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 (CIOB 1991). It is estimated that up to 90% of accidents could be prevented (HSE 1988). Recent studies have found that planning and control failures were related to 45.4% of accidents (Duff and Suraji 2000), and designers could have contributed to the prevention of up to 47% of accidents investigated as part of an HSE research project (HSE 2003).

Effective planning for Health and Safety (H&S) is therefore essential if projects are to be delivered on time, without cost overrun, and without experiencing accidents or damaging the environment or the health of site personnel (CIOB 2002; Teo, F et al. 2005). For projects in the UK, the initial planning has to also consider the needs of those maintaining and cleaning the structure (HSE 2001). 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).

Today's construction project planning 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 (Atkinson 1999; Westerveld 2003). 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 and 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 postulated by the authors 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. RESEARCH METHOD

The research problem was posed by the authors as a submission to the UK's Health and Safety Executive (HSE), who funded the project over an 18 month period. This problem was "how best to promote the effective integration of health and safety management into construction project planning, communication and control". The method employed was adopted in response to the research problem. This problem is industry based. This invariably means the solution requires an applied research approach which attempts to resolve practical problems or improve on accepted, traditional thinking (Holt 1998). To solve this particular problem the method needs to deal with the perceptions and views of industry experts. Therefore a qualitative method of action research suits the needs of the research problem well (Fellows and Liu 1997; Naoum 2001). The type of action research required should facilitate feedback to allow improvements of the solution. Field interviews provide a useful method for data collection and satisfies this requirement (Naoum, 2001). Semi structured group interviews are suitable for exploratory data and structured one-to-one interviews are more useful for objective data collection, such as that of validation exercises (Naoum, 2001). These methods were adopted in line with the research objectives:

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 H&S.
3. Validate the model in order to improve it

In order to achieve these objectives a programme of work was devised and carried out in five overlapping phases which incorporated both group and individual interviews:

Literature search into construction project management; health and safety management, and CDM. Information on Gateways was also investigated.

Industry Steering Group; to advise on strategic direction, review progress and outcomes and obtaining access to current "best-practice" construction organisations.

Expert (Brainstorming) group interviews; covering maintenance; construction; and planning and design; to investigate critical "Events" or "Tools" that would both ensure compliance with CDM and add value to the management of the project.

One to one interviews; with industry practitioners, to assist in the development and validation of the model, based on their industry experience. This consisted of 12 in-

depth interviews with senior professionals responsible for H&S within contractor, design, maintenance and client organisations.

The remainder of the paper discusses the model developed as a result of this process. In most cases the interviewees agreed on general points, where differing points of view were expressed this is accounted for by qualifications in the text. This also helps increase the robustness of the findings.

3. PROCESS MODEL FOR CONSTRUCTION PROJECTS

Process models for construction projects have been in use for some time. For example, there is the traditional RIBA Plan of Work (RIBA 2000), the Association for Project management guidance (APM 2002) and more recently Salford's Process Protocol (Kagioglou, Cooper et al. 1998). Although these make useful guides, any attempt to be this prescriptive reduces flexibility and creates problems when trying to apply them to different procurement methods (Winch and Carr 2001). The UK Office for Government Commerce (OGC) model for construction procurement (OGC 2003) has been the main source of the model's structure, having two major advantages. Its flexibility allows various procurement routes to be adopted; and it is primarily for general project management purposes, rather than promoting additional, health and safety specific, gateways and procedures. The OGC 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" (OGC 2001). Whether the team is internal or independent, the process facilitates consideration of the critical aspects of a project at key points through its life, providing assurance that everything is in place prior to progressing to the next stage. The gateways can also be moved or repeated to align with the procurement method.

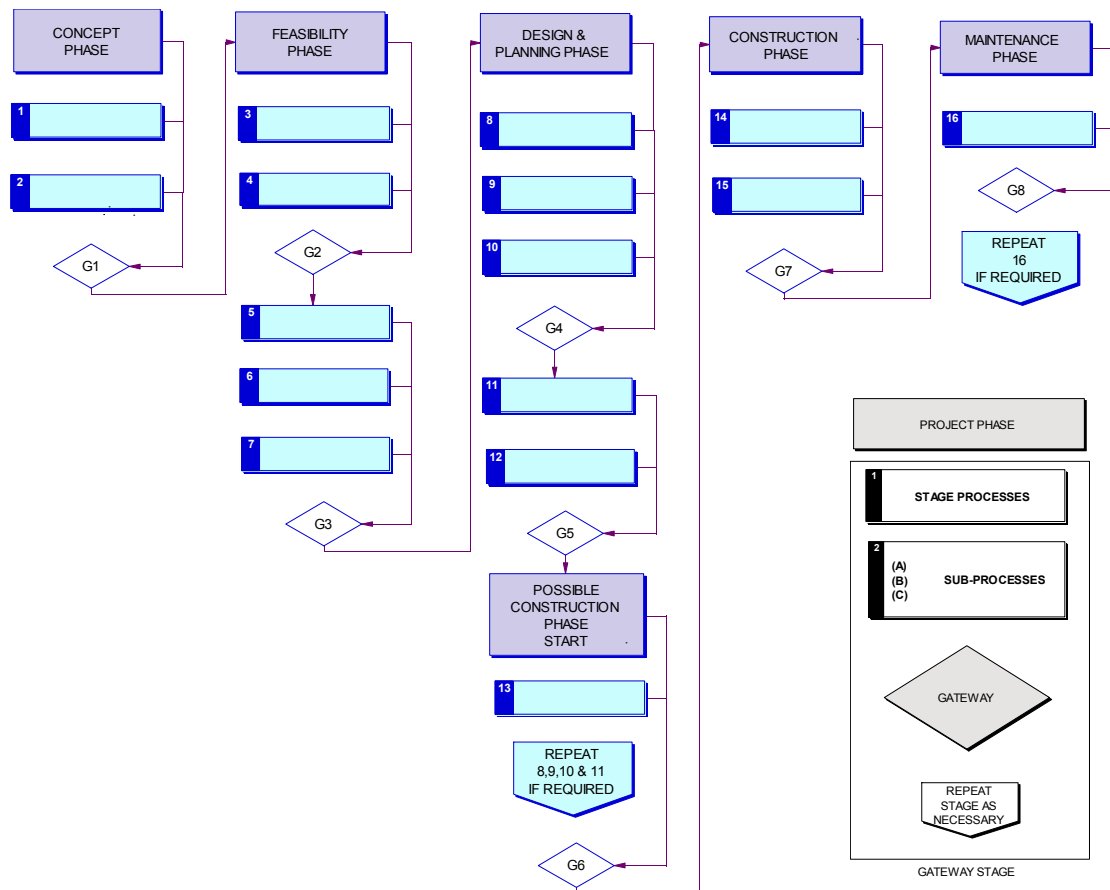


Figure 1: Gateway model for integration of health and safety

The model (Figure 1) shows a total of 8 gateways. Tables 1 to 5 show in more detail the processes required for each gateway phase, aligned to their project management processes.

4. PROJECT PHASES

4.1 Concept Phase

Table 1 shows the processes leading to Gateway 1. At this stage it is recommended that the client appoint a competent Planning Supervisor (PS) or health and safety advisor. Early appointment at this gate ensures compliance with the requirement to have the PS in place before commencement of design, which includes concept design. At gateway 1 it is expected that the strategic objectives have been set and strategic decisions taken.

4.2 Feasibility Phase

Table 2 shows the processes leading to Gateway 2 - Project Risk Assessment and Gateway 3 - Procurement Strategy. Whole life costing is 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.

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, including risk to health and safety.

Table 1: Concept 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.
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		
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 ACoP: Approved Code of Practice		

The preparation of the business case will require more detailed health and safety input. Key CDM milestones should be integrated into the programme at this point. 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 that the project is technically feasible, financially viable, plans are in place to manage the risks identified and timescales are realistic. All of which impact on health and safety.

Table 2: Feasibility Phase

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		
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.
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		

The Procurement Strategy Gateway stage sees development of the project brief. Health and safety Key Performance Indicators for the project can help focus attention. Best practice is now embracing behavioural indicators where concentration on safe acts will help facilitate continuous improvement. Gateway 3 marks the end of the concept and feasibility phases.

4.3 Design & Planning Phase

Table 3 shows the processes leading to Gateways 4 - Team Selection, 5 - Outline Design and 6 - Detailed Design. The Team Selection 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. Careful supply chain selection will always be a feature of well-managed construction projects and health and safety criteria should be seen as a key factor. OGC use a flow-chart which is an excellent guide to this process (OGC 2002). Gateway 4 is a critical point as it marks the move into the main design phase. Its main purpose is to confirm that the earlier plans are being implemented. This particular gateway can be repeated several times. The H&S Plan will need to be developed to a suitable degree before this gateway is signed off and sufficient time must be allowed for adequate completion.

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 must be considered. 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. A team building, health and safety workshop can both create a team spirit and aid hazard identification. Creating a Responsibility Chart will communicate the roles and responsibilities of each party, integrating health and safety responsibilities in a concise and transparent manner.

The design phase is one which can vary in complexity. Regardless of this, the key CDM functions to consider are design hazard identification and risk management. CIRIA Report C604 (CIRIA 2003) is a useful guide, HSE's new CDM website for designers features Red-Amber-Green lists (HSE 2003). These can highlight the main generic hazards to eliminate or avoid, as well as suggest good practice. It must be acknowledged that design is an iterative process. It is therefore recommended that several review points are included in the project programme to review buildability and maintainability. Gateway 5 may lead into the construction phase. Analysis of the method of construction goes hand in hand with the contractor's Risk Assessment. This Gateway should confirm that the design has progressed enough and no major client changes will be made. Changes are sometimes inevitable but a deadline for this goal is better than none at all. At detailed design the overall design should be well established, therefore the emphasis will be on development of specific details and the co-ordination of specialist contractors. This co-ordination that is necessitated by the design process should also lend itself to a **collaborative approach** to hazard identification and risk management.

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. Guidelines for site audits can be taken from publications such as HSG65 (HSE 2003).

Table 3. 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 vet supply chain. CDM requirements: competency and resources.
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	Decision via cost/performance criteria.	Ensure H&S criteria sufficiently weighted in decision.
GATEWAY 4 TEAM SELECTION		
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 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		
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. See 12 (C)	Per 12 (C)
14	Initial Works Contract	
		If Construction Phase started after Gate 5, see process 14 for details.
GATEWAY 6 DETAILED DESIGN		

4.4 Construction Phase

Table 4 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. Although the 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.

Gateway 7 marks the end of the construction phase. At this stage contractor and supply chain performance will be reviewed. 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.

Table 4: 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		

4.5 Maintenance Phase

Table 5 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.

Table 5: 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		

5. CONCLUSIONS

Views and experience of interviewees and discussion group members were gathered during the course of the research to develop and validate the model. It has been based on the OGC framework which has been recommended by *Accelerating Change* (Egan 2002) and *Revitalising Health and Safety in Construction* (HSE 2002). As such, the OGC model has already seen successful use in its application to construction projects. However, exploitation of the framework for improvement of health and safety planning has still to be fully realised.

Gateways, in general, have been proven to improve commercial success. The health and safety benefits of low contingency projects are obvious. It must be remembered, however, that the model is reduced from reality, and as such, can never be perfect.

With regard to the practical use of the Gateway model, a *conditional go* option at Gateways is not advisable. Although the incorporation of this as an option makes the process more flexible, there were concerns that weak managers would abuse it. Without good leadership the process will be in danger of becoming bureaucratic. Supporting tools, mentioned in the above text, have also been developed.

There are several factors peculiar to construction projects that need to be considered when implementing the model. 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. Secondly, the design process is often described as an iterative one. 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 model attempts to address these issues through its ability to repeat and overlap phases but only a full field trial will confirm its practical application.

Subsequent to the completion of this work HSE have incorporated gateway elements from this research into their proposed guidance for the new CDM Regulations and OGC have drafted new guidance for health and safety with their gateway model which also incorporates elements of this research.

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