Communication of construction health and safety information in design

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COMMUNICATION OF CONSTRUCTION HEALTH AND SAFETY INFORMATION IN DESIGN

by

Norhidayah Md Ulang

A Doctoral Thesis
Submitted in partial fulfillment of the requirements for the award of Doctor of Philosophy of Loughborough University

May 2012

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ABSTRACT

Occupational health and safety (H&S) is important to the design, construction, maintenance, refurbishment and demolition of buildings and facilities in all branches of industry, business and commerce. H&S issues have been a major consideration in construction. Far too many people get hurt, injured or die even though the situation has improved over recent years. Accident and fatality rates continue to be significantly higher than other industry sectors. Although all parties involved in the construction industry may address their respective responsibilities, the lack of integration between each organization often results in communication problems which jeopardize H&S. Of particular note is the communication during the design phase. All information pertaining to the project must be readily accessible for all parties, to ensure smooth and hitch-free project execution. This research reviews the challenges in the communication of health and safety information in the design phase of construction projects. It characterizes the various aspects of collaborative communications at this stage and highlights the problem area.

The research was conducted in the UK based on a combination of qualitative research methods including literature review, interviews and analysis of focus group interviews data. Observations on documentation and interviews are used to investigate the current industry practice. The literature reviews revealed that communication industry is facing challenges with its communication system due to the nature of industry itself. The construction industry is a fragmented and complex industry with too many parties involved in a project. These parties come from various backgrounds and involved in the project in a temporary duration. The parties who become team members must be able to establish a relationship
in such a short period of time and create a communication system that enables all of the parties to collaborate and interact with each other.

The barriers and challenges of the communication of H&S information in construction design are explored by interviewing the relevant key persons in the industry. The preliminary interviews conducted in two stages. The first stage was to investigate barriers, including potential limitations presented by conventional design practices. The second stage was mainly to investigate the flow of the H&S information in construction. In the preliminary interviews, the barriers, challenges and communication strength were also determined. The research further explored the issues in communication of construction H&S information in design by analysing data obtained from twelve focus groups, which was held for Prevention through Design (PtD) project. The factors that affect the H&S communication was determined by looking at each of the key person in the design phase. A model of Communication of Construction H&S Information in Design was then developed and validated to aid the designers to eliminate and reduce the impact of risks and hazards in their design.

**Keywords:** Construction Health & Safety, Communication in Construction, Communication of H&S Information, Design Phase and Construction Management.
ACKNOWLEDGEMENTS

ALHAMDULILLAH.

I wish to express my sincere thanks to all those who have contributed to the successful completion of my PhD research. I’d like to express the highest gratitude to my dear supervisors; Professor Alistair G. Gibb and Professor Chimay J. Anumba for their huge amount of help, patience, guidance, direction, information and perseverance and for having faith in me right from the very beginning of my research until the completion. Both of my supervisors are my source of motivation, encouragement and inspiration.

I would also like to extend my appreciation to my sponsors; The Ministry of Higher Education of Malaysia and my employer University Sains Malaysia for the funding they gave me for my PhD study. Finally, I’m very grateful to colleagues from Civil and Building Engineering Department, Loughborough University, my families and friends’ unlimited prayers and support. Thank you very much.
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CHAPTER 1
INTRODUCTION

1.1 Background

Construction safety is a serious concern to most construction companies, since accidents not only reduce productivity and damage equipment, but also injure human beings (Jannadi, 1996; Shabha and Rudge, 1997). Occupational Health & Safety (H&S) is relevant to all branches of industry, business and commerce. H&S issues affect all aspects of work, but solutions will vary widely. This may simply require a trained competent manager in a low-hazard organization. However, in a high-hazard sector, many different specialists, such as engineers (electrical, mechanical and civil), lawyers, medical doctors and nurses, trainers, work planners and supervisors may be required to assist the professional H&S practitioner in ensuring that satisfactory H&S standards are maintained within the organization. Jannadi (1996) found six important factors that most affect the construction industry:

- Maintaining safe work conditions
- Establishing safety training
- Educating workers and supervisors in good safety habits
- Effective control by the main contractor of the numerous subcontractors
- Maintaining close supervision of workers
- Assigning responsibility to all levels of management and workers

The construction industry has a reputation for having many reportable accidents, with construction workers approximately three times more likely to suffer from
fatal injuries than those in other sectors (Marsh, 1995). These appalling deaths occur despite a considerable volume of safety legislation aimed at improving safe working in the construction industry (Ridley, 1990).

Frick (1996) gives six reasons for poor H&S management performance:

- Limited resources
- Limited knowledge of regulatory requirements
- Poor awareness of the economic advantages of H&S
- Poor knowledge and understanding of safe working practices
- Short-term economic pressure and competition
- Inadequate enforcement and absence of preventive services

Ahonen (1997) states that whatever the reasons or combination of reasons for poor safety performance, they are clearly neither inevitable nor irresolvable consequences of enterprise size. Nevertheless, they do pose a challenge, especially when there are still major communication problems regarding the importance of having good H&S management throughout the construction industry.

Previous studies have found that design can influence H&S performance in a construction project (Gambatese and Hinze, 1999; Behm, 2005) and that risks and hazards are preventable (Ringen and Seegal, 1995). According to Behm (2005), design for H&S in construction can be defined as ‘the consideration of construction site safety in the design of a project’. In his study investigating the linkage between accidents and design on 224 fatality investigation reports, Behm (2005) found that 42% of the fatalities could have been avoided if the ‘PtD’ (Prevention through Design) approach had been implemented. As cited in Behm
(2005), the European Foundation for the Improvement of Living and Working Conditions (1991) came to the conclusion that 60% of fatalities in construction derive from decisions upstream from the construction phase.

Designers can positively influence H&S performance by integrating H&S into the design process (Gambatese and Hinze, 1999). Addressing the impacts of prevention through design has shown considerable positive outcomes to reduce construction site injuries and fatalities (Weinstein et al., 2005). One of the major issues in construction H&S is access to information (Ringen and Seegal, 1995). Due to the fragmented nature of the construction industry, effective communication has become a major challenge. Communication challenges among all parties involved in a particular construction project may result in an array of problems such as additional time needed for project completion, costs that exceed the budget and a lack of uniformity in design changes, including aspects of H&S. H&S issues in construction projects are critical and must be given the utmost attention. They must be the focus from the design phase through to the completion of the entire project.

Any negligence in project design or management may result in accidents or fatalities that will not only burden responsible companies in damages payments, but also tarnish company reputations and affect ongoing projects (Barber, 2002). In some other cases, the party responsible may face legal action and the claims and court process will waste valuable time and money (Hughes and Ferret, 2008).

1.2 Justification for the Research

The UK’s Construction, Design and Management (CDM) Regulations place a duty on all the principal stakeholders of a construction project to ensure H&S during the course of a construction project. One of the key elements of CDM requires the communication of safety information between all parties involved in a construction project.
The design phases in a project necessitate a continuous exchange of information between all the parties involved: client, designer, structural and mechanical engineers, quantity surveyor, supplier, CDM coordinator, contractor and sub-contractor, plus various specialists where required. The research project “Intelligent decision support to avoid collapses in structural refurbishment projects” (Kashyap, 2007) identified effective communication of all relevant structural and safety information as a key factor in completing a project safely. The communication of project requirements and of H&S information has to be organized at different stages and at different levels.

The first level of communication of project requirements is between the client and designers’ team as well as the CDM coordinator, where H&S problems need to be identified and eliminated, where possible, at the design stage as a requirement of the CDM Regulations. Therefore, the communication of design information and any assumed construction/project execution sequence is vital for the CDM coordinator to identify execution risks that can be eliminated or reduced at the design stage.

The second level of communication is between the designers. Project information has to be communicated in detail in order to share the architectural/engineering knowledge acquired during the design stage. This may result in modifications to parts of the design.

The third level of communication is between the designers and contractor’s team. Communication between designers and contractor during design changes is also vital. The exchange of information has to be mutual, because the contractor, through his experience and skill, may add additional considerations to the project. People on site need to understand the project, H&S information and what

---

1 The CDM Coordinator is a role specific to the UK. Other European countries use different terms and most projects outside Europe do not have this role.
they may find on site that could differ from what was foreseen by pre-construction investigations of the building to be constructed.

1.3 Aim and Objectives

The aim of this research is to investigate and model the content, processes, methods and effectiveness of the communication of H&S information between all parties involved in a construction project, particularly during the design phase.

The objectives of this research are as follows:

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<td>To review communication theories and explore their applicability to the communication of H&amp;S information in construction.</td>
<td>Literature review</td>
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<tr>
<td>2</td>
<td>To investigate current H&amp;S communication methods and strategies implemented for new build projects at the design stage.</td>
<td>Literature review</td>
</tr>
<tr>
<td>3</td>
<td>To determine the main H&amp;S issues to be communicated and the context in which such information needs to be communicated in design.</td>
<td>Preliminary interviews and focus groups</td>
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<tr>
<td>4</td>
<td>To investigate the potential for the use of various communication methods in the development of H&amp;S communication systems.</td>
<td>Preliminary interviews and focus groups</td>
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<tr>
<td>5</td>
<td>To develop and validate an integrated model for communication of construction H&amp;S information in design.</td>
<td>Model development and validation</td>
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1.4 Outline of Research Methodology

Qualitative research methods was used, including literature review, interviews, observations, focus groups and secondary data analysis involving large and small construction companies.

A combination of research strategies was utilised:

- Literature review on H&S in the construction industry and communication methods and strategies.
- Semi-structured interviews with designers, architects in particular, to address communication flow, methods, main content, barriers and challenges to H&S communication.
- Focus groups with representatives of various construction backgrounds – architects, engineers, H&S advisor, clients, quantity surveyors and suppliers.
- Development, validation and evaluation of a model for H&S communication in construction.
1.5 Thesis Structure

**OBJECTIVES**

To review communication theories and explore their applicability to the communication of health and safety information in construction.

To investigate current health and safety communication methods and strategies implemented for new build projects at design stage of different sizes and procurement routes.

To determine the main health and safety contents to be communicated and the context in which such information needs to be communicated in design.

To investigate the potential for the use of various communication methods in the development of health and safety communication systems.

To develop and validate an integrated model for communication of construction H&S information in design.

**PROCESS**

**CHAPTERS**

1. Introduction

2. Reviews on Construction Communication of H&S

3. Methodology

4. Preliminary Interviews

5. Focus Group Interviews

6. Review and Analysis

7. Model Development and Validation

8. Conclusion

**OBJECTIVES**

- How to achieve the objectives?

**CHAPTERS**

- What has been achieved?

**Figure 1.1: Thesis Structure**
Chapter 1 Introduction: briefly describes the background of the research. It includes the justification for the research as well as the aim and objectives. This chapter states the outline of the research methodology that will be discussed in detail in Chapter 4. It also gives an overview of the thesis structure.

Chapter 2 Communication of Construction H&S Information in Design: critically reviews the literature, including the relevant data, information, reports, statistics and issues raised by both academics and practitioners concerning construction H&S. This chapter then continues to present the findings from the extensive literature search to identify the core problems of adapting communication theories in construction H&S, the communication strategies in construction H&S, as well as identifying the existing barriers and challenges, methods and flow of communication. The findings from the primary literature review lead the research to identify the current issues raised in construction, particularly in H&S communication.

Chapter 3 Research Methodology: elaborates the research strategy, methodology and the methods adopted for the research into communication of H&S information in construction, namely literature reviews, interviews, focus groups, secondary data analysis, development of a framework and the evaluation and validation process. The importance of the methods adopted is also explained in this chapter in order to meet the aims and objectives of the research study.

Chapter 4 Preliminary Study and Analysis: presents the background of the preliminary study and the characteristics of the construction organizations that participated in the interviews. This chapter presents the findings from semi-structured interviews with architects as the lead designers, including H&S communication strength and flow, the methods of sharing information, barriers to H&S communication as well as suggestions for effective H&S communication in construction. The RIBA Plan of Work was used to demonstrate the construction
stages in order to investigate the flow of construction H&S information as well as
to determine the key person at each of the construction stages.

**Chapter 5 Focus Group and Analysis:** presents the background of each of the focus group delegates and the findings derived from the interviews. The focus groups were organized for the Prevention through Design project funded by the US Government via NIOSH (detailed information will be presented in Chapter 3 Methodology). The focus group comprised construction practitioners from various backgrounds such as designers, engineers, clients, H&S advisors, suppliers, contractors, CDM coordinators and quantity surveyors. The data obtained from the focus groups was analysed and summarized, for each focus group, to identify the broad themes related to construction H&S communication issues. The key findings are explained further in this chapter to identify the flow and strength, barriers and challenges, and suggestions from practitioners for effective H&S communication in construction.

**Chapter 6 Key Findings and Discussion:** highlights the key findings from both preliminary interviews and focus groups. The discussion of the key findings determines the flow and strength of H&S communication in construction and identifies factors contributing to barriers and challenges to effective communication. In the discussion, the views and opinions of the practitioners participating in the interviews regarding improvement of construction H&S communication are analysed.

**Chapter 7 Model Development and Validation:** describes the development of a construction H&S information communication model using the key findings and discussion from Chapter 6. The model was developed by applying the HSE Guidance for Designers – Eliminate, Reduce, Inform and Control (ERIC) and then validated via interviews with practitioners.
Chapter 8 Conclusions: summarises the processes and findings of the research study. The findings are concluded and the limitations of the research are discussed. This chapter also presents the contributions to construction H&S knowledge and highlights recommendations for further research.
CHAPTER 2

COMMUNICATION OF CONSTRUCTION H&S INFORMATION IN DESIGN

2.1 Introduction

“Communication is one of those everyday activities that is intertwined with all of human life so completely that we sometimes overlook its pervasiveness, importance and complexity” (Littlejohn and Foss, 2008). They believe that by understanding communication theories, one can develop certain important communication skills, which enable us to develop habitual thinking, to become more adaptable, flexible and more sophisticated in communication. Studies of communication began in antiquity but have been actively researched since the early part of the twentieth century. According to Stone et al. (1999), the oldest essay ever found was written in Egypt in 3000 BC and included advice on how to communicate effectively. Specific interest arose after World War One with advances in technology, and literacy became the topic of concern (Littlejohn and Foss, 2008).

In general, communication theories can be divided into two major divisions: human communication and mass communication. These consist of four sub-divisions: 1) interpersonal, 2) group, 3) organizational and 4) mass communication (Stone et al., 1999). In order to further understand the fundamentals of communication, communication models are used to demonstrate and elaborate the elements of communication. Shannon and Weaver’s Mathematical Theory of Communication (1949) is widely accepted as the pioneer in modern communication research (Fiske, 1990) and used in modern communication study even though it has been criticised because of its simplicity (Emmitt and Gorse, 2003).
This model is used to explain the basic communication elements of a communication process. The model consists of five elements of communication: information source, message, transmitter, signal, receiver and destination. Although this model demonstrates a linear communication system, it helps to understand how basic communication happens. Further discussion regarding communication elements will be included in section 2.2 of this chapter.

The effectiveness of communication relies on many factors. Dainty et al. (2006) summarize four factors that enable communication: the effectiveness of encoding and transmitting information through communication systems; channel and network; the suitability of communication medium and channels; reactions of the receiver and the abilities to control noise. Titus and Brochner (2004) suggest that sharing information is a key component of effective communication. On the other hand, according to Cheng et al. (2001), the significant reasons for ineffective communication are closed lines of communication due to protocols, unsuitable communication channels and unexpected communication breakdown. They add
that information overload, lack of openness and filtering of information may increase the lack of communication efficiency. The factors that affect effective communication of H&S information in construction will be discussed further in section 2.7 of this chapter.

Although this study focuses on personal communication, the influence of IT (Information Technology) or ICT (Information and Communication Technology) cannot be dismissed when exploring the current communication trend. IT rapidly developed in the 1990s and provided choices for easier means to transmit, store and access huge amounts of information quickly (Emmitt and Gorse, 2003). IT or ICT can be regarded as technology being utilized to manage data and knowledge (Klinc et al., 2010). IT has a significant impact on accessing data and information. However, it seems that attention is being overly paid to the speed of new technology rather than the information transmitted, and this has overshadowed the importance of human interaction (Emmitt and Gorse, 2003).

Another main focus of this research is construction H&S information in design. Construction has a reputation for poor H&S performance and consistently exhibiting poor accident records (Edwards and Nicholas, 2002). As in other countries worldwide, the construction industry in the UK has a poor record of H&S performance, with roughly three times more workers expected to suffer from injury than workers in other sectors (Marsh et al., 1995). Traditionally, the main contractor is the person who bears the responsibility for H&S risks (Hare et al., 2006). The introduction of the Construction (Design and Management) Regulations (CDM) in 1994 addressed the roles and responsibilities of each of the construction team members for H&S in construction projects. The CDM Regulations emphasize the importance of safety management and require the development of a safety culture (Langford et al., 2000).

The UK is subjected to legal directives which must be interpreted and implemented as part of European Union membership (Griffiths and Griffiths,
The CDM Regulations were revised in 2007 with new obligations specifically for clients, designers and contractors, and generally further engaged the project team members (Griffiths and Griffiths, 2011). CDM 2007 introduced the CDM Coordinator or CDMC as the replacement for the Planning Supervisor, introduced when CDM was launched in 1994. The CDMC, according to Barrett (2008), is the ‘person’ who ‘is bound to coordinate with the other persons upon whom duties are imposed by the regulations to ensure the H&S of persons carrying out and affected by the construction work’.

In order to investigate the communication of construction H&S information in design, the design stage must be well identified. The definition of the design stage is very much influenced by the procurement method of each project. According to the RIBA Plan of Work (RPoW), the design stage in construction consists of the outline proposal that begins when the architect’s brief has been determined in sufficient detail and continues until the tender action stage. In other words, in theory at least, during the design stage in construction, all the necessary information and arrangements to obtain the contract have been prepared and completed. The RPoW is derived from the traditional, ‘design and then build’ procurement method and has 11 stages; Appraisal, Design Brief, Concept, Design Development, Technical Design, Production Information, Tender Document, Tender Action, Mobilisation, Construction to Practical Completion and Post Practical Completion. In this research, the RpoW has been used to determine the construction activities at each phase. Further discussion is included in section 2.4.

It is very crucial that, during the design stage, careful planning is undertaken to ensure the smoothness of the project. At this stage, the amount of interaction among all the team members is constant. The clients expect a complete and detailed design, and the hired designers (such as the architect, engineers and other specialists) work to meet the clients’ requirements.
In construction, effective communication is very important, because many parties are involved in a project. These parties may consist of those who are strangers to one another (Dainty et al., 2004), cooperating temporarily in a construction project, which is known to be complex (Peansupap and Walker, 2005; Craig and Sommerville, 2006), highly competitive and fragmented (Ng et al., 2000), time and cost constrained (Wong et al., 2004), as well as having a complex communication nature (Charoenngam et al., 2003). These factors can create a problem if the communication systems of a construction project are not properly designed.

According to Church (1996), it is communication that enables people to coordinate, collaborate and make important decisions that would affect many individuals or a group of people that are united as an organization. A construction project involves feasibility, design, construction and maintenance phases that require the project team members to communicate the underlying knowledge effectively (Peansupap and Walker, 2005). In many situations, effective communication is often overlooked until something goes wrong (Emmitt and Gorse, 2003), such as accidents, falls and fatal injuries. Further elaboration regarding communication theories and their application to the construction design phase will be presented in the following sections.

2.2 Definitions of Communication & Communication Elements

Effective communication is an essential ingredient. There is much discussion in the academic world about what actually constitutes communication. Currently, many definitions of communication are used in order to conceptualize the processes by which people navigate and assign meaning.

Skyttner (1998) states that ‘communication applies to all sorts of transference in one or more directions of matter (of objects), energy or information. The problem of communication can be formulated as ‘making a representation in one place of a representation already present in another place’.
Shannon and Weaver (1949) broadly define communication as ‘all of the procedures by which one mind may affect another’.

‘Communication is the process by which individuals share meanings. More precisely, it can be defined as a “transactional process between two or more parties whereby meaning is exchanged through the intentional use of symbols” (Engel et al., 1994).

‘Communication is a process that is intentional: a deliberate effort is made to trigger a response. It is a transaction, and the participants are all involved in a symbolic interaction, in which words, pictures and other stimuli are used to convey thoughts’ (Blythe, 2000).

Therefore, communication can be defined as intentional procedures that transfer energy or information in one or more direction through the intentional use of symbols.

There are many communication models that describe communication elements and processes. According to Narula (2006), communication models can be categorised as linear and non-linear. Linear models describe simple communication act from the speaker (source) to the audience. On the other hand, in non-linear models a message flows in more than one direction (Narula, 2006). To demonstrate a linear communication, Shannon and Weaver’s Mathematical Theory of Communication (1949) and its communication elements will be elaborated further. The Shannon and Weaver’s Model was selected to explain the basic communication elements in detail.
The model consists of five elements of communication: information source, message, transmitter, signal, receiver and destination.

**Information Source (sender)**
The sender will respond to a stimulus, internal or external, and will create a message. The sender will encode the message in appropriate verbal or non-verbal symbols. The message will then be transmitted through a medium to the receiver. According to Skyttner (1998), human communication may be summed up by two transformations. The sender must make clear to him/herself exactly what to communicate. He/she must choose symbols which externalize the internal content (sound, gestures, bossy motions, words, intonation, etc.). Skyttner (1998) regards this as ‘the first transformation’.

*Figure 2.2: Mathematical Theory of Communication. Adapted from Shannon and Weaver (1949)*


**Message**

‘A message is composed of one or more signs consisting of signals and/or symbols, while the sign is everything which can be taken as adequately substituting for something else’ (Skyttner, 1998).

**Signal**

According to Skyttner (1998), a signal relates to the world or an object we can see and interpret, while symbols and language relate to abstract elements that our minds can interpret.

**Receiver**

The receiver gets the messages from the sender and decodes the message, interprets it and reacts or responds to it. It must be noted that the sender and the receiver should share a symbol that will carry the same meaning for both. If they do not, misunderstandings will occur. The second transformation, explained by Skyttner (1998), happens when the receiver must assimilate these symbols despite disturbances; that is, hear the transmission, know the language used and interpret nonverbal information. He/she must thereafter integrate all received symbols and transform them into internal content.

**Schramm’s Model of Communication**

Schramm’s Model of Communication (1954) emphasizes the process of encoding and decoding a message (Schramm, 1954). In addition to the six elements of Shannon and Weaver's communication model, Schramm incorporates feedback (Figure 2.3) and field of experience (Figure 2.4) concepts. The feedback concept is based on the receiver’s message to the sender while the field of experience is based on the individual’s beliefs, values, experiences and learned meanings as an individual or as part of a group.
Communication of Construction H&S Information in Design

Figure 2.3: Adapted from the Diagram of Schramm’s Feedback Loop

This diagram shows the message from one person (the sender) being conveyed to the other person (the receiver) who will decode and interpret the message. Reaction from the receiver will be encoded in a message and it will be conveyed back to the sender. This process is essential in the communication of construction health and safety information particularly in the design phase. For example, in a meeting during the design proposal phase, when the designer is trying to present his or her idea but it creates construction risks that could be avoided, the client or the CDMC must give feedback to the designer and tell him/her that the idea will result in H&S problems. This process will happen in a cycle until both parties are satisfied with the information they receive from one another.

Schramm (1954) further explained that a message can be interpreted differently by different people based on their beliefs, values, experience and learned meanings as illustrated in Figure 2.4. The difference in interpretation can be complicated therefore cyclical communication is essential as the sender and receiver will be able to repeat the communication process until all parties involved in the communication process understand the message.
Schramm’s model, although less linear, it still counts only for bilateral communication between two persons. The multilevel communication is still beyond this model.

It is well known that many people are involved in a construction project, such as the client, designers, engineers, contractor’s team, workers, and suppliers. The communication process in a construction project can vary between two individuals (linear) or more than two people (non-linear) such as in meetings. The linear communication process is easy to comprehend. The non-linear communication process is more complicated as more factors need to be considered to ensure the receiver gets the right message that the sender is trying to convey. There are many models that describe the non-linear communication such as Transactional Model of Communication (2009), Dance’s Helical Spiral (1967), Westley and McLean’s Conceptual Model (1957) and Becker’s Mosaic Model (1968). However, to describe the non-linear communication in construction, the Transactional Model of Communication will be explored, as shown in Figure 2.5.
The Transactional Model of Communication illustrates that the communication elements are interdependent. Each person in the communication circle acts as speaker and listener as well as simultaneously sending and receiving information. The implications of the model can be related to communication of H&S information in construction such as:

- ‘Transactional’ can be defined as ongoing and continuously changing process (Wood, 2009). The communication of construction H&S information in a construction project is a continuous process from the beginning of the project until project completion. The clients must produce certain H&S information for designers and this information will be conveyed to the CDMC, quantity surveyors, engineers, contractors, sub-contractors and so on. The communication process continues as long as the H&S information is being shared and highlighted to all team members to ensure people involved in the project are aware of the risks and hazards and of methods to resolve the issues, until the project completion.
• In the Transactional process, the communication elements are interdependent (Wood, 2009). The communicator A and B (in the model) acts as sender and receiver simultaneously. The outer line of the model indicates that the communicators share the same situation or system. In this case, both communicators are in the same construction project.

• Each person in the communication acts according to factors such as their background, experiences, attitudes, cultural beliefs and self-esteem (Wood, 2009). It is crucial for the construction experts involved in a construction project to give feedback on H&S issues based on their knowledge, background and experiences in regards to H&S in construction. Collaboration among team members in a project would solve most H&S issues more effectively. For example, the early involvement of the CDMC helps to coordinate H&S information that can be used in the particular project. Participation of the contractor in the design phase would benefit the project as the contractor would share his knowledge to eliminate or reduce risks and hazards based on his knowledge from past experience.

**C-HIP**

Another model that can describe communication and its elements is the Communication – Human Information Process (C-HIP) model, shown in Figure 2.3. This model was developed in 1997 and revised in 1999, and was intended to organize and structure the findings in warning research (Wolgater, 2006). The model consists of communication components such as the source of information, the channel for delivering the communication and the characteristics of the receiver as well as social-cognitive elements such as the attitudes and beliefs of the information source (Wolgater et al., 2002).
The first part of this model illustrates the simple communication process (Wolgater, 2006). Each phase of the model enables the information to flow through to the next stage, or a bottleneck may occur which blocks the flow before the process ends in behavioural fulfilment (Conzola and Wolgater, 2001). The components of this model are elaborated below.

**Source**

In regards to the model, Conzola and Wolgater (2001) state that 'a source is the originator or initial transmitter of the risk information'. In regards to general
communication processes, a source or a sender is the person who responds to a stimulus to send any message to one or more persons. The message will be encoded and transmitted to the receiver via a medium chosen by the sender. The medium can be any means of communication such as conversation, writing, signs and symbols.

**Channel**

The channel is how the information is transmitted to one or many receivers (Conzola and Wolgater, 2001). According to Conzola and Wolgater (2001), there are two basic dimensions of the channel in terms of warning of risks and hazards. First is the media in which the information is embedded, such as posters, brochures, labels and oral presentations. Another type of communication channel is via visual means such as symbols and text warnings and via audio means such as an alarm or voice recording.

The second part of the C-HIP model focuses on the receiver and how the receiver processes the information received (Wolgater, 2006).

**Receiver**

According to Conzola and Wolgater (2001), the receiver’s mind processes the message from the sender in a few stages. In order for the warnings (of risks and hazards) to be highlighted, the message must catch the attention of the receiver and cause the receiver to extract the necessary information. The process occurs in stages, as follows (Conzola and Wolgater, 2001):

*Attention Switch*

An effective warning must attract the attention of the receiver. The message from the sender must stand out, as in the environment there are other messages that will attract the receiver’s attention and distract from the warning message.
Attention Maintenance

Attention maintenance means the message received from the sender must attract the attention of the receiver long enough to ensure that the receiver encodes the message and understands it. In some cases, the receiver gets a message but does not encode it, thus the message from a symbol or picture about the warning is not extracted and understood.

Comprehension

A warning message must be understood by the receiver. According to Wolgater (2006), a warning message must include these factors to attract the receiver: hazard information; instructions of what the receiver should and should not do regarding the risks and hazards; consequences of the warnings and safety symbols. According to Conzola and Wolgater (2001), the comprehension of a message should be written according to the lowest level ability of the population.

Attitudes and Beliefs

According to the C-HIP model, the success of the warning is very much dependent upon the receiver’s beliefs and attitudes (Conzola and Wolgater, 2001). For example, if the receiver believes that a product or an action has a certain impact on them, they search for a warning. It is almost the same situation with attitude. If the receiver believes that the product or their action has a certain impact on them, they will be more careful and take cautious action in using the product or executing the action.

Motivation

Motivation energizes the receiver to carry out the action to avoid the consequence of risks and hazards. Although, according to Wolgater (2006), cost, time and effort are associated with preventing risks and hazards, the receiver is
ready to comply when they are motivated. The environment motivates the receiver of the warnings to take action to prevent risks and hazards.

**Behaviour**

If the warning of the risks and hazards attracts the receiver’s attention, and the messages are encoded in such a way that the true message motivates the receiver, the receiver will exhibit warning-directed behaviour (Conzola and Wolgater, 2001).

**Suitability of C-HIP for this thesis**

The C-HIP model relates best to communication where the receiver is the person at risk and hence there is some degree of stimulus to listen, understand and respond. However, during design, the parties are not themselves at risk and so the model is less relevant to this thesis than Shannon & Weaver's model. The C-HIP model would be appropriate for communication to workers during the construction phase.

**2.3 Construction Industry & Construction H&S**

The construction team can be summarized as a group of specialists who carry different values and intentions for a specific purpose in a construction project (Emmitt and Gorse, 2007). Team members possess different skills, and each sets out to be self-sufficient (Cheng et al., 2001). According to Craig and Sommerville (2006), ‘construction projects are highly complex collaborative events involving many different bodies and organizations, e.g. clients, designers, consultants, contractors and inspectors’.

Construction is known for its poor reputation in H&S (Ringen and Seegal, 1995; Gyi et al., 1998; Murie, 2007). It is considered to be hazardous, dirty, difficult and dangerous (Murie, 2007). Workers in construction are at risk of fatalities and
injuries (Ringen and Seegal, 1995) and being exposed to diseases such as lower respiratory disease, pneumoconiosis, skin disease, musculoskeletal disorders, poisoning (Gyi et al., 1999) and many more complications such as deafness, vibration syndromes, back injuries, exposure to hazardous substances, dust and stress (Murie, 2007).

According to HSE UK (2011), in construction for there were 50 fatal injuries in 2010/11, with a rate of 2.4 deaths per 100 000 workers. The following table shows the numbers of fatal injuries for 12 months from 1 April 2010 until 30 March 2011.

<table>
<thead>
<tr>
<th>Main industry SIC2007</th>
<th>Agriculture</th>
<th>Extractive; gas and electricity supply</th>
<th>Manufacturing</th>
<th>Water supply; sewerage, waste and recycling</th>
<th>Construction</th>
<th>Services</th>
<th>All Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees</td>
<td>13</td>
<td>3</td>
<td>25</td>
<td>10</td>
<td>32</td>
<td>37</td>
<td>120</td>
</tr>
<tr>
<td>Self employed</td>
<td>21</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>18</td>
<td>10</td>
<td>51</td>
</tr>
<tr>
<td>Workers**</td>
<td>34</td>
<td>3</td>
<td>27</td>
<td>10</td>
<td>50</td>
<td>47</td>
<td>171</td>
</tr>
<tr>
<td>Members of the public</td>
<td>8</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>305</td>
<td>318</td>
</tr>
<tr>
<td>Total fatalities</td>
<td>42</td>
<td>3</td>
<td>29</td>
<td>11</td>
<td>52</td>
<td>352</td>
<td>489</td>
</tr>
</tbody>
</table>

Table 2.1: Numbers of fatal injuries 2010/11 (HSE, 2011)

From the table, it can be seen that construction industry records second high in fatalities among other industries in the UK. Nevertheless, the rate has been decreased from 2.8 deaths per 100 000 workers in the previous five years to 2.4 per 100 000 workers (HSE, 2011). In addition to its poor H&S record, construction is also known for being highly fragmented, resulting in low productivity, high costs and time overruns, conflicts between team members as well as time-consuming litigation (Mohamed, 2003). Although there has been improvement over the years, there is still much that should be done (Bilbao Declaration, 2004; Gyi et al., 1999).

Generally, many factors contribute to the poor performance in construction H&S such as the lack of or poor ‘site conditions, site tidiness, availability of technical
resources, inter and intra-group cooperation, control and supervision of work, effective long-term planning, role and position of safety officers and safety representatives and pay structure, care and attention by the individual, skill and experience brought to the job, safety training, origins of safety norms, accuracy of subjective risk evaluations, perceived responsibilities and feeling of competent autonomy or fatalism’ (Langford et al., 2000).

Ringen and Stafford (1996) identified communication as a major challenge for construction due to its complex nature. The construction players must share up-to-date information to minimize errors, decrease delays and avoid the rework cycle (Mohamed, 2003). However, ‘the life of a construction project is a phased process’ (Behm, 2005). This has been a barrier to smooth information sharing.

Separation of the design phase from the construction phase disables the construction team members from communicating frequently and delivering H&S information from the client to downstream stakeholders. A research study by Gibb et al. (2004) shows that changes in design can reduce the likelihood of accidents happening. Behm (2005) conducted an investigation into two hundred and twenty-four accident reports and found that 42% of the fatalities could be linked to the design concept. What is identified as missing in these two studies is the connection between the design phase and the construction phase; one of these missing links is the communication of H&S information.

Communication challenges among all parties involved in a particular construction project may result in an array of problems such as an addition in the time needed for project completion, costs that exceed the actual budget and a lack of uniformity in design changes, including aspects of H&S. H&S issues in a construction project are very critical and must be given utmost attention. H&S must be focused on from the design phase to project completion.
2.4 The Construction Design Process

To some extent, the word ‘design’ can be described as generic. It is the end product that we have to pay attention to simply because different designers produce different design products depending on their domain (Lawson, 2005). ‘Process’ can be defined as a dynamic entity that can change during its enactment (Tuzmen, 2002). Rampersad (1995) defines a design process as translating customers’ order or instructions into prescriptions and the use of a system. According to Rampersad, a good design process is derived from mutual communication between designers and the client to solve problems as well as achieving the aim and objectives. McGrath and Hollingshead (1994) state that a good design group is characterized by internal communication, external communication, information sharing, and decision-making.

The design process, although separated from other construction processes, is not an isolated phase of construction. It normally runs parallel to other construction activities such as the early construction phase, site clearance or site investigation. In their research focusing on interfaces between the design and construction stages, Mitchelle et al. (2010) argue that the design stage does not proceed separately. It is rather done simultaneously with other processes such as primary site works, the appointment of new project team members and so on. During the design phase, the other specialists needed for design completion will also be hired. These specialists or subcontractors will add more details to the existing massive amount of information. One of the most critical pieces of information that needs to be highlighted during the design phase is H&S information.

The RIBA Plan of Work (RpoW) is a construction framework that is widely adopted by the construction industry in order to identify the main stages in the construction process (Emmitt and Gorse, 2003).
**Preparation**

3. Appraisal Stage
Stage A involves the identification of the client’s requirements and any possible constraints on development. Studies to enable the client to decide whether to proceed and to select the probable procurement method are prepared. The latter is a particularly important decision, as it will determine the way in which project resources, responsibilities and risks are apportioned between the client and its consultants and contractors.

B. Design Brief
This is the preparation of a general outline of the requirements and planning of future action on behalf of the client, with the client confirming the key requirements and constraints. Procedures are identified and procedures and organisational structures established. A range of consultants and others are engaged for the project. The strategic brief is a key output from this stage and becomes the clear responsibility of the client.

**Design**

C. Concept
In Stage C, the designers provide the client with an appraisal and recommendation in order that they may determine the form in which the project is to proceed. They must ensure that it is feasible functionally, technically and financially. At this point, the development of the strategic brief into the full project brief begins and outline design proposals and cost estimates are prepared.

D. Design Development
Stage D determines the general approach to the layout, design and construction in order to obtain authoritative approval of the client on the outline proposals. The project brief will be fully developed and detailed proposals will be made and
compiled, generally in a ‘Stage D’ report. The application for full development control approval will be made at this point.

E. Technical Design
This stage sees the completion of the brief, with decisions made on the planning arrangement, appearance, construction method, outline specification and cost of the project. All approvals will be obtained at this stage, including for Building Regulations.

In effect, during this stage, final proposals are developed for the project sufficient for the coordination of all its components and elements to realise the construction.

Pre-construction

F. Production Information
Final decisions on every matter related to design, specification, construction and cost should be made in Stage F. For a traditional procurement process, production information is first prepared in sufficient detail to enable a tender or tenders to be obtained. Any further production information required under the building contract to complete the information for construction is then prepared. All statutory approvals should be obtained by the end of this phase.

G. Tender Document
In Stage G, the team prepares and collates tender documentation in sufficient detail to enable a tender or tenders to be obtained for the construction of the project. It should be noted that this stage, and Stage H, are much more relevant to traditional forms of procurement. With other procurement routes, some form of evaluation of suitability to construct the project occurs, but often not in the simplistic manner suggested by the RpoW.
H. Tender Action
At Stage H, all information and arrangements for obtaining tender(s) are prepared and completed. Potential contractors and/or specialists for the construction of the project are identified. Tenders are obtained and appraised, with recommendations made to the client body or steering group to allow an appointment to be made. It is important that the contractors’ understanding of, and commitment to, the project vision and its sustainability is tested at this stage. This can be achieved by the inclusion of this as a key selection criterion early in the procurement process.

Construction

3. Mobilisation
At Stage I, the building contract is let and the contractor appointed. Production information is issued to the contractor and the site is handed over to the contractor.

J. Construction to Practical Completion
Here, the contractor programmes the work in accordance with the contract and commences work on site. The client or their representative – the architect in traditional procurement – administers the building contract up to and including practical completion (this is the point at which the contractor hands back ownership of the site and the completed project to the client). Further information is supplied to the contractor as and when reasonably required.

Use
L. Post Practical Completion
This stage is clearly separated from the construction phase. Final inspections are made to ensure specifications have been met. In addition, the final account is settled.
The model, as demonstrated in Figure 2.4, was developed by Markus (1969) and Maver (1970), demonstrates the elements in a linear design process; however, the shortcoming of this model is that it does not allow for flexibility to reframe the brief and overall concept if problems appear in the design process (Lawson, 1997).

Figure 2.7: Markus/Maver map of the design process (Lawson, 1997)

Figure 2.8: A Generalised Map of the Design Process (Lawson, 1997)
The model developed by Lawson (1997) was intended to overcome the weaknesses of the model developed by Markus (1969) and Marvel (1970). The generalised map of the design process by Lawson (1997) has three main elements: Analysis, Synthesis and Evaluation. The Lawson design map has two differences that overcome the weaknesses of the previous model (Abadi, 2005). Firstly, Lawson’s model allows for return loops from each function to the previous function. This allows modifications to be made to the design if the solution to the problem arises or the design development fails. The design process must restart from the previous stage. Secondly, Lawson (1997) believes that the design process is one huge process that includes analysis, synthesis and evaluation of the design. Therefore, it is impossible to determine the stages detailed in Markus (1969) and Marvel’s (1970) model – outline proposal, scheme design and detail design.

2.5 Different Procurement Routes and Their Effect on Relationships between Parties

There are a number of different procurement routes for construction projects in the UK. The difference in procurement routes practiced by different organizations influences the way all information is communicated, including H&S information. The main routes that are relevant to this study are Traditional, Design and Build and Partnering or Framework Agreements.²

² It is acknowledged that there are many variants on these procurement routes, but this broader discussion is outside the scope of this thesis. This section has concentrated on the routes that have the most effect on communication flow and that were relevant to the research interviews.
Traditional Method

In the traditional procurement method, the developer of the project separately employs the designer to design and the contractor to build. The contractor is the sole party responsible for the construction phase (McCann, 2008).

In traditional procurement methods, as illustrated in Figure 2.9, the design stage is separated from the construction phase. The designers are not involved in construction tasks and activities, and likewise, the contractor is not normally involved in the design. Therefore, the contractors will construct the project based on their understanding of the design given to their team. This can be a barrier to H&S communication between designers and contractors for many reasons, including:

1. Failure of CDMC to coordinate the H&S information between the designers and the contractor.
2. H&S information from clients and designers is written in a thick document that will possibly be ignored by the contractor’s team.
3. Communication in the design phase can be both formal and informal. In formal H&S communication such as meetings, it is possible for the designers or the CDMC to track the crucial H&S information and compile the information for the team members to use. But in informal or individual communication, it is impossible to record all of the H&S information.

**Design and Build**

![Design and Build Diagram](image)

*Figure 2.10: Design and Build Procurement Route (McCann, 2008)*

As can be seen in Figure 2.10, in design and build, a contractor employs the design team and is responsible for both the design and construction phases. McCann (2008) states that, although responsibilities are combined, communication between the parties is still required. It should also be noted that the client or developer will usually employ a designer to complete some initial scheme designs, which are then passed to the contractor. This initial designer may then be employed by the contractor, or the contractor may employ a different design organisation.
Partnering / Framework Agreement

To establish framework agreements, single suppliers or a limited number of suppliers can be appointed at the same time (Skills Funding Agency, 2011). According to the Skills Funding Agency, framework agreements enable the ‘suppliers’ to be brought together with the appropriate skill and experience, which can result in savings to all parties, particularly where a number of projects are involved. It is important to note that ‘suppliers’ in this case includes the designers as well as construction and materials organisations. These arrangements will typically be long term, such that the different parties become familiar with one another and many of the protocols and procedures become standardised. Therefore, communication among the team members is much more straightforward, as the relationships between them are well established.

As illustrated in Figure 2.11, Contractor A will build two schools and Contractor B will build another two. These projects have been created for a period of time, which are normally of a long duration. This method benefits the user in terms of a clear definition of project output, significant scope for innovation and the opportunity to transfer certain risks to the private sector in government projects. According to Hughes et al. (2006), their research showed that many companies are engaged in collaborative practices. However, although the contractor and supplier are brought into the team at the beginning of the project, which benefits H&S communication, their early appointment, especially of the contractors, is associated with costly negotiations and serious commitment. These factors slow down the implementation of the project.
2.6 H&S Communication during the Design Phase

In this section, Shannon and Weaver’s Mathematical Model of Communication Theory (1949) will be used as a framework to discuss H&S communication processes during the design phase as well as highlighting the actors involved based on the RpoW and the CDM Regulations.

As discussed in Chapter 1 (section 1.2), the first level of communication of project requirements is within the client’s team and the designers as well as the CDMC, during which H&S problems need to be identified and eliminated, where possible, as a requirement of the CDM Regulations.
Figure 2.12: First Level of Communication between the Client’s team and the Designers & CDMC (adapted from Shannon & Weaver, 1949)

As seen in Figure 2.12, in the first level of communication (between the client’s team and the designer and CDMC, the primary sender is the client. The client is the initiator (sender) and the party which will propose a construction project. The client approaches the designers (receiver) and messages will be sent to the designers via a communication channel chosen by the client. Typically, these will be documents and drawings supplemented by meetings and discussions. The designer will encode the message and respond to the client (feedback). The CDMC at this stage should be in a central position between the client and the designer to coordinate and facilitate H&S information from the client and designers. In this way, the CDMC helps the designers to decode the messages from the client and encode feedback information.

The second level of communication is among the designers. Project information has to be communicated in detail in order to share the architectural/engineering knowledge acquired during the design stage. This may result in modifications to parts of the design.
The second level of communication is between the designers of the project. At this stage, the designer acting as the project manager (typically the architect) will be the sender of the first message to other designers (receivers). And, likewise, the other designers will respond (feedback) to the initiator of the communication, and a series of H&S communication will occur. At this stage, in terms of H&S, the designers will share expertise and knowledge and refine the design. The outcome of the collaboration in terms of H&S issues in the project will be recorded and managed by the team members, namely the CDMC. The CDMC should actively facilitate and coordinate the H&S information and make it available to all team members.

The third level of communication is between the designers and the other team members including contractor’s team. The exchange of information has to be mutual because the team members especially the contractor, through their experience and skill, may add additional considerations to the project.
At this level, the designers or the CDMC of the project will be the sender of the construction H&S information (messages) to the other team members (receiver). At this stage, the channel of communication can be verbal, written, such as the preliminary H&S file or contract conditions, or via drawings and notes on the drawings prepared in the design stages.

The series of H&S communications that occurs among the team members will result in a complex situation or a ‘spider-web’ network (Ruikar et al., 2003), as shown in Figure 2.15. This affects the smoothness of the communication of construction H&S. Many barriers and challenges derive from this situation as well as other factors that affect H&S communication in construction. According to Cheng et al. (2001), a massive amount of information is shared between parties in a construction project; therefore, poor communication results in misunderstanding, misinterpretation and the information being ignored.
2.7 Factors Affecting Construction Communication

There are many factors that influence the effectiveness of H&S communication in construction.

Complex Industry

The construction industry has a complex communication nature, because many of the parties are involved in the business process (Charoenngam et al., 2003; Bouchlagem et al., 2004). An example of this complex nature is the fact that multiple reports must be prepared to ensure that information is delivered to all the organizations, departments or individuals involved.

Cheng et al. (2001) state that the parties involved in construction represent different professions, including architecture, structural engineering, quantity surveying, civil engineering, project management, building surveying, etc., and their multidisciplinary skills limit the scope of cooperation between them. The significant reason for this lies with problems in communication. According to Stank et al. (1999), inter-organisational coordination must be supported by
effective communication, information exchange, partnering and performance monitoring.

**Highly Fragmented and Non-Collaborative**

The construction industry is considered to be divisive and fragmented, where construction parties pay attention to conforming to contractual requirements (Latham and Egan, 1994). Ng. Et al. (2001) state that the underlying perception of the UK construction industry is that it is highly fragmented, non-collaborative and unique. Although the industry tends to be conservative when there is a need for change (Cheng et al., 2001), the industry needs to change its current culture to one which supports continuous improvement by adopting collaborative working practices. Latham (1994) and Egan (1998) argue that this collaborative culture should facilitate information sharing between projects and teams and across organizational boundaries (Egbu, 2000). This fragmentation in the construction industry is well demonstrated by Evbuomwan and Anumba (1998) (see Figure 2.16).

![Figure 2.16: Over the Wall Approach (Evbuomwan and Anumba, 1998)](image)

The figure shows that due to the separation of the various disciplines involved in a project, many problems arise in terms of communication of H&S information, such as the lack of communication between each of the disciplines during the
development process, fragmentation of design information and difficulty in maintaining data consistency as well as loss of information (Evbuomwan and Anumba, 1998).

**Multidisciplinary Team Members**

To understand the nature of construction communication in design, we must first understand that this phase involves many parties with different roles, expertise and interests. A project’s life cycle from design to construction, maintenance, refurbishment and demolition involves many tasks that demand collaboration between many professionals, experts and organizations (Bouchlagem et al., 2004). The collaboration between these parties requires the exchange of a large quantity of information at different points of the project schedule and venue. Church (1996) strongly believes that as long as the organization exists and goes through many changes or developments in terms of management, leadership, structure or reward systems, it is communication that binds the individuals or groups and function together as a whole.

Some of the professionals are involved right from the start, some experts might be hired temporarily at a certain point of the process, and many others might be involved only during the construction phase to completion. Notwithstanding everyone’s involvement and their service period, all the people involved in the project must obtain the appropriate information and data, particularly H&S information. In his article about organizational communication, Church (1996) argues that it is communication that enables people to coordinate, collaborate and make important decisions that affect many individuals or groups of people that unite an organization.
Client and Designer’s Motivation

As stated by Mitchell et al. (2010), the clients at this stage can be divided into two categories: the external client or the customer who wants a building and the internal clients who expect to get information from the design stage. The information at this stage is complex, ranging from planning the construction, the design process, to construction and maintenance.

In the UK and across the European Union, designers, who normally focus exclusively on the needs of the facility’s users, must also consider the safety hazards that their design poses to those completing the work. Designers may not be able to eliminate all safety and health risks, but they can make significant contributions to workplace safety if they are motivated to do so, as should be the case in the EU due to legislation. Owners are in a strong position, as clients, to motivate the designers to make these considerations.

According to Hislop (1999), the risks associated with other works are less appreciated and the opportunities to reduce those risks are often overlooked, such as designing welding locations or steel connections at easily accessible points.

Emmitt and Gorse (2003) mention that the two key factors that influence effective communication in construction projects are the client and the site; i.e. the distinctive organizations employed to design and assemble the constructed works and the individuals within the various organizations. According to Cheng et al. (2001), due to the multiple parties involved in a project, effective and efficient communication relies on a few aspects such as inter-organizational communication, a communication channel created for close or distant parties, and the choice of channel must be appropriate depending on the amount of information and the speed of the channel to deliver the information.
Information Management

Information flows from construction team members from the beginning of the project, or when they are appointed, until project completion (Cheng et al., 2001). Gyampoh-Vidogah and Moreton (2003) found from their exploratory case studies in the construction industry that the management of information is characterised by systems in which:

- Information exchange between project parties is limited to paper, resulting in slow and inefficient retrieval.

- Functional departments maintain their own data structure to suit their particular needs.

- Most information searching and transfer between project parties and clients is paper-based, providing a constant source of delays.

- No efficient interfaces exist between departmental systems to access information electronically.

- The impact of IT investment has been limited.

Resistance to IT

One of the aspects that all parties involved in construction should pay attention to in order to improve the quality of project management is the communication system. A multitude of communication strategies may be employed to help good communication among all parties, including developing and increasing the usage of IT in construction.

Thomas et al. (2001) adds that the adoption and utilization of an information management system within the construction industry has not been as rapid as other industries, e.g. manufacturing. However, over the last few years, significant
advances in the collaborative technology sector and increased levels of uptake have been recorded, especially on the larger projects where IT budgets can be justified. This shift in attitude is mainly due to pressure by clients on contractors to improve productivity and value for money (Ingirige and Aouad, 2001).

According to Anumba et al. (1997), the benefits of modern information and communication technologies include:

- Easier access to appropriate project team personnel, third parties and information.
- Fast and efficient access to design and other project information.
- Secure communication of design and construction information within a project team.
- Enhanced visualization of design information and the project as a whole.
- More realistic communication of design intent and rationale to the client and other members of the project team.
- Improved coordination of inter-disciplinary perspectives.
- Increased consistency of project information.
- Reuse of project information from other disciplines or project stages without the need for re-input.
- Improved corporate knowledge due to a centralized pool of project information and improved communication protocols.

Wickforss and Lofgren et al. (2007) state that in every construction project, there is resistance to the introduction of the technology within the industry. This resistance is not only based on awareness of technical shortcomings, but there are also significant non-technical elements, such as methods and routines. They add that time deadlines, financial pressures and shortcomings in previously developed technical documentation affected relations and cooperation between the members of the construction team.
CDM Regulations
The Construction (Design and Management) Regulations have existed in the UK since the mid 1990s, with the most recent version becoming law in 2007. They are based on a European Directive, The Temporary and Mobile Construction Sites Directive, and similar legislation exists in each of the European member states. By their very nature, requiring that the health and safety of construction, maintenance and demolition workers is considered by designers, they have an effect on the communication of H&S during the design and pre-construction phases.

Figures 2.17 and 2.18 illustrate the involvement of designers and contractors in regards to communicating H&S information in design as outlined in the CDM Regulations.

*Figure 2.17: CDM (2007) Stakeholder Responsibilities (adapted by Gibb from www.aps.org.uk)*
The various parties have specific duties under CDM, as explained in the following sections.

**Client**

As shown in the figure, a client will approach a designer to propose a project and the designer will design the project as requested. A CDMC should be appointed at this stage in order to develop a safe design concept. According to CDM 2007, at the start of the proposal and design phase the client must produce 'pre-construction information', which is divided into two parts. Firstly, it is the information that the clients have to provide under Regulations 10 and 15 of CDM 2007 (the full version of CDM 2007 can be downloaded at [http://www.legislation.gov.uk/uksi/2007/320/contents/made](http://www.legislation.gov.uk/uksi/2007/320/contents/made)), and secondly refers to the information that is used to provide information to those bidding for, or planning, work and for the development of the Construction Phase Plan (APS, 2009).
Designers

As shown in Figure 2.17, designers are involved in a project from the proposal stage with the client and CDMC, as well as at the start of the design phase until the tendering stage. In terms of communication of construction H&S information, the designers have to collaborate with the CDMC to prepare and pass on H&S information during the design development stage, which is known as ‘pre-construction information’. In the development of concept detail in the design phase, the risks and hazards existing in the design will be identified and, at best, eliminated. The specific requirement for risk assessment has been removed from the 2007 Regulations; however, many designers still complete them.

CDM Coordinator

According to the Guide to the Management of CDM-Coordination by APS (2009), a CDMC is responsible for facilitating cooperation and coordination among design team members as well as providing related H&S information to them. It is essential that a CDMC ensures that the right H&S information is made available to whoever needs it. As shown in Figure 2.18, a CDMC should be involved in the project from the earliest stage, mainly to coordinate H&S information and to facilitate a safe design concept and the cooperation of all parties in terms of H&S matters.

2.8 Summary

As this study focuses on communication of H&S information in design, literature reviews have been executed to determine the communication theories and elements and their applications in communication construction H&S information in design. This literature search shows that the communication field was first explored thousands of years ago and has been actively researched since World War 1 due to advances in technology, such as the invention of the radio. The importance of communication theory is that it can help people to communicate effectively and ensure that the message is conveyed to the right person and in
the right manner. This will be exploited in order to communicate H&S information in construction.

Exploring the current situation in construction shows that the industry worldwide is known for its poor record in H&S. This is partly due to the challenges and barriers to communicating H&S information. The literature review showed that prevention through design would reduce the risks and hazards in the construction phase, thus reducing the injuries and fatalities on site. The construction design process has been defined by looking at the RIBA PoW stages and a model developed by Lawson (1997). It was also found that the existing factors that affect communication include the complex, highly fragmented nature of the industry, the involvement of multidisciplinary team members, the client and designers’ motivation, and resistance to IT and information management.

2.9 Conclusion
This chapter has explored the communication theories and the current state of the construction industry in terms of H&S, and the design process has been identified. Factors that affect H&S communication in construction have been identified and explained. Through the literature review, it has been found that H&S performance in construction can be influenced positively if the risks and hazards are identified and eliminated in the design phase. Many studies of prevention through design show that the elimination of risks and hazards in the design stage effectively reduces the number of accidents and fatalities later in the construction phase. These findings led the author to investigate these issues further by getting feedback from the industry.
CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

According to Maxwell (1996), the strengths of qualitative research are based on its inductive approach, focusing on specific situations or people as well as emphasizing words rather than numbers. Qualitative methods have been developed to help researchers understand people and the social and cultural contexts (Faisal, 2009). Thus, qualitative methodological design was used for this research study. This was applied due to the complex nature of the research area, which combines two disciplines: communication and construction H&S. Multiple qualitative methods were used such as literature reviews, interviews, focus groups and secondary data analysis as shown in Figure 3.1.

This study began by reviewing the existing issues and problems in construction H&S communication, particularly at the design stage. This was determined by an extensive literature search. The research then continued with eight preliminary interviews in two stages with leading architects of the companies chosen. Twelve focus groups were held to get a better understanding of the issues. Participants of the focus groups were from various construction backgrounds. All of the participants involved in the data collection were construction professionals in the UK. Feedback from the industry was then analysed before the Communication of Construction H&S Information in Design model was developed and validated.
3.2 Research Design

Research design is a crucial element in a research study. As argued by Maxwell (2005):

“A good design in which the components work harmoniously together, promotes efficient and successful functioning: a flawed design leads to poor operation or failure.”

In order to meet the objectives of the research, a well-planned strategy for the study must be established (Yin, 1994; Frankfort-Nachmias and Nachmias, 2007). Yin (1994) also states that a research design must address at least four issues of the study: research questions, relevant data, data to collect and how to analyse the findings. A research design will elaborate every component that will be incorporated in the process. In addition, a research design must be able to aid the researcher to find the answers to the research questions (Simister, 1995; Aaker et al., 2007). The research framework, as illustrated in Figure 3.1, is the backbone of this study.

Literature reviews were conducted to explore the current construction industry issues and challenges, H&S information, the design process, communication and construction management. The research then continued to collect primary data through fieldwork. Open-ended, face-to-face interviews formed the preliminary data collection phase, followed by an in-depth analysis of 12 focus groups that were conducted as part of a broader study into prevention through design. Data gained from the interviews were transcribed and analysed using content analysis. A framework was developed and validated before conclusions and recommendations for improvements were made.
Communication of Construction H&S Information in Design

**Literature Reviews:**
1. Communication in Construction
2. Communication of Construction H&S in Design

**Research Questions Identification**

**Research Methods Selection**

**Field Data Collection**

**Preliminary Interview Phase 1**

**Preliminary Interview Phase 2**

**Focus Group Interviews**

**Content Analysis for Data Collected**

**Framework Development**

**Validation and Evaluation**

**PhD Writing Up Completion**

*Figure 3.1: Research Design Framework*
Although the framework shows that the research process seems straightforward, in reality there were many processes that had to be done continually from the beginning and repeated a number of times in order to address the specific issues of this study. Maxwell (2005) states that, in qualitative research, no linear model could adequately represent the research process. This is because many components of the design might be reconsidered or modified during the study in response to new developments or changes. However, the intention of the research design framework is to demonstrate the processes involved in this study in a logical sequence.

3.3 Research Methodology and Methods
There are two major divisions of research methodology – qualitative and quantitative. Quantitative research is often employed for studies related to natural phenomena (Faisal, 2010) and when there are clear conventions that a researcher can use (Miles, 1979). On the other hand, qualitative research requires data collection instruments that are sensitive to underlying meanings, such as observation, interviews and analyses (Merriam, 2009).

Based on the research questions of this study, qualitative research methods were chosen. This is due to the need to understand the nature of the issues being investigated. The literature reviews revealed that there are communication issues in construction, particularly in the design stage. However, there were only limited sources that could aid the author’s understanding of the issues of communication of construction H&S information in design. To investigate these issues, face-to-face and open-ended interviews were conducted with a number of construction professionals to produce a rich description of the issues under investigation (Merriam, 2009).
3.4 Research Methods Adopted

3.4.1 Literature Review

A literature review is a published account by an accredited scholar or researcher (University of Toronto, 2011). According to Hart (1998), a literature review is a tool for the researcher to show authority in the research area, to demonstrate the understanding of the issues and to justify the research topic, design and methodology. In order to launch a research project, the researcher must equip himself with the knowledge of the research area. A literature search also helps the researcher to gain knowledge about the theoretical background of the study, refine the research methodology and determine the contribution of knowledge derived from the research study as well as present their findings (Kumar, 2005; Yin, 2011).

There is a chance that the researcher might find another study that is similar to theirs (Yin, 2011). The literature review is a platform for the researcher to evaluate, compare and contrast existing publications from different authors to shape their research and cast the research findings into the body of knowledge (Kumar, 2005).

The literature review revealed that there are a number of research projects on communication in construction and, in particular, communication of H&S information such as ‘Identification of Critical Factors Affecting the Communication of Safety-Related Information between Main Contractors and Subcontractors in Hong Kong’ (Wong et al., 2004). However, these studies show that there is no one solution for each and every problem that arises in the industry. Thus, construction projects are unique and differ from one another (Dawood, et al., 2002). The literature search continued through each stage of this study.

Several keywords were used to search the related journals, books and articles, including: construction H&S, communication in construction, communication of
H&S information in construction, design phase in construction, construction management. As stated previously, there are many publications that consider the issues in construction communication. Some directly address the construction design phase, but very few focuses on communication of construction H&S information in the design phase, so this became the main focus of the review. Online databases such as Google Scholar and Emeraldinsight were the most important platforms for this process as well as books and articles from inter-library loan.

3.4.2 Interviews

An interview involves verbal communication between two individuals (Goddard and Melville, 2001). According to Panneerselvam (2004), interview components are the researcher, the interviewer, the interviewee and the interview environment. The researcher or interviewer initiates an interview session by contacting the interviewee, setting up time, date, venue and certain rules (Gubrium and Holstein, 2001). For instance, the interviewer should ask the interviewee whether they agree that the outcome of the interview be either published anonymously or publicly acknowledged. Depending on the respondents’ readiness to share information from the questions asked, capturing the conversation by audio recording provides rich data (Emmitt and Gorse, 2007).

Interviews were used to obtain data and feedback from practitioners. The scope and the nature of the industry had to be understood to ensure an appropriate mix of participants. Interview questions were structured and divided into three categories *(please refer to Appendix 3.1 – Interview Questions Stage 1)*:
Background and responsibilities

These questions determined the background of the interviewee, such as education, roles in construction, involvement in H&S matters, duration of service in construction and level of awareness of H&S issues.

Systems and content in communicating H&S information in construction

The second set of questions investigated the systems that the interviewee uses for H&S communication as well as the effectiveness of the system. The interviewees were also asked about the content of the H&S information, to whom they communicated the information and whether the information was imparted to all of the parties involved in the project or to specific team members.

Towards improving the communication of H&S information in construction

Here, the interviewees were asked their opinions regarding the current practices that impact upon the communication of H&S information positively and negatively. They were invited to explain what practices they thought would help overcome the issues in communicating construction H&S information. They were also prompted to give suggestions for improving the communication of H&S information in construction.

Before holding the interviews, the questions (please refer to Appendix 3.1 and 3.2) were piloted with colleagues from the author’s university to ensure that the interviewees would understand the questions when the interview sessions commenced. Eight preliminary interviews (divided into two stages) then took place in the interviewees’ premises in the UK’s East Midlands area. The interviewees were first contacted by telephone to explain the area of research as well as the procedure of the interview. If the relevant person contacted agreed to be interviewed, a formal invitation was sent along with a brief explanation of the research study and its aims. The brief explanation helped the interviewees to
anticipate what type of questions they would be asked and prepare mentally for the interview session. Each of the interviews lasted about one hour.

The interviews used a face-to-face, open-ended style and the conversations between the researcher and the interviewees were recorded. Before the interview session commenced, the interviewee was asked whether they would prefer to be acknowledged in any publication derived from the study or remain anonymous. The interviewees did not have a problem with the recording, but some of them preferred to remain anonymous.

The preliminary interview was divided into two stages. In the first stage, in order to understand the issues deeply, the author sought feedback from the industry about the general practice of communicating H&S information in construction from the view of experienced designers. The findings of the first stage of interviews were put together and published in a conference paper for ARCOM 2009 (Ulang et al., 2009). The elaboration and findings of the preliminary interviews will be discussed further in Chapter 4.

Another four lead architects from four companies in the East Midlands, UK were interviewed for the second stage interview sessions. The interviewees were approached using the same procedure as for the first stage. The difference between the two interview stages was in the interview questions. In the second stage, an additional diagram required the interviewees to demonstrate the flow of H&S information in construction (please refer to Appendix 3.2: Interview Questions Stage 2). The findings from the second stage preliminary interviews were compiled in a conference paper and published at the CIB World Congress 2010 (Ulang et al., 2010). The elaboration and findings of the preliminary interviews will be discussed further in Chapter 4.
3.4.3 Focus Groups

“A focus group is a special type of group” due to its purpose, size, composition and procedure (Krueger and Casey, 2000). It is a group of people that discusses a topic raised by the interviewer with the guidance of a moderator (Morgan, 1998). Members of the focus group are selected by certain criteria related to the topic of discussion. The use of focus groups is a qualitative research method (Edmunds, 1999; Rabiee, 2004; and Stewart et al., 2007), where the results are more likely to be data rich and less structured (Edmunds, 1999). Edmunds (1999) and Greenbaum (1998) mention that focus groups are best used to discuss a new concept or idea. However, Stewart et al. (2007) argue that the focus group will materialize differently for different areas of research due to the diversity of research fields and objectives.

A focus group creates lines of communication, whether between the moderator and the participants or between the participants (Morgan, 1998). It is crucial that the moderator of a focus group is a qualified person for the topic being discussed (Greenbaum, 1998). Morgan (1997) mentions that one of the advantages of focus groups is that rich data can be obtained in a short period of time. But this depends on the moderator’s ability to manoeuvre the interview session. A competent focus group facilitator is able to turn the interview questions into a lively discussion that addresses the research topic (Morgan, 1998). The effectiveness of focus groups is also affected by the participants’ willingness to communicate their knowledge, opinions, ideas or experience openly in front of other participants (Stewart et al., 2007).

For this research, preliminary interviews determined the roles played by designers in addressing and communicating H&S information in construction. The face-to-face interviews also aimed to investigate the flow of H&S information in construction from appraisal to completion of a project. However, in order to focus on the issues of communicating construction H&S information in design, a
A focus group method was chosen. The focus group participants were experienced construction practitioners from different disciplines from all over the UK. Twelve focus groups were held and each of the sessions lasted at least one and a half hours, with membership of between four and eleven people.

Focus groups allow the researcher to gather a lot of information via discussion with experienced professionals from the industry. The professionals tended to give their opinions and comments regarding H&S communication issues in the design stage as well as giving many examples from their years of experience involved in the industry. The discussions were recorded and transcribed. It was easier to extract the information needed from text. The transcriptions were analysed using a content analysis method.

The focus groups were organized as part of a broader study into Prevention through Design, funded by the USA Government via NIOSH, led by John Gambatese of Oregon State University. The group covered the designing for safety topic and the author was able to extract and analyse the data relating to communication aspects for the purpose of this PhD thesis as secondary data analysis.

### 3.5 Analysis of Data

The data obtained from the industry, both from preliminary interviews and secondary data from the focus groups, were analysed using a content analysis method. This section will explain the classification of secondary data and briefly discuss the content analysis method.

#### 3.5.1 Secondary data analysis

Secondary data is a set of data which is collected by someone else other than the user (McCaston, 2005; Boslaugh, 2011). According to Novak (1996), secondary data is very useful in subsequently designing the main research, as well as providing a baseline for comparison for the primary data collection. In
many cases, analysing secondary data involves reviewing a mass of information (McCaston, 2005). Therefore, the research purpose and design must be well defined. To get a clearer picture of the secondary data, Boslaugh (2011) presents an example:

‘A researcher poses questions that are addressed through analysis of data from the Behavioral Risk Factor Surveillance System (BRFSS), a data set collected annually in the United States through cooperation of the Centers for Disease Control and Prevention and state health departments. In this case, the person performing the analysis did not participate in either the research design or data collection process, and the data were not collected to answer specific research questions.’

The secondary data for this study was obtained from 12 focus group from the Prevention through Design (PtD) project. As explained previously, PtD was funded by the USA Government via NIOSH, led by John Gambatese of Oregon State University. The targeted participants of the focus group interviews are representatives of six different professional “communities” within the UK construction industry: architects, design engineers, facility owners/developers, constructors (general contractors and trade contractors), manufacturers / suppliers, and health and safety consultants. These communities represent the primary participants involved in the development, implementation, and control of the planning, design, construction, and safety and health aspects of construction projects, and are the key implementers of the requirements set forth in the CDM regulations. The author attended one of the focus groups and analysed the data from all the groups by classifying the findings into six main categories: background and experience with PtD, organizational impact, barriers and enablers, impacts on H&S innovations, perspectives on PtD and future implementation of PtD.
The outcome of the focus group has been published in a paper entitled ‘Industry’s perspective of design for safety regulations’ (Gambatese et al., 2009).

3.5.2 Content Analysis

A few methods to extract information from qualitative data are available and have proved to be successful. Among all of the methods, content analysis is one of the most well known and regularly used. Content analysis, according to Krippendorff (2004), entails a systematic reading of texts, images and symbolic matter. In line with this statement, Webber (1990) agrees that content analysis classifies textual material, reducing it to more relevant, manageable bits of data. According to Berger (2011) the advantages of content analysis are: ‘it is unobtrusive, relatively inexpensive, it can deal with current events, uses material that is easy to obtain and it yields data that can be quantified’. Berger (2011) added that content analysis is considered as unobtrusive because the researcher does not have any effect on what is being studied, thus it does not affect the outcomes. Stacks (2011) stated that the advantages of using the content analysis method are that it can ‘objectively and reliably describe a message or a group of messages’ as well as focusing on the actual messages and communication in practice. On top of the advantages listed above, Royse (2008) added the advantage of using content analysis in that it can deal with massive data sets. This is very useful practically to analyse data and information relevant to this thesis from the focus groups, as the overall data set from twelve focus groups was substantial.

However, content analysis has its downside such as it requires the actual communication or messages be recorded for analysis purposes (Stacks, 2011). According to Berger (2011), content analysis methods require the researcher to carefully determine the representative sample. If the sample is not correct, the findings will not be convincing. For this study, it has been determined that the interviewees have construction background, preferably with a considerable amount of experience in construction industry. Apart from that, content analysis can be extremely time consuming.
The data obtained from the focus groups was analysed using this method. The data was classified into four broad themes: communication flow, methods, barriers and challenges as well as suggestions for improvement. Categories for each theme developed as more factors that affect the particular theme were identified in the transcription. The evidence identified was then coded and classified based on its category. The coding system was based on the group number, page and the selected sentence. For example, for code ‘N2-3a’ – this evidence was identified in focus group number two, in page 3 and the ‘a’ indicates that this is the first evidence in the page.

For example, in the transcription of group 3 (page 2) of the focus group, it was said that: “Within all these [practices] or [03:36] we’ve got what we call a CDM Advisor who is basically a CDM champion who can help the group or the practice when you have issues relating to health and safety risks during design. …there are people who are more switched on, more proactive with regards not only to regulations but also with the topics.”

Also, for example, it can be noted that a particular interviewee agreed that the “CDM Coordinator helped the team members in regards to health and safety issues” which is related to this study. This evidence was taken and coded as ‘N3-2a’. ‘N3’ represents the group number three and ‘2’ indicates that this evidence was taken from page two and ‘a’ indicates was the first evidence found on the page. The evidence found was put in a table for cross analysis for all the 12 focus groups. (Please refer to Appendix 3.3: Example of Data Classification and Coding).

3.6 Conclusion
This chapter has explained the methodology and methods adopted for this research study. It has also shown the process of planning and conducting this research in order to meet the aims and objectives. Justifications have also been given for the methods chosen to carry out the study. It is clear that the
combination of data collected from the preliminary interviews and focus groups and the literature findings regarding the issues in communicating construction H&S information in design represents the actual challenges faced by the construction industry today, regarding H&S issues in particular.
CHAPTER FOUR

PRELIMINARY INTERVIEWS & FINDINGS

4.1 Introduction

The first stage of preliminary interviews characterised the various aspects of collaborative communications and highlighted the problem areas. However, while opportunities to address safety in design may exist, design-phase barriers that inhibit or even prohibit their implementation were perceived to be present. The barriers, including potential limitations presented by conventional design practices and the knowledge and understanding of design professionals related to designing for safety, were identified.

The aim of the second stage of the preliminary interviews was to investigate the flow of H&S communication in the design stage of a construction project. Communication flow was examined at each design stage according to the Royal Institute of British Architects (RIBA) Plan of Work (RPoW). The RPoW comprises eleven stages: appraisal, strategic brief, outline proposal, detailed proposal, final proposal, product information, tender documents, tender action, mobilisation, construction from practical completion to after practical completion. This interview stage determined the communication strength, challenges and barriers, and also the media used for H&S communication, including potential limitations related to designing for safety.

4.2 Background to the Study

To investigate the communication of H&S information in construction, the author began with architects, the professionals who have a primary role at the very early design stage. Lead architects from four East Midlands design companies were contacted by telephone, followed by a formal letter with an invitation to join the
study and the research abstract. Interviews were held in their premises and each lasted about one and a half hours.

### 4.3 Characteristics of the Construction Organizations

**Table 4.1: Participating companies and interviewees for preliminary study Stage 1**

<table>
<thead>
<tr>
<th>Overview</th>
<th>Company</th>
<th>Industry</th>
<th>Interviewee</th>
<th>Position</th>
<th>Years of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>Construction</td>
<td>A</td>
<td>Architect (Partner/Director)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Construction</td>
<td>B</td>
<td>Architect (Director)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Construction</td>
<td>C</td>
<td>Architect (Director)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>Construction</td>
<td>D</td>
<td>Architect (Associate Partner)</td>
<td>10</td>
</tr>
</tbody>
</table>

### 4.4 Preliminary Findings – Stage 1

The findings of the interviews are discussed based on the key issues: H&S communication flow, methods of sharing information, H&S communication content and communication barriers and challenges in general.

#### 4.4.1 H&S communication strength and flow

Generally, all four companies share similar opinions and much the same experience regarding communication flow in construction. Based on design and
build projects, for example, the communication starts with the client proposing an idea for a construction project, and they request an architect to put their ideas into drawings. At this stage, the architects bear the responsibility to ensure that the construction project can be carried out and maintained safely. The architects, as the lead designers, will include the potential risks in the schematic plan. Communication will then expand to other designers such as structural and mechanical engineers. These engineers will enrich the drawings with necessary detailing, including the specification for H&S aspects.

All four interviewees agreed that, at this stage, communication with other designers is fairly straightforward. They highlight the possible risks and put the appropriate details onto the drawings. Any changes to the drawings will be communicated to all of the design team members via meetings or fax and emails.

Design risk assessments are carried out to highlight the potential risks and hazards. Risk assessment forms are used by all four companies. In this way, all the changes and possible risks are recorded and filed for future reference. Interviewee B mentioned that in using a risk assessment form, only the main or important potential risks are highlighted, rather than all the minor 'conventional' risks such as the danger of not wearing hardhats on construction sites. Sharing the same opinion as Interviewee A, Interviewee B mentioned that all the usual potential risks repeated in every construction project should not be highlighted. Rather, only the unusual risks should be pointed out.

After the design stage, communication will continue as the main or principal contractor is appointed. Project information has to be communicated in order to share the architectural/engineering knowledge acquired during the design stage. The exchange of information has to be mutual, because the contractor, through his experience and skill, may add additional considerations to the project.
4.4.2 Methods of sharing information

All four interviewees basically used the same method to share information regarding H&S. Throughout the design process, regular meetings were held among designers to produce a set of drawings that would, at best, eliminate the potential risks. According to Interviewee B, in every meeting they include a subsection to discuss H&S in that particular construction project.

Interviewee A strongly emphasized the need for discussion regarding H&S right from the beginning of the proposal meeting with the client. According to him, some of the clients are not aware of (or not knowledgeable enough about) construction in general to be aware of potential risks. Interviewee D shares the same opinion and experience with companies A and B. However, Interviewee C does not discuss H&S aspects at the appraisal until the outline proposal stage. The element of H&S is then included in the drawings, based on his knowledge and experience, and the clients update this from time to time, starting from the detailed proposal stage.

Meetings during the design stage are much simpler according to Interviewee C. Other professionals are informed about changes to the design via meetings, faxes or emails. According to him, communication becomes more complicated at the construction phase due to the expansion of communication channels.

4.4.3 Communication barriers and challenges

Interviewees A, C and D explained that the extent and nature of the communication barrier depends on whether the other professionals they deal with are local or come from other places. If the other parties are local, communication regarding the project they are working on is much easier and
quicker and they can conduct meetings on a regular basis. However, this does not apply if the other disciplines they deal with are based at different places.

Communication takes place through telephone calls, emails and faxes. None of the interviewees regularly use other communication methods such as video conferencing or Skype. As most of the decisions, changes, risks and hazards or even changes in the design need immediate attention, the process of communication via telephone, fax and the Internet takes longer than face-to-face communication. Face-to-face meetings allow the team members to take immediate decisions on any issues that arise. Interviewee B had different views on the H&S communication barriers. In the context of communicating H&S information, in his opinion, the CDM coordinator should be actively involved in the construction as well as keeping all the professionals involved on track. Nevertheless, he admitted that this does not happen in the real construction world. According to Interviewee B, it is the architect who has always been the person to be relied on for H&S information and action.

When communication reaches the contractors and subcontractors, the expansion of H&S communication is greater. As a result, communication will be ad hoc, and it is thought that contractors do not retain the same H&S information as the designers. Also, too much documentation, in Interviewee B’s opinion, leads to crucial H&S information being overlooked. At the end of the communication process, all the thick documents such as the H&S file and the tender documents would not be read. Interviewee B suggested that the risks they have assessed should be highlighted individually, and this information should be kept and used accordingly.

Interviewee A mentioned that one of the challenges he has to face in managing a construction project is dealing with a lot of paperwork. According to him, too much paperwork takes too much time to prepare and draws the focus away from
the risks that they really should pay attention to. What are really important are the unusual risks that are likely to occur in each particular project.

Interviewees B and D shared similar experiences and challenges regarding H&S communication in design. The main challenge they experienced was how to ensure that the contractor retains all the H&S documentation and uses it appropriately where necessary. This is to minimize and ideally eliminate all potential risks that would lead to fatal injuries. Contractors, as the main players for a project in the construction phase, should also share all the H&S information with subcontractors and site workers. The designers argued that this crucial responsibility should be taken seriously.

### 4.5 Preliminary Findings – Stage 2

*Table 4.2: Participating companies & interviewees for preliminary study Stage 2*

<table>
<thead>
<tr>
<th>Company</th>
<th>Industry</th>
<th>Typical Procurement Type</th>
<th>Position</th>
<th>Years of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Construction</td>
<td>Traditional</td>
<td>Architect</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>Construction</td>
<td>Design and Build</td>
<td>Architect (Partner)</td>
<td>22</td>
</tr>
<tr>
<td>C</td>
<td>Construction</td>
<td>Design and Build</td>
<td>Architect (Associate Director)</td>
<td>10</td>
</tr>
<tr>
<td>D</td>
<td>Construction</td>
<td>Framework Agreement</td>
<td>Architect (Design Manager)</td>
<td>21</td>
</tr>
</tbody>
</table>

In the second stage of the preliminary studies, the interviewees were given a diagram that indicated the eleven stages in the RIBA Plan of Work (RPoW) (*Please refer to Appendix 3.3*). The interviewees were asked to show the H&S communication strength and flow at the different stages. For simplicity, this survey combined the various stages into three phases.
Phase 1: Appraisal and Strategic Brief
Phase 2: Outline Proposal, Detailed Proposal, Final Proposal & Product Information
Phase 3: Tender Document and Tender Action

During the interview sessions, the interviewees were asked to state the barriers, challenges and methods of H&S communication that apply to each stage.

4.5.1 H&S communication strength and flow

**PHASE 1: APPRAISAL & STRATEGIC BRIEF**

*Figure 4.1: Frequency of H&S communication at Appraisal and Strategic Brief stage*
As demonstrated in Figure 4.1, in general, communication of H&S information at this stage is very frequently discussed between the designer (in this case, the architect), the client, CDM Coordinator and quantity surveyor. In order to produce a safe design, the designers have frequent interactions with those three team members to gain as much H&S information as possible about the project.

From the architect’s point of view, communication of H&S comes into consideration as soon as a client approaches them with a proposal. At the first two stages, appraisal and strategic brief, based on traditional design and build procurement type, Interviewee A will communicate with the client, quantity surveyor, mechanical and structural engineers as well as the CDMC, classifying the communication of H&S at these two stages as ‘often’.

Interviewees B and C, who mainly work on design and build projects, communicate H&S issues to the client and CDMC very frequently at these two stages. Apart from the client and CDMC, Interviewees B and C communicate H&S information to the quantity surveyor, mechanical and structural engineers, albeit ‘seldom’. From their experience, design engineers will be contacted if there seem to be issues in their work scope. Interviewee B mentioned that suppliers are rarely involved at these stages. Working under a framework agreement, Interviewee D only communicates with the client and quantity surveyor at the appraisal stage and expands the communication of H&S to the CDMC and
principal contractor at the second stage. At these two stages, communication of H&S to the client and the quantity surveyor can be classified as ‘frequent’, whereas the communication of H&S to the principal contractor and CDMC is described as ‘often’. In order to illustrate the trends in the changing frequency of communication between the architect and the other parties through the three main phases, scores have been allocated as follows:

<table>
<thead>
<tr>
<th>Communication Level</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Communication</td>
<td>0</td>
</tr>
<tr>
<td>Very Seldom</td>
<td>1</td>
</tr>
<tr>
<td>Seldom</td>
<td>2</td>
</tr>
<tr>
<td>Often</td>
<td>4</td>
</tr>
<tr>
<td>Frequent</td>
<td>8</td>
</tr>
<tr>
<td>Very Frequent</td>
<td>16</td>
</tr>
</tbody>
</table>

It is acknowledged that the allocation of scores is somewhat arbitrary, but the scores have been allocated to acknowledge the significance of the ‘very frequent’ responses. It is also acknowledged that the sample size is very small and therefore no statistical significance is suggested; the figures are intended to be indicative. Using this scoring system, communication frequency for Phase 1 is shown in Table 4.3 and Figure 4.2.

### Table 4.3: Overall frequency of communication between the architect and other parties during Phase 1

<table>
<thead>
<tr>
<th></th>
<th>QS</th>
<th>Supp</th>
<th>M&amp;E</th>
<th>Struct.</th>
<th>Site</th>
<th>SC</th>
<th>PC</th>
<th>Clnt</th>
<th>CDMC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int A</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Int B</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Int C</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Int D</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
<td><strong>0</strong></td>
<td><strong>8</strong></td>
<td><strong>8</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>4</strong></td>
<td><strong>8</strong></td>
<td><strong>40</strong></td>
<td></td>
</tr>
</tbody>
</table>
Figure 4.2: Representation of overall frequency of communication between the architect and other parties during Phase 1
PHASE 2: OUTLINE PROPOSAL, DETAILED PROPOSAL, FINAL PROPOSAL & PRODUCT INFORMATION

Figure 4.3: Frequency of H&S communication at Outline Proposal, Detailed Proposal, Final Proposal & Product Information

Key:

- Interviewee A - RED
- Interviewee B - GREEN
- Interviewee C - BLUE
- Interviewee D - ORANGE
- Very Frequent
- Frequent
- Often
- Seldom
- Very Seldom
As illustrated in Figure 4.3, it can be concluded that communication of H&S information in the proposal stages is more frequent and involves almost all the project team members. Although the communication of H&S information is not frequent, the H&S information is always highlighted and mentioned at this stage.

In the proposal stages, outline proposal, detailed proposal and final proposal, Interviewee A communicates H&S to the CDMC very frequently. At this stage, the H&S issues are highlighted and taken into account in the preparation of the tender documents. From experience, Interviewee A finds that it is crucial to highlight H&S issues at the proposal stage to ensure that the proposed project can be constructed safely and the H&S facilities are included in the budget and time frame.

Communication with other disciplines is still ongoing at these stages for Interviewee A, but either ‘seldom’ or ‘very seldom’. All parties are kept informed of any updated H&S information. Basically, the other parties have already given their input regarding H&S information. CDMCs and architects record and compile the information in the preparation of tender documents and final drawings.

At the proposal stage, Interviewees B and C tend to communicate H&S information to the client, CDMC, quantity surveyor, suppliers, mechanical and structural engineers. For Interviewees B and C, communication involving all parties can be classified as ‘often’ at the proposal stage. All parties involved are contacted regularly. This is to ensure that all H&S information is taken into account. Communication of H&S is less significant in the final proposal stage, as all the information is now compiled and inserted as part of the tender documents.

Architects again review the H&S plan at this stage to assess the design and ensure that the initial concepts, ideas, risks and site restraints have all have been considered, and the design is ready for construction because they have a
framework agreement with the client. However, company D does not have an outline proposal stage.

At the Final Design stage, the design is, in theory at least, frozen. From the frozen layout, the proposal is directly discussed in the detailed proposal stage involving the client, principal contractor, CDMC, subcontractor, structural and mechanical engineers and quantity surveyor. The discussion will cover all aspects of the construction of the project as well as H&S issues. According to Interviewee D, when handling small projects there are not many things to be considered. However, communication of H&S remains ongoing in the detailed and final proposal stages.

Internally, company D has its own four-stage risk assessment system: feasibility risk assessment, design risk assessment, build risk assessment and maintenance risk assessment. These risk assessment stages are used to eliminate H&S risks. In these stages, communication among the parties involved with Interviewee D can be classified as ‘often’.

In the product information stage, Interviewees A, B and C communicate H&S issues with the client, CDMC, quantity surveyor, suppliers and mechanical and structural engineers. Basically, as the job progresses, communication frequency between the designers and the client increases. For example, at the product information stage, the client has preferences for the materials to be used, and the designers and other parties involved will provide the H&S aspects in regard of the material chosen. Communication with the suppliers also becomes more frequent. The designers will have to check the quality of the materials and ensure that the criteria of the materials used suit the Building Regulations. For Interviewee D, the product information would already have been discussed in the final proposal stage. Using the scoring system introduced earlier, the communication frequency for Phase 2 is shown in Table 4.4 and Figure 4.4.
Table 4.4: Overall frequency of communication between the architect and other parties during Phase 2

<table>
<thead>
<tr>
<th></th>
<th>QS</th>
<th>Supp</th>
<th>M&amp;E</th>
<th>Struct</th>
<th>Site</th>
<th>SC</th>
<th>PC</th>
<th>Clnt</th>
<th>CDMC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int A</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Int B</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Int C</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Int D</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>9</strong></td>
<td><strong>14</strong></td>
<td><strong>14</strong></td>
<td><strong>1</strong></td>
<td><strong>5</strong></td>
<td><strong>5</strong></td>
<td><strong>12</strong></td>
<td><strong>28</strong></td>
<td></td>
</tr>
</tbody>
</table>
PHASE 3: TENDER DOCUMENTS AND TENDER ACTION

Figure 4.5: Frequency of H&S communication at Phase 3 – Tender Documents and Tender Action stage

Key:

- Interviewee A – RED
- Interviewee B – GREEN
- Interviewee C – BLUE
- Interviewee D – ORANGE
- Very Frequent
- Frequent
- Often
- Seldom
- Very Seldom
At the tender stages, as showed in Figure 4.5, communication of H&S information becomes less condensed and in most cases 'seldom'. For the tender stages, tender documents and tender action, communication between Interviewee A and the client, quantity surveyor, structural and mechanical engineers is very seldom; it is just a formality to keep them informed of what is going on at this stage. However, H&S communication between Interviewee A and the CDMC is very frequent at this stage to ensure that H&S issues have been taken into account and compiled in the tender documents.

At the tender stages, communication between Interviewee B and C with the CDMC is less frequent or seldom, but is vital. For example, they typically have only one meeting with the CDMC, but the H&S issues discussed in the meeting are crucial and must be inserted in the tender document. Interviewee D does not practice tendering, as they are in a long-term framework partnership.

According to Interviewee B, the pre-contract meeting is very important because at this meeting, the designers, client and contractor meet face to face to discuss the construction strategy. At this meeting, the relationship among all parties should be confirmed. Interviewee A shares this opinion. A good relationship between the parties involved is crucial to ease communication. Based on Interviewee A’s experience, H&S issues on site are better communicated verbally. To achieve the maximum effect of verbal communication there should be good understanding between the parties. Therefore, the pre-contract meeting is very important as a platform to establish good client-designer-contractor relationships.

It is important to note that this study is considering communication from the architect’s perspective. It is accepted that there will be significant levels of communication directly between other stakeholders that do not involve the architect specifically. Figure 2.7 in Chapter 2 illustrates the additional complexity when all stakeholder communications are considered.
Table 4.5: Overall frequency of communication between the architect and other parties during Phase 3

<table>
<thead>
<tr>
<th></th>
<th>QS</th>
<th>Supp</th>
<th>M&amp;E</th>
<th>Struct</th>
<th>Site</th>
<th>SC</th>
<th>PC</th>
<th>Clnt</th>
<th>CDMC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int A</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Int B</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Int C</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Int D</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
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<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.6: Representation of overall frequency of communication between the architect and other parties during Phase 3

Figure 4.7 shows how the communication frequency changes through the phases and clearly shows the domination of communication between the architect and CDMC regarding H&S issues.
Figure 4.7: Representation of overall frequency of communication between the architect and other parties during the three phases.
4.5.2 Methods of sharing information

PHASE 1: APPRAISAL AND STRATEGIC BRIEF

Figure 4.8: Main methods of H&S communication at Phase 1 – Appraisal and Strategic Brief stage

Key:

- Interviewee A – RED
- Interviewee B – GREEN
- Interviewee C - BLUE
- Interviewee D - ORANGE
- Formal & recorded (all interviewees)
- Informal (all interviewees)

Throughout the design process, all companies interviewed use the same methods to communicate H&S. H&S communication is shared either verbally, in writing, or through drawings. In the appraisal stage, the interviewees tend to have meetings with the parties involved and record the H&S information. In normal
cases, only communication between the architects and clients and CDMC are recorded. Communication between the interviewees and the structural engineers and quantity surveyor at this stage is informal, mostly by telephone or informal emails to gain H&S information and the budget from each discipline. Communication continues in the same pattern in the strategic brief stage. The interviewees continue to communicate with the same parties involved, informally, either meeting individually or by telephone.

**PHASE 2: OUTLINE PROPOSAL, DETAILED PROPOSAL, FINAL PROPOSAL & PRODUCT INFORMATION**

![Diagram showing communication at Phase 2](image)

*Figure 4.: Main methods of H&S communication at Phase 2 – Outline Proposal, Detailed Proposal, Final Proposal and Product Information stage*
In the proposal stages, the pattern of H&S communication in construction continues to be the same. Communication is verbal and written at this stage but more formal. More meetings are held, and the H&S information is recorded. On rare occasions, according to Interviewee B, suppliers are also contacted to get some information regarding the materials that will be used in the construction. In the final proposal stage, according to Interviewee A, it is not easy to pin down the communication of H&S, because it is very dynamic and is not recorded all the time. They have discussions and meetings regarding the project, and simultaneously H&S information is taken into account and the information in the risk assessments is highlighted.

All four interviewees agreed that at the proposal stages, communication goes on and becomes more condensed, but the communication of H&S is not a major topic. Since all the parties involved in the proposal stages are coordinating the design together, they include H&S as part of their discussions. According to Interviewee B, the architects have separate meetings with the CDMC and review the H&S information in depth.

During the product information stage, the communication of H&S continues in a more formal way than the previous stages. All four interviewees have more formal meetings, sending emails, faxes and letters and having conversation via telephone calls with the client, suppliers, engineers, quantity surveyor and the CDMC.
All the considerations of H&S have been made in the previous stages. According to Interviewee B, they have only one meeting with the CDMC, but the meeting is considered to be very important to review the H&S risks. This is to ensure that all the information is gathered and the design is safe to be constructed. In some cases, at this point the contractor has already been appointed. Therefore, according to interviewee B, communication between the architects and the contractors happens mainly via meetings and drawings.
### Table 4.6: Summary of Methods at Phase 1

<table>
<thead>
<tr>
<th>Stage</th>
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<tr>
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**Key**
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- Important = 4
- Less Important = 2
- Not important = 0

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**Figure 4.11: Representation of overall method of communication in Phase 1**
Table 4.7: Summary of Methods at Phase 2

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Key: Very Important = 8  Important = 4  Less Important = 2  Not important = 0

Figure 4.12: Representation of overall method of communication in Phase 2
### Table 4.7: Summary of Methods at Phase 3

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</tbody>
</table>

**Key**

- Very Important = 8
- Important = 4
- Less Important = 2
- Not important = 0

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**Phase 3 - Interviewees A, B, C & D**

![Diagram](image.png)

**Figure 4.13: Representation of overall method of communication in Phase 3**
4.5.3 Communication barriers

Getting H&S information input from the client

All four interviewees agreed that one of the challenges to communicating H&S is to get the most H&S input from the client. According to Interviewee B, H&S information must be collected from the earliest point of the design stage. This is very important to ensure that H&S is considered in the design. This view is shared with Interviewee D: based on experience, the investigation of H&S risks should be done as soon as the client approaches the designer with a project proposal.

For example, the investigation of asbestos existence in a construction site should be carried out before the appraisal or strategic brief stage so that at the proposal stage the precautionary steps to minimise the risks of asbestos can be included or considered as the design of the project develops. If the existence of asbestos is not established until the final proposal stage, the design would have to be revised, and it will take longer to finalise the design. In a worst-case scenario, if asbestos is only found during the construction phase, this will put the workers or site agents in danger and also significantly delay the project. Therefore, it is very important to carry out a thorough site investigation and compile the H&S information before the design starts to minimise the risks at any point.

Client’s construction/buildability knowledge

In regard to the client, all four interviewees also have much the same opinion about the clients’ knowledge of construction. If the client comes from a construction background, they are likely to understand the importance of highlighting the H&S risks. Problems arise if the client is from a different discipline or has very little knowledge about construction. Some of the clients that Interviewee A and D have dealt with did not know about the CDM regulations. Therefore, it is not easy to gain H&S input from them and they would hesitate to spend more money to hire specialists for site investigations or land surveying.
Interviewee B mentioned that some clients have their own H&S standards, but related to their business rather than construction. Therefore, it is crucial for the designers to communicate with these clients regarding the outline of H&S requirements and regulations for construction projects. In other situations, clients with little knowledge of construction rely on the CDMC to advise them about H&S in construction. However, according to Interviewee A, the problems occur when clients became too dependent on CDMCs. Many decisions must be made by the clients such as budget approval for H&S facilities, changes in design to coordinate H&S information and so on.

Too much documentation

The interviewees also agreed that too much documentation can lead to missed crucial H&S information. The most important aspect of the H&S plan for each project is to highlight the specific residual risks that the designers have not been able to ‘design out’ rather than including all the generic risks. Interviewee B thinks that it is human nature to avoid reading thick documents such as tender documents. Therefore, vital information such as H&S information should only point out the specific potential risks, which should also be communicated verbally and visually.

At some point in a project, there could be changes in the design, budget or time scale. The representatives from each discipline should be senior enough to make decisions when a problem needs immediate attention. The interviewees identified some cases where meetings were attended by junior representatives from other disciplines, which meant that the problems could not be adequately addressed.

Problems recording H&S information

Interviewee C finds it difficult to record all the H&S information and send all the information to other disciplines. Some of the conversations held were via the telephone. Interviewee C pointed out that the CDMC should be more proactive in
coordinating H&S information and to ensure that the parties involved get the same information. This aspect of the CDMC’s role remains contentious, despite clarification efforts made in the revised CDM 2007 regulations.

4.6 Discussion of Findings from the Preliminary Interviews

CDM Regulations

The findings from both the stages of the preliminary interviews are presented accurately from the interviewees’ views and opinions based on their current practice when the interviews were commenced. However, some of the practices do not appear to fully implement the CDM Regulations.

As discussed earlier, some of the clients depend solely on other team members in terms of H&S matters. As stated in the CDM Regulations, a client must be aware of their duties on H&S matters, but on the other hand, the designers are also responsible for checking that the clients are aware of this duty. A CDMC must be appointed so that the project is well coordinated and the client properly advised. Although the CDMC is the party who will have to coordinate H&S information between team members, according to CDM Regulations, the designers also make sure that they are competent and adequately resourced to address the H&S issues likely to be involved in the design. The designers must provide information about significant risks associated with the design and coordinate with others to improve the way risks and hazards are managed and controlled.

Differences in Procurement Methods

As explained in Chapter 2, the difference in procurement routes practiced by different organizations influences the way that H&S information is communicated. For example, in the second stage preliminary interviews, Company A practices a traditional procurement method, Companies B and C use the design and build
method and Company D uses the framework agreement procurement method. Therefore, the communication flow between the interviewees and their team members is also different.

For Company A, which practices a traditional procurement method, the developer of the project separately employs the designer and the contractor of the project. Therefore, the contractor is solely responsible for the construction site. It can be assumed that communication of H&S information between the designers and the other team members occurs at the end of the design stage, which, according to the RIBA Plan of Work, is at the tender document stage. The contractor will construct the project based on his/her understanding of the design given to them.

For companies B and C, which practice the design and build method, a contractor will employ a team for the project that will be assigned for both the design and construction phases. Effective communication among team members is crucial to ensure that all parties get the same H&S information. The hindrances that can be derived from the actors’ attitudes and limited H&S background which affect effective H&S communication will be discussed in Chapter 5.

For Company D, which practices the framework agreement method, an arrangement between the designer and the other team members (which in this case are known as suppliers) is made prior to the project proposal, which is typically for a long term. As mentioned by interviewee D, company D do not have many things to consider, as they outline all the necessary requirements of the project before its execution.

**Communication in the design stage is summarized as ‘straightforward’ (formal and informal)**

In general, the findings from the interviews with senior staff in the architecture companies showed that communication during the design phase is not as
complicated as communication involving contractors and professionals at the construction stage. Communication among designers is still classified as straightforward, and they do not experience major issues or challenges in sharing information between the designer teams.

The communication circle between designers is both via formal and informal meetings with the aid of telephone calls, faxes and emails. For H&S issues, risk assessment forms are used to highlight the potential risks and hazards and, at best, try to eliminate them. These forms have successfully reduced the amount of time spent going through thick documentation such as H&S files and tender documents.

**Geographic location is one of the major challenges for H&S communication**

Geographic location was identified as a challenge for the designers from all four companies to communicate with the other team members. Contemporary communication technologies such as video conferencing or Skype may assist with this challenge but are not currently used by the interviewees. One of the many examples of an advanced IT tool to aid the remote collaborative team members is an interactive intranet collaborative whiteboard called Collaboard (Kunz et al., 2010). Collaboard was developed to support mixed and geographically distributed team members. This tool allows team members to interact and share construction information via an interactive virtual whiteboard. The team members are able to access the databases through intuitive interfaces in order to integrate and maximise lifecycle-related parameters into a new product. The live video of the remote team members also allows for meta-information such as gestures, and results in more natural distant collaboration (Kunz et al., 2010).
A study was conducted by Ramalingam et al. (2011) to compare the usage of three different tools for remote collaboration, namely Skype, Videoconferences and Second Life. This study has shown that these three tools are able to aid communication among dispersed team members. An in-depth investigation of the effectiveness of the tools has shown that videoconferencing is the most effective tool; second place goes to Second Life, because the richness of the communication media of the two tools increases project performance. Skype (being the least rich communication medium) can aid communication between dispersed team members but is considered to be less effective. Another study was conducted by Pretto and Pocknee (2008) to determine the use of Skype, Elluminate Live!, Carrick Exchange and an Access Grid. In conclusion, this study found that the incompatibility of communication tools used by team members has been a major barrier to successful collaborative online project management. It can be assumed that some construction players refuse to implement the usage of IT due to this factor.

**Highlight only unusual risks and hazards & the use of a risk assessment form**

The architects interviewed also agreed that highlighting only the unusual risks on a particular project is essential. The risks and hazards highlighted should be specific. This saves time and produces less documentation on H&S matters and is particularly important with regard to construction projects involving many disciplines. Again, this aspect was highlighted in the revised CDM (2007) Regulations: the requirement in the original regulations for designers to produce a Pre-Construction H&S Plan had been leading to unnecessarily lengthy documentation, and this was replaced by the more flexible requirement to provide ‘Pre-construction Information’.
Client’s awareness

From the interviews, the lead architects agreed that clients should be more aware of the importance of H&S information by giving more input to the team members. Budget allocation should take H&S matters into account in order to provide the designers and the contractors with proper results of various site investigations and tests.

According to the interviewees, clients should provide H&S information at the earliest stage of a project so that all the considerations can be included in the design. Simultaneously, this could avoid clients having to spend money on avoiding risks that will not occur. The interviewees stressed that it is also very important for the clients to be willing to spend more money on H&S facilities and to understand their role and responsibilities to ensure that the project is planned and constructed safely. This is crucial to avoid accidents and injuries during construction.

Emphasize the CDMCs’ roles, responsibilities and relationships

The interviewees considered that CDMCs should play a larger role in recording all the H&S information and ensure that all parties obtain the same information. One of the interviewees suggested that the CDMC should be actively involved in every stage from the beginning of the appraisal stage until completion. It is noted that this is not required by the CDM Regulations, as the CDMC does not have responsibilities for construction.

One of the findings from the preliminary interviews is that the designers should also cooperate with the CDMC in reinforcing the H&S regulations. Regular communication should be made between the team members either verbally, in writing or visually to remind them of their roles and responsibilities in H&S. The interviewees also suggested that the principal contractor should be involved from
the earliest design stage, because with their knowledge and experience they can provide additional H&S input.

**Ensuring that the contractor’s team obtains the same H&S information**

It also becomes a challenge for the designer to ensure that the contractors get the necessary H&S information and use it appropriately. It is very important for the contractor to obtain H&S information, because the contractors need to ensure that all the work carried out on the construction site is safe and all the possible risks had been reduced or eliminated. In the CDM Regulations section in Chapter 2 it was explained that, under CDM, the designers must provide pre-construction information, outlining the main residual hazards that they have not been able to design out. The Principal Contractor should use this information to develop the H&S Plan for the construction. In an ideal world, the design would be frozen and this designer-generated information would only need to occur once. However, in reality, some elements of the design do continue into the construction phase, requiring the continuation of communication between the designers and contractors. The contractors must also ensure that the subcontractors and site workers receive the appropriate H&S information. This in itself is a complex area but is outside of the scope of this thesis.

Communication becomes greater in the construction phase. The interviewees felt that it was ‘almost impossible’ to keep track of all the H&S information communicated by different contractors, subcontractors, site agents and workers. Verbal communication is very important to ensure that every person involved is aware of particular issues. To produce effective verbal communication, the stakeholders must establish good relationships from the very beginning of the project. In this regard, all four interviewees agreed that it is better to focus on specific potential risks rather than generic risks.

Contractors have great responsibilities on site with regard to H&S. Therefore, they have to ensure that the subcontractors, site agents and workers get all the
H&S information and understand the work they are doing. The need for site agents and workers to have proper H&S training was also emphasised. The role of contractors is outside the scope of this thesis. Communication between team members and suppliers and subcontractors is also vital. Suppliers can be from a range of backgrounds and each product they supply to the construction site has different specifications. Subcontractors also come from different sectors, which brings its own challenges.

### 4.7 Conclusions

The findings include the acknowledgement that communication at the design phase is relatively straightforward, at least compared to the later construction phase. Designers communicate using both formal and informal methods. Geographic location remains an important barrier to good communication, but contemporary communication technologies such as video conferencing are not being used to address this. Effective communication along the full supply chain to contractors and subcontractors and suppliers is essential and remains a significant challenge. The need to only emphasise the unusual risks and hazards and avoid excessive paperwork was highlighted. The roles played by clients and CDMCs are important but, in the experience of the interviewees, are not fully realised. Clients should lead and CDMCs should coordinate. Overall, establishing and maintaining good relationships among team members, including suppliers, is an important and often neglected issue. The findings from the interviews were used to develop a model of communication of H&S information in construction (Chapter 7).
CHAPTER FIVE

FOCUS GROUP FINDINGS AND ANALYSIS

5.1 Focus Groups

The 47 participants involved in the focus groups were practitioners from various construction backgrounds, as summarized in Table 5.1. The groups were held across the UK to facilitate the attendees’ travel arrangements but were not intended to represent any regional variations.

Table 5.1: Focus groups participants’ individual positions and backgrounds

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5.2 Introduction

As stated in Chapter 3 Research Methodology, the focus groups were organized as part of the broader Prevention through Design project, funded by the USA Government via NIOSH, and led by John Gambatese from Oregon University. The focus group participants were expressing their views and opinions about designing for safety, including, but not limited to, the relevant areas of H&S communication, which are the focus for this thesis.

In order to determine the factors that affect the communication of construction H&S information in design, an in-depth analysis of the focus group data was executed to highlight the most relevant drivers and barriers that exist in current practice in design, in terms of communication of H&S information. This secondary analysis of the data gained from the focus groups aimed to explore:

- Factors that hinder the main players and their ability to communicate construction H&S information effectively
- Opportunities for improvement in the effective communication of H&S information
- Communication methods used.

Summary findings from this analysis are presented, with the main points illustrated by unattributed quotes from participants. Participant codes are used to protect anonymity. The professional background of the participant is added where relevant.
5.3 Factors that hinder the main players and their ability to communicate construction H&S information effectively

5.3.1 Client hindrances

Many clients try to avoid dealing with H&S matters and leave them to other team members. It is neither easy to encourage the communication of H&S information from the beginning of the project nor to obtain H&S information from the client.

“I was presenting at a university and one of the guys came to me afterwards and told me to go back into his practice and deliver a lunchtime session, to scratch the surface, but who wasn't there? The senior partner [owner of the company].” (N522c – CDMC)

According to the focus group participants, clients typically place the responsibility onto other parties such as the architect, contractor or CDM coordinator whom they appoint.

“Somebody that the client can just go to re H&S … there you go. You’re my agent; you deal with it.” (N3-29a – CDMC)

Some clients are not interested in knowing about H&S, and they do not have much awareness of it. One of the contractors mentioned that a client was solely dependent on him in terms of H&S matters:

“I want you [the contractor] to tell me [the client] that you are compliant with CDM, but that’s the extent of my involvement.” (N7-26c – Contractor)

To be able to communicate H&S information, a client should have knowledge of construction, buildability and design as well as H&S aspects. Some clients are from different, non-construction, business backgrounds. The situation limits the client’s awareness of important aspects that should be focused on from the earliest stage of a project, H&S aspects in particular. This was agreed by one of the respondents, who reported that:
“Our bigger problem is the client’s understanding of their duties under the H&S regulations.” (N14-5b)

Despite the extra cost of H&S implementation, the clients must be willing to contribute as much as possible to ensure that a project is carried out safely. One of the challenges from clients is that they are likely to neglect to appoint a CDM Coordinator at the earliest opportunity. And when they have appointed one, they still neglect their role in H&S, as reported by some of the respondents:

“The bit, as a CDM Coordinator, I still struggle with is the client accepting his responsibilities and not wishing to appoint the CDM Coordinator until he’s really sure that he’s going to do a building…” (N12-5b – CDMC)

“And I think a lot of them think that if they employ a CDM coordinator who … they just pass their responsibility onto the CDM coordinator. And in fact, I know that’s what they think because if you go to them and say ‘as a client you’re supposed to be providing me with information on drawings and all that sort of stuff’ they just say ‘oh, it’s not my responsibility – nothing to do with me, speak to the CDM coordinator.’” (N14-55e)

One of the CDMCs who participated in the focus groups believed that his early involvement would benefit the project:

“There’s an awful lot of changes by lack of knowledge on the project manager or the client representative side, and they don’t see the point of keeping us within the information loop and alerting us earlier. That’s where we make a difference, by early and significant involvement in the early stages.” (N4-9b – CDMC)

A lot of H&S issues arise when the client gets involved in a project, but often they do not communicate with the other team members.

“…there’s a missing link between the client and the designer and going forward as to why that doesn’t happen.” (N12-12a)
“When you partner, if you don’t talk, then nothing happens. The value engineering doesn’t work if you don’t partner right and the way the discussions go with design, they say, ‘okay then, we’ll go with that one but can you do something with that one?’ And they say, ‘okay,’ so a balance is created…” (N6-21b)

So, in summary, according to the focus group participants, communication with the client is seen to be an essential part of successful H&S risk mitigation. Participants claimed that clients have a tendency to be disinterested and thus avoid H&S matters, preferring to delegate the role whilst abrogating their own responsibility. Furthermore, some clients neglect their role even further by not even appointing a CDMC. The lack of construction knowledge and expertise amongst clients and their agents further limits their ability to communicate effectively. It is right to acknowledge, however, that there were no client representatives in the focus groups, so the opinions expressed here may be biased.

### 5.3.2 Designer hindrances

Designers are the members of the team who are involved from the early stage of a project and have the ability to influence H&S right from the start. This can be executed by considering H&S aspects in their design. During design development, communication between designers and the team members is essential. However, there are a few factors that hinder effective H&S communication between the designers and the other professionals involved.

According to some of the participants, some designers have no interest in H&S aspects:

“…it’s being sold here as a H&S issue. And it’s not a design issue. I’m a designer. I’m not a H&S person. The two wouldn’t work together, and it was very difficult to get people to go forward.” (N5-20b – Designer)
“...the designers I talk to, the first thing that is always exceptionally apparent is the designer is there because they want to do something they have a passion for. And all the other things that go with that while they are taught, while they learn, are part of the job. If they’re not taught, they’re not part of the job.” (N5-29a)

It is impossible to gather H&S information when the designer is not interested. Some designers also claim that they only do what has already been agreed in the contract with the clients. And they are not paid to design for H&S.

“Consultants are also saying we do what the clients want … they don’t go out of their way to do more than the client is going to pay for…” (N5-21d)

“The designers would reluctantly produce a risk assessment, for what worth it was, and there were some difficulties in that.” (N12-6a)

The designers’ attitude can create a communication breakdown, as some designers think themselves better than other people. This was expressed by a participant, who mentioned that:

“There’s also an element where the designers seem to think themselves a cut above everybody else. So they don’t talk to the engineers or the consultants, whatever it is, because they’re beneath them. And because of that then you get this breakdown in communication.” (N13-33a)

Furthermore, some designers think that they do not have any impact on construction H&S:

“I don’t think from a practical point of view in terms of what we do as designers, we would probably not change anything to be honest.” (N9-68a – Designer)

Some designers think that H&S is solely the contractors’ responsibility:
“…still a lot of ‘well it's the contractor, he can deal with that on site’” (N12-42c)

“…well, the constructor should solve his own problems…” (N2-16a)

Even if the designers consider the H&S aspects in their design, challenges exist when the designers do not collaborate with other team members, resulting in H&S information not being communicated and understood by them:

“They might be doing their job, but they're not doing it collaboratively. They're not getting together.” (N13-32a)

“But then if you move to the services engineers, electrical – I think it’s in between the two. This is my feeling, you’d expect them to be up there with the structural and civil engineers and actually they’re not.” (N5-44c)

Lack of inter- and intra-organisation communication has disabled the communication of H&S information:

“We had one contractor come back to me and told me about one of the designers and how he doesn't reckon much to the design. It was their company that's engaged in the design. It's like we engage a lot of design and build. So, effectively, their design, their in-house designers are designing it for their builders. And you would think that they would know and understand their processes for building things, but they don't. There’s no communication with inside the company, let alone within the organisation that forms the strategic alliance.” (N13-17a – CDMC)

“I remember when I did my apprenticeship, I worked in a sheet metal workshop and one of the things the guy said to me was the designers NEVER come down. So when I went up in the design team … 'What are you doing down here? We shouldn't be having to tell you, you should know, go away,' and they wouldn't talk to me. That happens quite a lot in a
Some designers do not have the knowledge to communicate construction H&S information with the other team members or to advise the client about it:

“Now if you look at what the designer does, in most cases as far as risk assessment is concerned, he has no basis for making an assessment of risk. No rational way of saying that way of doing it is more dangerous than this way of doing it.” (N9-8e)

“…but if you get twenty groups of engineers together in a room, and I’ve actually been part of such an exercise, and ask them to risk assess the same subject, you’ll get twenty different answers…” (N9-9a – Designer)

Another barrier preventing the designers from communicating H&S information effectively is that they do not spend much time on site. This has an impact on designers’ buildability knowledge, especially young designers:

“How do you translate it across to the contractor if you – there’s a gap in between drawing and site. It’s because they don’t do what we do, as you said. If they stay away from sites and don’t want to be involved then that’s why there’s no looking after the site work…” (N14-12a – Architect)

“I think one of the big problems the designers face these days is that new graduates, younger engineers do not get time on site to see the construction in practice and find out about buildability.” (N6-11a)

So, in a similar way to clients, some designers are just not interested in H&S and therefore do not communicate in that area. Some can have a superior attitude, believing that it is all the contractor’s responsibility and, in some way, beneath them. A lack of collaboration and inter- and intra-organisation interaction further exacerbates the difficult communication environment. Designers’ limited
construction and H&S understanding, combined with a lack of site experience and exposure, creates another barrier to effective communication.

5.3.3 Contractor hindrances

Contractors are the party whose main responsibility is the construction phase. Apart from maintaining safe construction, they have a major responsibility towards the site staff and workers who are exposed to hazards and risks on site. In current traditional practice, the contractor is normally appointed after the tendering stage or after the design stage (see the discussion on procurement routes in Chapter 2). The findings from the focus groups show that the construction practitioners are keen to see contractors appointed earlier to communicate H&S construction expertise to the design team. However, they also acknowledge the difficulties in achieving this:

“But the age-old problem is when do you engage a contractor and that’s the problem…” (N7-12a)

“But quite often now the view we have is you may not be running with that contractor at the end of the project, but you need to bring contractors in at design stage of the project, so the invitation is there, there is no guarantee you’re going to get this project because it’s going to go out (to tender)…” (N2-11c)

Although the early involvement of the contractor is an ideal suggestion to establish H&S communication, some contractors regard H&S issues at this early stage as the designers’ responsibility:

“For the most part, in that conversation the contractors aren’t very interested in talking to you about H&S.” (N14-21e – Architect)

“And he will, in his own mind, have an idea of how he’s going to build it. And the problem occurs is that how he builds it is not safe. He may have
As the contractors’ construction knowledge and experience is highly appreciated and needed, the other construction players feel that the contractor should communicate with them and listen or take part in discussions wherever necessary. However, the contractors’ ‘can do’ attitude, sometimes irrespective of the risks, can somehow make the other team members refuse to discuss any issues with them. This was brought up by an engineer in the focus group:

“There’s still a problem with the cultural issue of contractors that they still have a ‘can do’ attitude … and that’s a cultural issue but I think it’s gradually changing, but we’ve still got a long way to go on that.” (N3-32c – Engineer)

Some contractors also have blinkered views when it comes to trying new, innovative methods:

“…when I talk to contractors in this country they go, you can’t get the gear. And you’d think that you’re talking garbage.” (N8-44a)

So, in summary, the early appointment of contractors seems to be an eminently sensible way of improving H&S communication, particularly at the early stage of the design. However, some contractors find it hard to communicate with designers at this early stage, preferring to let the designers get on with the design so that they can concentrate on the construction process. Sometimes, the contractors ‘can do’ attitude and approach can restrict effective communication about reducing or eliminating risks. Some contractors want to stick to their tried and tested methods and won’t engage in dialogue about alternative ways of building.
5.3.4 CDM Coordinator (CDMC) hindrances

In CDM 2007, it was highlighted that the CDMC’s role is to coordinate H&S aspects of design work and to facilitate good communication between client, designers and contractors alongside a few other main duties. However, the focus groups stated that some CDMCs have neglected these duties and are not fulfilling their role, nor providing value for money:

“I mean, I had to copy him in on minutes of weekly meetings, etc., but he was meant to come and come to our organisation and review our competency and audit us and audit the process all the way and nothing at all. So, as far as I was concerned, he was getting money for old rope and we were doing what we do anyway.” (N7-37b – Designer)

CDMCs who participated in the focus groups mentioned that appointing a CDMC inevitably increases the cost to the actual budget for the project, and this can lead to prejudicial views against them:

“But if I have a notifiable project, I am legally required to appoint one (a CDMC). I don’t want to spend the money, I don’t see why I get to spend the money, I have to. And there’s a risk that the CDMC is seen as someone who will be there to disable the project, rather than safety … whereas actually if we’re used right we make it quicker and more efficient…” (N3-54b – CDMC)

“Well, we started – from a fee point of view, and probably an interesting one again, as consultant offering services. We’ve now on a number of projects been able to offer a fee that takes it up to a certain stage. So to sit with the team at an early stage through to, let’s say, planning application it will cost you a figure of £xxx. Depending on the project, obviously; that’s a bit of a floating scale.” (N12-11a – CDMC)
Due to the extra cost that the owner of the project has to bear, CDMCs might not be appointed until later stages. Therefore, the purpose of a CDMC as coordinator of H&S information would be more challenging. Also, according to the CDMC participants, a late appointment means that the opportunities to make cost savings from changed materials, means or methods have largely passed and changes are only likely to increase the cost:

“Cost. Nine times out of ten they will not take us on board until they know that they are going to build that project, purely because of the financial implications. I mean, from our point of view, the cost really doesn't change too much because you know all we see is we've now flagged up … you've brought us in at the later stage, there's all the things that you should have done, how are you going to manage that.” (N12-11d – CDMC)

“They don't see the results of that work being a solution which will make it safer to build, make it safer to maintain or even might even make it cheaper as a scheme.” (N12-11e – CDMC)

“But then the role of bringing the team together from the design perspective, there's this gap where the CDM Coordinator as I say won't be appointed until they see the time is right to appoint them. And by then too many decisions have been made more often than not.” (N12-10d)

This was also admitted by the other professionals in the focus groups:

“In that two-year period you've got plenty of time to do the prevention through design. Absolutely. But the thing is our organisation certainly doesn't engage the CDMC at that stage.” (N13-24d – Client)

“I know that the clients are supposed to appoint a CDM coordinator right at the very beginning of the project, but it’s very rare in our experience that they do…” (N14-17e – Designer)
Although the CDMC’s main role is to facilitate good communication of H&S information, they are often not appointed from the early stages due to the cost. This has resulted in a lack of safety H&S awareness for the other team members, as mentioned by one of the CDMCs in the interviews:

“There are still difficulties with it because again, as I say, we are not appointed until the 11th hour still in most cases. And I think that appointment then is just unfortunately you’ve missed all the opportunities.” (N12-6e – CDMC)

Another barrier faced by CDMCs to communicating H&S matters is when designers do not cooperate with them, as claimed by one of the CDMCs:

“I constantly, from a CDM point of view, would look at a design; I’d flag up the issues. I’ve got my work at a height. I’ve got my open stairwells. I’ve got my roof work, you know my non-slip surfaces, and now I’ve got my manual handling as well thrown in. All of these things. When you sit down with a design team, and this is where I have a huge problem, particularly when you are working with different designers, is how do we deal with design risk and the design interventions that we need to put in place along the way. And also the information that has got to go forward in a sensible manner.” (N12-36b – CDMC)

Designers, on the other hand, do not like to be reminded about something repetitiously, according to one of the CDMCs in the interviews:

“The CDMC … one of the unfortunate things that most designers perceive is that we ask the questions that they’ve actually neglected to ask themselves, and that can make us unpopular.” (N3-54c – CDMC)

However, according to other construction players through their experience dealing with CDMCs, the CDMC has typically been invisible to them. They could interact with a CDMC in only a very limited number of meetings:
“Well, my previous experience where a client appointed the CDMC, I saw him at one meeting. A kick-off meeting, and then I never saw him again.” (N7-36c – Designer)

“The biggest issue I came across in relation to CDMCs within our business is that when I asked of our people what they think of CDMCs, they turn around and say: ‘We’ve never seen them.’” (N9-65a – Designer)

A CDMC justified why they are not in every meeting held by the other team members, in particular designers:

“And sometimes, because of our situation, you are purposely made to be last on the list in terms of your meetings. You’re purposely made to … you know, can you deal with it outside of the meeting or whatever. And equally … you don’t need to attend every meeting to get your point across, which sometimes they think now they’ve employed you, you’ve got to be there at every meeting…” (N12-38a – CDMC)

According to some of the focus group participants, the CDMCs that they had dealt with previously did not have appropriate H&S knowledge and background. Therefore, the communication of H&S information with them was limited.

“…we are introducing some young people into CDM, and I’m thinking: ‘What are we doing?’ They just don’t have enough industry experience to remotely carry out a CDM Coordinator’s role…” (N12-38c)

It was argued that some of the CDMCs do not know their roles and responsibilities because of their lack of experience, background and knowledge about H&S in construction. Due to the lack of these qualities, the CDMC was not able to communicate H&S matters in a manner that would help the other team members to deal with risks and hazards; instead, according to some participants, they are trained to prepare a lot of unnecessary documentation.
“I could tell you that now we’ve had CDMCs\textsuperscript{3} in 94. So it has been 14 years. I can say without exception, in all the projects I’ve done in 14 years, I have had one CDMC or Planning Supervisor who has had any input, apart from creating loads of bureaucracy and paperwork. They don’t talk. They just give me a load of stuff, don’t ask any questions. I get regurgitated a load of stuff which again nobody reads it, total waste of time.” (N8-63b – Designer)

“I tell you now; I’ve thought – looking back through all the jobs I’ve done since CDM came in, and I can’t think of one [CDMC] who’s made a positive contribution, anywhere…” (N9-64a – Designer)

As much as the CDM Coordinators are expected to be involved in the design stage, they are also expected to make site visits from time to time to ensure that H&S information is being updated and used throughout the whole project. Concerns regarding the suitability of CDMCs to influence the design through their construction knowledge were raised:

“…the CDMC doesn’t tend to get actively involved in design issues related to safety. No. It almost needs the same people that come and actually check the building on site, it needs them to almost come at the design stage and check the drawings.” (N14-36a)

The main issue raised regarding CDMCs is that they are typically appointed too late to make an effective difference to the H&S outcomes. The extra cost of their appointment was acknowledged. The late appointment and lack of cooperation from some designers made effective H&S interaction with CDMCs difficult. Strong views were expressed that some CDMCs were not seen to offer value for money, were silent observers and generators of unnecessary paperwork. Comments were made about the lack of site experience and H&S knowledge of CDMCs, similar to the comments made about designers.

\textsuperscript{3} Actually, the 1994 Regulations used the term Planning Supervisor – but the role was similar to the CDMC.
5.4 Factors for Improvement

All parties involved in the focus groups realize the importance of communication of H&S information in construction. They strongly agree that effective communication among construction industry players from the design stage could reduce and control hazards and risks. One of the architects stated:

“…project teams have always talked. They've always had to talk. Architects and engineers have always had to make sure that the things coordinate and stitch together. What I think [is] there is now is a far better recognition … decisions I make as an architect will affect like the hazard profile and structure an engineer has. And I'm in a better position to make sure he’s aware of that and he has dealt with it and I understand the implications that has on me … as an architect…” (N3-30a – architect)

Focus Group participants agreed that there are things that can be done by all parties to improve the situation.

5.4.1 Client improvements

The focus groups highlighted that clients and designers are the key people that can have a positive influence on H&S performance in a construction project:

“But now the onus is more on the client and the designer and they’re more culpable and I think that’s having an effect in the short term…” (N6-42a)

Due to the rising awareness of the clients, H&S matters are becoming more of a priority regardless of the extra cost and additional time that they have to consider:
“Some of our ‘Process Water’ clients are industrial commercial clients, and they are far more aware at least of CDM, as it affects their building and plant…” (N7-26c)

The client’s role should be emphasised in order to drive change from the top:

“To me it’s at least 10 years late. If it had started off from okay let’s start with the client and then look at the process, we might have had a better, more comprehensive take-up, and then the issue of cost would have also been better understood.” (N7-27b)

Where there is awareness and commitment from the client, the H&S messages can be cascaded down to the other parties involved in the project:

“…the client setting the tone is really important for our culture to be passed on down through our supply chain. And for that message to be cascaded down, we’ve set what I call continuous improvement groups…” (N13-8a)

“I mean a lot of it comes down to the client. At the end of the day it says CDM obviously looks at the client role and says they’ve got the biggest impact on making sure H&S is within the design process, within the scheme, within the structure and everything else.” (N12-10c)

Some of the clients insist that H&S information is included on the drawings, which can impact positively on communication of H&S information among team members:

“…some clients, they insist that you put H&S information on the drawing, so on some projects, they would be different now to where they would have been in 1992…” (N4-29b – Designer)

The findings from the focus groups highlighted that clients should appoint competent team members. Competent team members are like a supporting tool that initiate and encourage positive collaboration between them. H&S information
interaction would be much easier if the team members are aware of their roles and responsibilities:

“The client, or whoever is dealing with you, should check whether you are competent on this project, or this area of work before even getting involved with you, so that is a plus on the legality side, but of course if that’s happening you are getting people around the table who actually understand what this building is going to be about and how, through our experience, knowledge and contacts, we can now bring something to the table to add value, rather than just pointing out you mustn’t do this, this…” (N12-12a)

The appointment of competent team members should also prevent the production of excessive paperwork, as each party will be expected to fulfil their role competently and only require the exceptional issues to be highlighted in documents:

“The starting point is that the client is appointing a competent team. That means, therefore, that each of the players in the team is competent in their area. So the way I look at all this stuff is the fact that, therefore, if you’ve got a competent construction team, it follows that everything that they do in normal construction, they’re competent to handle. And, therefore, it follows that the architect or design team only needs to point out things which are not common.” (N8-30d)

The client should also appoint team members at the early stage of the project, although it would cost the client extra money.

“...our repeat clients generally have good projects because they know what they’re talking about, they got the right advice. Sometimes they volunteer a coordinator early on, and the message cascades down.” (N5-60a)
In summary, clients are the key stakeholders. The best thing that could happen to improve H&S communication is to ensure that clients are committed to H&S. Where they are committed they make H&S issues a priority and the appropriate messages are conveyed. They are directive in requiring appropriate information to be added to the drawings. They appoint competent team members at an early stage. The competence of the players means that only the exceptional, unusual hazards need to be communicated – the competent designer or contractor can be relied upon to deal with the standard conditions.

5.4.2 Designer improvements

Designers are the construction professionals who are involved in projects from the early stages after being appointed by the client. The designer converts what a client requests into graphics. Therefore, their early involvement is very beneficial for the early detection and elimination of hazards and risks.

“For me, designers should come in at the top. So they should think about the risks first of all and then if they can’t avoid, reduce and work their way down the line. But what we find is when we get engaged, because it’s late on in the design process, they are there in the hierarchy, somewhere down the hierarchy.” (N5-32b – CDMC)

When the designers understand the risks and hazards, particularly at the interfaces between different elements and systems, they should include H&S considerations as their design develops. The design of complex buildings often strongly influences or even dictates the construction sequence. This concentration on interfaces would encourage H&S communication between designers, clients and the rest of the project team.

“Because that’s the thing ... the design is not just design of structure or looking at how the M&E are coordinated with the structural façade but it’s also the planning and sequencing of [the activities] and where a lot of
designers in general are shying away because, clearly, in certain circumstances, when you have for example façade and structure, how the two packages interface can remove or introduce significant risks.” (N3-37a)

“Something more towards the end, when you think of a plant room somewhere in your design, you make sure that your designer has worked through how he’s going to get the equipment up there and then subsequently it has to be replaced. So that’s a problem that’s been addressed and solved by the designer before he gets on site.” (N4-26b)

There was also a link seen between H&S and buildability. That could be one way to increase the focus on designing for H&S, which could link in to the focus on interfaces.

“The whole H&S in construction, buildability issue and then how it’s communicated out. We have thoughts, we put them down on paper or electronically or something, and we communicate them out in various guises to everybody. (N14-62a – Designer)

A designer must have basic H&S knowledge as well as buildability knowledge. Designers must know how to build the building to know that the design will enable a safe method.

“...you’d expect designers to at least have one safe method of doing that, the contractor may choose another…” (N4-27a – CDMC)

“But again, we have to be able to see a safe way of doing it. That may not be what the contractor elects to do.” (N9-30a – Designer)

The designer should know their responsibility for H&S in construction. Whenever there is an unsafe practice in construction, they should talk to the people who carry out the task. This attitude could make changes in the construction industry:
“Take the designer – the designer feels uncomfy about challenging somebody about doing something safely or going and talking to the contractor about it, they won’t do it because they don’t want to feel uncomfy. If they do it all the time, it will just happen.” (N5-40c)

Some designers in the focus groups suggested that the designer should be able to communicate H&S information amongst themselves, even without any external influence:

“So what we need to do is we need to, you know, think about it ourselves now and talk about it first, as soon as the contractor is appointed, about how he is able to do that in terms of getting those things in place.” (N14-40a – Designer)

Site visits are essential for the designers. They need to understand the nature of the site where the project will be located. The focus group participants also agreed on this:

“…it’s this thing you end up making sure that people get on site to actually see what the decisions they’re making as a designer, how they manifest themselves once they actually get onto a site.” (N4-48a).

They also stressed the benefits of site experience for designers:

“I’d love to see architects particularly spend at least six months if not a year out in the muck and bullets…” (N6-40c)

“I think that the designers and the architects should have some on-site training.” (N13-60c)

It is essential for designers to have construction H&S training. The training would aid the designer to design for safety.

“I don’t know. We talked about it for a long time about having given the engineers and the architects more training on design safety in rather than
trying to engineer it out. So it started to be – at the beginning, because if you try engineering solutions, people will try and get round those. They'll always try to get round these potentially. But if it's designed out completely at the beginning then we shouldn't be able to look at it really, I suppose.” (N13-60b)

“I echo what's been said about training and education of designers. I think that's all-important. I'd like to see the professional institutes take more of a lead in raising it as an issue, as a profile.” (N13-61c)

Above all else, H&S needs to be moved higher up the list of priorities for designers:

“And so through that whole process, yes; H&S is, you know, from our standpoint, higher on the list.” (N14-62a – Designer)

So, in summary, the focus groups considered that early involvement of the designer would facilitate better H&S communication. Concentrating on interfaces and buildability, leading to a better understanding of the construction process and sequence, would often be enhanced by communicating with the construction team, but could also be aided by more focussed internal interaction. The buildability link may help to prioritise this concentration on construction. Designers should know at least one way of building their designs safely, and if they cannot, then they must seek advice from the constructors. Construction site experience for designers is seen as a significant precursor for safe design along with regular visits to the project site itself. Training in H&S would improve designers' understanding. Designers must move H&S up their list of priorities.

5.4.3 Contractor improvements

Contractors’ teams are exposed to the risks and hazards on site. As discussed previously in this chapter, contractors and their staff have a ‘can do’ attitude.
However, some contractors are not ready to change their way of working even though it is dangerous, because they have been lucky to get away with no accidents. The role of contractors in H&S is a very large area. This section focuses only on the communication aspects, particularly those connected with the design.

The focus groups acknowledged that contractors have a very high impact on improving construction H&S:

“… the contractor, through his management and his temporary works and things, has a much bigger impact…” (N8-6b)

“These are contractors running their own initiatives. It's about behaviour and so, as I said, looking at more behaviour safety which, yes, you get hearts and minds and change the behaviour and attitude, then we start reducing accidents.” (N13-11a)

One of the changes that the participants from the focus groups would like to see is that the contractors are appointed from an early point of the project.

“But one of the things recommended was early contractor involvement, which brings the contractor into the design team so you can discuss with him how you’re going to build this thing, so if the designer is lacking or … it’s really complicated to build, talk to him about it and say, well, how would you build this, and it’s great to have that role.” (N3-47a)

“Where you're bringing in together at the start of the project – 'the team', being the client, the designer, the builder, any sub-contractors that are there, and by engaging the constructors at that stage, you’re getting their input into what is possible with the equipment and the processes that they’ve got with what actually is needed to be done.” (N5-13b)

“…the best improvements in design have been through early contractor involvement.” (N6-10a)
The positive result from contractors’ early involvement is that they can directly discuss H&S issues during the design stage. Therefore, in the design development process, H&S can directly be considered in the design.

“...at the minute, the designer designs; it’s the contractor that builds. The link we have with CDM is, we know that ... start talking, start discussing and the earlier you can start a discussion the better it’s going to be all around, because we may be able to resolve quite a lot of issues in your design that we would’ve had as a contractor.” (N2-20a – Contractor)

“...we’ve found by early contractual involvement and actually helping us design the structure it’s gone much better.” (N6-10b – Designer)

Contractors are expected to be an expert in terms of the construction process more than the other parties. Simultaneously, contractors are believed to have a big impact on positive H&S performance, if they are ready to change their attitude towards H&S:

“...before you can move the industry on far enough so that it really does become the way we do things around here, it does sound as though we’re having to make a decision or make a prompt that perhaps in an ideal it really should be the contractor automatically doing it.” (N4-23a)

In terms of contractors’ relationship with subcontractors, it was suggested by a participant from the focus group interview that it is essential for the contractors to have partnering arrangements with subcontractors to avoid communication breakdowns. This echoes the findings from the preliminary interviews, where the designer who was involved in partnering generally experienced more effective communication:

“I think the one thing we need to home in on is the word partnering. I know it’s a bit of a cliché and all the rest of it, but if you have partnering right from the design, right to the end of the construction phase and to the users’ phase with everybody all the way through, everybody who is
actually involved in the project [are] then both from the H&S point of view. And it’s important that the contractors are having partnering arrangements with their sub-contractors. (N6-14b)

However, there was some scepticism regarding nominated sub-contractors:

“Of course, that all goes out of the window when it becomes a nominated sub-contractor by a designer who’s not been involved in the process, so you end up with one broken cog in the machine that can wreck the whole system.” (N6-14b)

In summary, the focus groups concurred that the contractors have a major influence on H&S. They agreed that if they were appointed early they could have a more positive influence on the design. However, the attitude of some contractors needs to be challenged, particularly regarding their apparent willingness to ‘just get on and do the job’. Partnering of the supply chain was seen as beneficial to effective H&S communication.

5.4.4 CDM Coordinator improvements

The CDM Coordinator plays the biggest role to coordinate H&S information in construction:

“It depends on the coordination, but that’s one thing where the CDMCs were saying they have a lot more responsibility to make sure that happens, and they want to be postmen. I disagree entirely, because that’s the design team job, they should be doing that anyway, CDMC or no CDMC. CDMC is the coordinator, to bring them together…” (N2-27a)

“Within all these [practices], we’ve got what we call a CDM Advisor who is basically a CDM champion who can help the group or the practice when you have issues relating to H&S risks during design.” (N3-2a)
CDM Regulations 2007 state that the CDM Coordinator should have a central role to coordinate H&S communication among team members:

“…changes with the 2007 Regs, where there’s a more of an emphasis on competence and, as you’ve suggested ... that the CDMC is positioned more centrally in that pivotal role…” (N2-12b)

With these changes, it has been positively seen that the CDM Coordinator communicates not only to clients and designers, but they also communicate H&S information to the contractors’ team:

“…we’ve seen a lot of evidence that CDMC is now speaking, liaising with the contractors…” (N2-12c)

The CDM Coordinator is the person who would communicate H&S issues, risks and hazards to all project team members, as their role is to advise on these matters. Communication with the CDM Coordinator becomes natural, as their presence in the construction industry is to advise the practitioners, not to catch them out on any H&S issues.

“I know. I’ll speak for everybody. The intention of the CDM Coordinator is to be a health [and safety] advisor, it’s an advisor, he’s not a policeman, he shouldn't force anything, and actually the power of the CDMC is close to nothing.” (N4-44a – CDMC)

“It's an advice, it's a help that you’ve got there and he has to contribute to the design development, making sure that designers are taking H&S into consideration.” (N4-44b)

There is also the possibility that the promotion of discussing H&S and construction in general will bring other benefits to the project and result in better designs:

“Well it may be that externally, people, you know CDM co-ordinators, can have that kind of impression among architects and designers, but actually
what we’ve always found is once you’ve actually become involved in detailed design and been involved in workshops that they’ve actually said afterwards that was really helpful, not just on H&S but on the other design issues too.” (N4-44d)

Although some clients would appoint other professionals to be the CDM Coordinator of their project, the focus groups generally saw the person who manages H&S issues as an independent person, and this independence is important for the role as it has developed over the years:

“The original intention was actually to have … the role of CDMC … added onto one of the existing roles so the architect could be a CDMC as well. But it evolved over a period of time, but that didn’t work because they weren’t independent. You need that independent person to have that focus and to keep everyone thinking about it.” (N3-55b)

As the H&S professional, the CDM Coordinator would have meetings with the team members about the H&S issues that arise. This encourages H&S communication, especially between the client and the designer:

“That’s where it’s probably different; as safety professionals we have a problem and we would sit down together and resolve it because I think a lot of these other clients are probably designers; it’s their innovation they want to hold ownership to you and spread the message.” (N6-21a)

The CDM Coordinator would initiate H&S communication from the beginning of a construction project and be involved in the construction design development process to advise clients and designers regarding H&S matters:

“But the thing is if you’ve engaged them and they have input, be it for five minutes at the very start of the meeting; that five minutes can be crucial and save you so much time and effort two or three stages down the road that it pays dividends…” (N13-25a)
“What we always tried to do was get involved in the design process, support them through that process, have some interventions where the opportunity is there to review the design and allow some sensible decisions to be made. And we’ve tried to carry that forward with a bit more weight thrown at it from the new CDM regs, saying look, this is a process that we ought to be involved in early, this is a process you ought to be considering within your design, and the sooner we’re appointed the sooner we can support that role.” (N12-6c – CDMC)

The other construction practitioners generally appreciated the CDM Coordinator’s involvement in a project. Where the CDM role has been properly implemented as part of a competent team, the CDM Coordinator is seen as a source of H&S information, and where there are H&S issues, the CDM Coordinator’s input can always be relied upon to help resolve them:

“Obviously it does, because you’ve got experience and that is your value to your clients that you are … but my heart says to me you’re doing more than a CDM Coordinator, you’re just a jolly valuable member of the team with your wider knowledge.” (N12-25a – CDMC)

“Even to the point from a CDM point of view – they will pick up the phone and they will say, ‘this is coming up where we’ve got to build, we’re just looking at it now, we’ve got an issue on a certain aspect of it … what’s your involvement or what do you think your comments are, or can you talk to the designer…’ whatever the circumstance may be. And that is absolutely excellent.” (N12-39c – CDMC)

“…we start with CDMC and are approachable. And if we have dilemmas, issues we want to discuss, they are supportive and helpful…” (N14-20c – Designer)

The focus groups acknowledged the central, pivotal role of the CDMC. Where the role has worked it has worked very well. The CDMC provides an independent
input to the design, as an advisor rather than a policemen or just a postman, merely passing on information between the parties. CDMCs should be both the initiators of H&S dialogue and the source of H&S expertise, information and knowledge. The attitude of the CDMC is crucial here and their approachability is central to the success of the role.

5.5 Methods of Communication
This section looks at a number of communication methods that were raised by the focus group discussions. The focus group questions were not specifically designed to focus on these methods but were rather raised by participants.

This section considers verbal communication; written communication; graphical and visual communication; and IT and video enhanced communication.

5.5.1 Verbal Communication
This sub-section on verbal communication briefly discusses both informal discussions and formal communication, typically in meetings. The use of formal training sessions is also covered. In any industry, informal communication is very important to build good relationships between the people involved in a project:

“So the H&S immediately comes into the conversation. You know, it’s one of the decision factors that will be part of resolving that problem whatever the problem is.” (N3-30b)

Dialogue or face-to-face communication is an effective way to discuss H&S issues and means to solve them.

“I think they also need to talk to contractors more as well, have actually a sort of dialogue between them so that they understand construction methodology, which often they get a general idea of how a thing will be constructed.” (N4-38a)
One of the most effective methods of communicating H&S information in construction is via formal meetings, normally attended by most of the team members of the project. It is easy to convey H&S information during meetings when most of the involved parties sit together and discuss risks and hazards issues, as agreed by some of the participants:

“What we tend to do – I’m not saying that it’s the best way but I think that it is efficient – is sitting down with the representatives of the project team…” (N4-30c)

“In two of three projects where I – every Wednesday all day I was at the design team meeting, every week. Fantastic. A real positive contribution to the outcome. You know where the design is, if you get to one meeting a month you’d probably losing the speed with the designers, so if you’re not there you can’t influence and you can’t – its very difficult to keep up to date. So if the client's not going to put any resources into it…” (N5-48b)

The participants from the focus group interview think that even though there are many H&S sources such as H&S websites, books and training courses, meetings are a very effective platform to gain H&S knowledge:

“You may have like sort of list of hazard and risks, you can have manuals, one to one, you can have a huge number of books, but they need to be seen as a small, small part. I always say you can learn more in attending a two hours meeting than reading five books.” (N3-53a)

Another method via which H&S information is being conveyed is H&S training and courses:

“I run H&S courses. I find that they’re generally well received because it strikes me that people who are intelligent, which almost all of our colleagues are … well all of our colleagues are, I find that a lot of them are actually quite interested in H&S…” (N4-42a)
“...of course there's buckets of CDM training courses so they can whack their people onto those and accrue a few credits for having gone to do some training courses.” (N12-29b)

5.5.2 Written Communication

Written H&S information in construction offers the construction practitioners a tremendous amount of H&S information. The written sources can be instructions, reports, letters, emails and other documentation. This sub-section on written communication briefly discusses the use of H&S documentation, risk assessment forms and registers, regulatory documentation and advisory leaflets.

“...hazard register or hazard log? Hazard register, yeah. That is used by designers, for example if you have a specific package or a specific solution, how to record the hazards and the design measures or design changes that have been applied in order to either eliminate or reduce.” (N3-12a)

One written document that is widely used in construction H&S is the risk assessment form. Risk assessment forms and registers are used to highlight risks and hazards in a construction design and track them through the project.

“But what's inside is ... effectively is a design risk management tool that you list your hazards and your risk and your measures and then you work through those with the aim and theory of eliminating them completely.” (N3-14b)

Risk assessments are also used as a record, or even as a way of justifying the work done.

“...risk register ... It's a technique that many designers use for showing that they have considered, and these are the results of their considerations.” (N4-50b)
Construction practitioners keep a lot of safety H&S information for future reference. The H&S documentation is a way to convey H&S information to other parties involved in the project. H&S information that has been filed and documented can be used by other people:

“You know it’ll be documented. If there is an accident ten years down the line and somebody falls off while they’re maintaining that spire, you know the HSE will rake through the project and go: ‘Well, designer and architect, did you think about this?’ ‘Yes we did. The client said...’ and unfortunately it does get to that…” (N3-23a)

Legislation and regulatory guidance can be aH&S information sources for designers and constructors:

“Because what's interesting in terms of CDM, I notice now, most structural engineers in their rebar drawings put a little note telling the contractor how heavy rebar is. For a 25 mm bar, a length of 23 m or something is more than 20 kg.” (N12-50b)

“…wherever we use joist hangers now, make sure we put some notes on our drawings, safety notes about joist hangers and the depth of the beam must be this and so on and so forth. Because the HSE through their structural link has actually put a note out – there's been some collapse or some problem and they're saying now that joist hanger information, all structural engineers should put joist hanger information on their drawings.” (N12-51c)

There are also guidance leaflets from various organisations that contain H&S information being circulated to construction practitioners:

“And we also get – there’s another series of advice leaflets where you get tips and advice and there’s a H&S sort of version of that. (N14-14c)
5.5.3 Graphical and Visual Communication

Drawings are one of the most effective means of construction H&S communication. This sub-section briefly discusses development sketches, formal drawings and the use of colour coding, notes and symbols on drawings. The complexity of activities in a construction project makes it impossible for everyone involved in the project to get the same H&S documents:

“Yes. Because drawings are the accepted method of communication in the construction industry.” (N4-29d)

“2007 when the HSE said we prefer H&S information on drawings. In ’94 it was just provide information, that usually became a report or a document, but actually the guy with the spade would never really have read the document.” (N3-28a)

“…the client loved the sketch…” (N2-56a)

To enhance H&S understanding, designers add notes or symbols to drawings to highlight risks and hazards as well as to ensure that the contractors get to understand the drawing much better (see Figures 5.1, 5.2 & 5.3 for examples).
Figure 5.1: Notes and symbols on a drawing showing potential asbestos locations (Courtesy Paul Bussey, DIOHAS)

“...he came up with the idea of symbols on drawings. And that was something we looked at in terms of asbestos...” (N8-25b)

“...the notes and the significant issues are on the drawings because that’s what people look at on the site; they don’t look at reams of paper and risk assessments to highlight the significant things on the drawings for that particular area. I think that’s one of the main things that came out of the designer guidance when it first came out in 1995 was notes on drawings.” (N6-16b)
Some construction practitioners communicate H&S information in construction via sketches (such as Figure 5.3). According to some of the focus group participants, the sketch system helps them to enhance their understanding of the project.
“...we have a sketch system where these ideas are knocked around, edge protection, wire mesh or core drill sketch option, there you are, Mr Contractor, you do what you want…” (N2-23c – Designer)

“...we want to see is mark-ups on drawings. Because that’s the language that designers work in. So let’s have informal notes, let’s have sketches, let’s have all sorts of stuff that follows the train of thought.” (N8-26d – CDMC)

Another way to communicate H&S information visually is to put different colours on drawings to distinguish the different types of risks and hazards:
“Well, I can give you an example. The red, amber and green list that you were talking about, it's a guidance and I think therefore really you should have a look at the H&S standard developed for 2012 is available on the website so you can download it.” (N4-19c)

“But this is, sort of, a traffic light system that tells you what we should always try to design out, which some would say this is not acceptable, it is not acceptable to leave this in red with design and you’ve got yellow – let’s try to be careful and do something about it and green which is what should be encouraged in the design.” (N4-19d)

5.5.4 Software/IT and Video Enhanced Communication

With the developments in information technology, there are a lot of ‘new’ technologies that enable the communication of H&S information in construction, such as the intranet, video-conferencing, film-based training and Internet access. The use of a project intranet can significantly facilitate intra-organization communication and knowledge sharing:

“…we’ve got a fantastic intranet, health and … which is divided into three areas, which is safety in the office … which is straightforward and there’s nothing to talk about, safety on site and safety in design…” (N3-11b – Designer)

With the aid of video-conferencing via the Internet, construction H&S issues can be discussed virtually with others from all over the world:

“A number of networks where our people basically exchange and all topics … you know if you have a problem in design [with kerbs] you tap into the system and someone else from New York will help you out and stuff like that.” (N3-11c)
Film-based training on video or DVD could be a way to help the construction practitioner to gain H&S knowledge and understanding. Previously, it has been discussed that some construction practitioners are no longer able to go to the site for various reasons. Therefore, they lack construction and buildability knowledge and understanding. Participants considered that videos could aid this issue:

“…we were talking at both meetings about site experience and the fact that some engineers were lucky to have a year out, but that would only be on one project. Would there be any value in a video library of construction activities? Lots of small clips.” (N4-54a)

“There’s lots of other elements about getting service information and all that sort of stuff, but the DVDs are excellent, and I actually thought, I thought if this as an organisation takes it forward and the following videos are of the same quality, if the design – I mean we rent office space out of a design practice, and I've said to them – I said 'these videos are something I’m going to sit you down and just talk you through'.” (N12-16a – CDMC)

Nowadays, the Internet is widely used all over the world. It is easy to gain any H&S information and in particular construction H&S information. A construction practitioner may use any search engine available on the Internet to resolve their query about any safety H&S issues they are facing. The main disadvantage, however, is that the Internet user must know the validity of the information they find:

“…there's information out there for designers to understand, be it the sector guidance for working with designers, there's the sheets – I'm trying to think of what they – there's different websites out there and I can't think of all the names, but I've got stuff back in the office which is aimed purely at – even from the early days of the CDM for designers…” (N12-42b)
“The only thing I’ve used is – really is the Internet; used that quite a lot. Well, particularly to keep up to date with information.” (N14-13a – Designer)

5.6 Conclusion

The focus groups raised a number of issues that hinder the main players and their ability to communicate construction H&S information effectively and suggested various actions that could improve the situation. All stakeholders should move H&S higher up their list of priorities.

Clients were seen to be the key stakeholder and communication with them is an essential part of successful H&S risk mitigation. But clients have a tendency to be disinterested and thus avoid H&S matters, rather delegating the role whilst abrogating their own responsibility, sometimes not even appointing a CDMC. Where clients are committed, they make H&S issues a priority and the appropriate messages are conveyed. They appoint competent team members at an early stage, ensuring that only the exceptional, unusual hazards need to be communicated.

The groups suggested that some designers were also not interested in H&S, having a superior attitude, believing that it is all the contractor’s responsibility and beneath them. A lack of collaboration and both inter- and intra-organisation interaction further exacerbates the difficult communication environment. Designers’ limited construction and H&S understanding, combined with a lack of site experience and exposure, creates another barrier to effective communication. Concentrating on interfaces and buildability was thought to bring more focus to H&S dialogue.

The lack of construction knowledge and expertise amongst clients, their agents, design teams and CDMCs was seen as a major challenge to be overcome to achieve effective H&S communication.
Timely appointments of competent and experienced designers, CDMCs and contractors was seen to be an essential precursor to effective H&S communication along with working hard to facilitate effective interaction between all the main players throughout the design process and through construction. Construction teams should learn to communicate more effectively with designers about construction hazards and alternative construction approaches in a design context, and designers should learn to listen better. Partnering of the supply chain was seen as beneficial to effective H&S communication.

CDMCs are typically appointed too late to make an effective difference to the H&S outcomes, which, when combined with a lack of cooperation from some designers, made effective H&S interaction with CDMCs difficult. Some CDMCs were not seen to offer value for money, to be silent observers and generators of unnecessary paperwork. Where it works well, the CDMC provides independent input as an approachable advisor rather than a policemen or just a postman, both initiating H&S dialogue and being the source of H&S expertise, information and knowledge. The attitude of the CDMC is crucial here and their approachability is central to the success of the role.

Various methods of communication were discussed by the focus groups. Verbal communication includes both informal discussions and formal communication, typically in meetings and the use of formal training sessions. Written sources can be instructions, reports, letters, email and other documentation such as risk assessment forms and registers, regulatory documentation and advisory leaflets. Drawings are one of the most effective means of construction H&S communication and the groups discussed the use of development sketches, formal drawings and colour coding, notes and symbols on drawings. ‘New’ technologies such as the intranet, video-conferencing, film-based training and Internet access can facilitate more effective communication of H&S information in construction.
In the next chapter, the focus group findings will be analysed further with the findings from the literature search and preliminary interviews to develop a framework of communication of H&S information in construction.
CHAPTER 6

DISCUSSIONS AND ANALYSIS OF PRELIMINARY INTERVIEWS AND FOCUS GROUPS

6.1 Introduction

In order to identify the real issues that affect H&S communication in construction, feedback from the industry is urgently needed. Following the literature review, two stages of data gathering were carried out. The preliminary interviews were mainly intended to address the problem and to identify the flow of H&S communication at the design stage. Barriers and challenges as well as suggestions for improvement were also determined. The findings were very useful in determining that there are critical communication issues in conveying H&S information to practitioners involved in the design stage of a project. The next stage of the research was to conduct focus groups. There were twelve groups comprising construction practitioners from various backgrounds. In the interviews, the issues of construction H&S communication were determined in detail and the themes were similar to the preliminary interviews. Barriers and challenges as well as suggestions for improvements were explored.

In this chapter, the findings from the industry are summarised (section 6.2) and categorised into the three phases of communication (sections 6.3, 6.4 and 6.5). By categorising the information, the issues of communication of construction H&S information in design are clearly identified and remedies proposed.
### 6.2 Summary of the Findings from Interviews and Focus Groups

**Table 6.1: Factors that hinder the communication of construction H&S information effectively**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Interviews</th>
<th>F. Groups</th>
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<tbody>
<tr>
<td><strong>Actor</strong></td>
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<tr>
<td>Designer</td>
<td>To provide H&amp;S information</td>
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<td></td>
<td>To ensure the contractor retains the same H&amp;S information as upstream of the project.</td>
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<td></td>
<td>No interest in H&amp;S aspects.</td>
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<td></td>
<td>Designers are not paid to design for H&amp;S.</td>
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<td></td>
<td>Lack of inter and intra organization communication.</td>
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<td>Think that they do not have an impact on construction H&amp;S.</td>
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<td></td>
<td>Lack of collaboration and H&amp;S information sharing with other team members.</td>
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<td></td>
<td>Lack of construction H&amp;S background and experience.</td>
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<td>Client</td>
<td>Lack of construction knowledge.</td>
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<td></td>
<td>Not interested.</td>
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<td></td>
<td>Depend too much on designers/CDMC.</td>
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<td></td>
<td>To provide H&amp;S information.</td>
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<td></td>
<td>Not willing to increase budget for H&amp;S.</td>
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<td></td>
<td>Avoid communicating H&amp;S issues/no awareness.</td>
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<td></td>
<td>Incompetent project team’s appointment.</td>
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<td></td>
<td>CDM Coordinator’s late appointment.</td>
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<td>CDMC</td>
<td>Not actively involved in coordinating H&amp;S information.</td>
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<td></td>
<td>CDM Coordinator’s appointment adds cost.</td>
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<td></td>
<td>Late appointment.</td>
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<td></td>
<td>Designers refuse to cooperate with CDM Coordinators.</td>
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<td>Invisible to other project team members.</td>
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<td></td>
<td>Lack in construction H&amp;S knowledge and experience</td>
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<td></td>
<td>Do not know their exact responsibilities</td>
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<td>Prepares a lot of unnecessary documentation</td>
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<td>Lack of site visits</td>
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<td>Contractor</td>
<td>Late appointment.</td>
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<td></td>
<td>Think that H&amp;S designers’ responsibility</td>
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<td></td>
<td>‘Can do’ attitude.</td>
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<tr>
<td>Method</td>
<td>Document</td>
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<td></td>
<td>Too much documentation</td>
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<td></td>
<td>A lot of paperwork takes too much time</td>
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<td>Information not understood due to lack of integration among team members.</td>
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<tr>
<td>Drawing</td>
<td>Too much information written on drawing and the information being ignored</td>
<td>√</td>
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<tr>
<td></td>
<td>No integration between designers to produce the drawings</td>
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<tr>
<td></td>
<td>Design change</td>
<td>√</td>
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<tr>
<td>Telephone</td>
<td>Some conversations were held via telephone and therefore not recorded.</td>
<td>√</td>
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<tr>
<td>Site Visits</td>
<td>Construction practitioners do not know what to expect from the actual site.</td>
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<td></td>
<td>Lack of good relationships with people working on site.</td>
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<tr>
<td>Environment</td>
<td>Location</td>
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<tr>
<td></td>
<td>Geographic Location determine the smoothness of H&amp;S communication between team members.</td>
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### Table 6.2: Factors to improve effective communication of construction H&S information

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<thead>
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<th>Actor</th>
<th>Designer</th>
<th>Interviews</th>
<th>F. Groups</th>
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<tbody>
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<td></td>
<td>Early involvement is very important to identify risks and hazards.</td>
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<tr>
<td></td>
<td>Must have understanding of hazards and risks to implement H&amp;S aspects in the design.</td>
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<td></td>
<td>Must have H&amp;S knowledge and experience.</td>
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<td>Should make regular site visits.</td>
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<td>Must be aware of H&amp;S responsibilities.</td>
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<td>Client</td>
<td>H&amp;S is a priority to some clients.</td>
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<td></td>
<td>Awareness of H&amp;S issues is increasing.</td>
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<td></td>
<td>It’s very important that clients allocate budget for H&amp;S implementation.</td>
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<td></td>
<td>Demands H&amp;S information on drawings.</td>
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<td></td>
<td>Should appoint competent team members.</td>
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<td></td>
<td>Must have construction and buildability knowledge.</td>
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<td></td>
<td>Should appoint relevant team members at early stage of construction.</td>
<td>√</td>
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<tr>
<td>CDMC</td>
<td>H&amp;S is a priority to some clients.</td>
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<td>Awareness of H&amp;S issues is increasing.</td>
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<td>It’s very important that clients allocate budget for H&amp;S implementation.</td>
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<td>Should appoint competent team members.</td>
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<td>Must have construction and buildability knowledge.</td>
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<td>Should appoint relevant team members at early stage of construction.</td>
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<td></td>
<td>Source of H&amp;S information</td>
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<td>√</td>
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<td>Contractor</td>
<td>Early appointment.</td>
<td>√</td>
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<td></td>
<td>Should have H&amp;S construction knowledge, experience and necessary skills and training.</td>
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<td>Should prioritise the H&amp;S aspects.</td>
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<td>Partnering arrangements.</td>
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<td>Method</td>
<td>Document</td>
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<td>Should be short and straight to the point.</td>
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<td>As reference to construction practitioners.</td>
<td>✓</td>
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<tr>
<td></td>
<td>Thick documents and files could be avoided</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Drawing</td>
<td>One of the most effective media for H&amp;S communication.</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Drawing</td>
<td>Risks and hazards are highlighted with different colours on drawings.</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
6.3 Phases of Communication of Construction H&S Information in Design

The findings from the preliminary and focus groups are categorized into three phases of H&S communication at the design stage, as illustrated in Figure 6.1. The phases are developed from the research done by Kashyap (2007), which identified that H&S communication must be organised at different levels (section 1.2 in Chapter 1). These levels or phases are matched with the RIBA Plan of Work, which consists of three main stages – the pre-design stage, the design stage and the construction stage – and is subdivided into eleven activities. However, this research focuses on the design phases; therefore, the three phases of communication in this chapter are derived from the appraisal stage to the tender stages according to the RIBA Plan of Work stages.

Phase 1: Client’s team and designers and CDMC (Appraisal & Strategic Brief)

Phase 2: Designers’ team (Proposal Stages & Product Information)

Phase 3: Designers’ team and other team members (Tender Stages)

Communication of H&S information Phase 1 focuses on the pre-design stage, which determines the communication process of H&S information between the client’s team and the newly appointed designers as well as the CDMC and the quantity surveyor. Communication of H&S information Phase 2 addresses the design stage, which determines the communication process of H&S information among the designers involved in design development until the final design has been produced. Communication Phase 3 covers the H&S communication process between the designers and the other parties as well as the contractor’s team involved in the construction process. All these phases are illustrated in Figure 6.1. Although the design process is not straightforward due to changes and alterations of the design, the phases of H&S communication in the design stage are intended to identify the H&S issues. The communication process will be repeated several times until a design is finally approved.
Figure 6.1: H&S Communication phase in the design stage
6.4 H&S Communication Phase 1: Client’s Team and Designers

The first phase of H&S communication, as illustrated in Figure 6.2, is initiated at the start of a new construction project.

![Diagram of H&S Communication Phase 1: client’s team and designers]

*Figure 6.2: H&S Construction Communication Phase 1: client’s team and designers*

The project starts with the client issuing a proposal. As stated in both Chapters 4 and 5 regarding the findings from the industry, some clients might be equipped with construction knowledge while others barely understand construction or buildability. This has created challenges for H&S communication from the earliest point of a project.

From the preliminary interview and focus group findings, it appears that the communication challenges start when a client lacks construction H&S knowledge or is not interested to know about H&S aspects in further detail. In a worse case scenario, some clients depend too much on designers or the CDMC to solve H&S issues. These attitudes affect H&S information output from the clients. Rather than communicating the H&S issues with the project team members, the client will appoint an agent to deal with these matters.
At this phase, in order to initiate effective H&S communication from the beginning of a project, the client must be clear about his/her role and responsibilities with respect to construction H&S. Only then can the H&S culture be embedded in the working environment and H&S information cascaded down the line. With regards to the communication issue with the clients, some of the interviewees in the focus groups suggested that the client should be actively involved in the project and equip themselves with the necessary knowledge.

As the owner of the particular project, the client could encourage H&S to be considered right from the start if they understood the requirements. Budget allocation for H&S implementation must be included when the client proposes a project. Although the budget for H&S implementation used to be an issue for most clients, the industry is seeing improvements due to the growing awareness of the need for safety in construction projects. The H&S budget should include the hiring of the CDMC and contractor at an early point of the design. Their knowledge and experience will assist the designer to design for H&S. According to one of the participants in the focus groups, prevention through design results in less work that has to be done on site.

“…if you put more into the prevention through design at the beginning, you do less on site.” (N11-54b)

The findings from the focus groups show that there are improvements from some clients who make H&S a top priority. At the first phase of H&S communication in construction, the client appoints designers, a CDM coordinator and a quantity surveyor to the team to finalise the primary design. At this stage, the client has frequent contact with the team members, especially the architect, to develop the preliminary design either verbally or in writing. The main method of H&S communication at this stage is via meetings. Telephone calls, emails and faxes are also used. At this stage, risks and hazards are identified. Therefore, it is
crucial that the client encourages the project team members to eliminate these risks and hazards and communicate with each other to solve the issues.

At this stage, communication between the client and the engineers is rare. Design engineers are likely to be contacted (via informal meetings or telephone calls as well as via email) only if there seems to be an issue in their work scope. The frequency of H&S communication between the client and the CDMC is the same as with the architect. The feedback from the industry clearly shows that the team members and the CDMCs would like to see the CDMC being appointed at an early stage of the construction. Communication of H&S with the quantity surveyor at this point is very limited apart from making budget calculations for H&S implementation in the project. Figure 6.2 shows the communication flow in H&S communication Phase 1: Clients’ Team and Designers, which has been described in this section. Figure 6.3 presents the main hindrances to and facilitators of good H&S communication in this phase.

![Figure 6.3: Main hindrances to and facilitators of good H&S communication in Phase 1](image)

Figure 6.4 shows the frequency of communication between the architect and the other parties in this phase, along with the main methods of communication, based on the combination of data from the preliminary interviews.
6.5 H&S Communication Phase 2: Designers’ Team

After the design has been finalized, in the second phase of construction H&S communication, designers mainly communicate H&S information. The development process of the final design of a project enables the designers to see each other more often and to get involved in frequent discussions regarding the project and, in particular, issues regarding risks and hazards. It is crucial that the risks and hazards detected are eliminated at this point of design.

Traditionally, the architect is the main actor involved in developing a design. The architect defines the client’s ideas and concept in drawings. The engineers will later complete the design with the necessary details such as the structure, services, materials and so on. In this process, many risks and hazards will be identified. According to the findings from the industry, communication in this phase becomes more condensed and is held in more formal ways. More meetings are held and the H&S information is recorded. To facilitate informal
discussions with one another, the designers use telephone calls, emails and faxes to keep each other updated or to demand more information.

In order to develop a safe design, it is crucial for the designers to have the necessary knowledge, skills, experience and training to design for H&S. It is clear that one of the main barriers for designers to communicating effectively about H&S is a lack of construction and buildability knowledge. Some of the designers do not understand how a building is constructed. One of the architects involved in the focus groups admitted that although he had been in the industry for more than 20 years, his knowledge of construction is still limited:

“I mean I know how buildings are put together but I don’t know how they’re built. I don’t know how somebody is going to build something and I’ve been building buildings for sort of 25 years now.” (N14-36b – Architect)

It is understood that the communication of H&S cannot be effective when the actors do not understand their roles in producing a safe design. The knowledge and skills to design for H&S can be obtained by attending the appropriate courses and training. Young designers can also be equipped with construction H&S knowledge if the subject is included in their courses. Education could help designers to understand their roles and responsibilities for H&S in construction.

The designers are not only expected to produce a safe design, but they are also expected to think beyond it. They must consider the safest ways for the constructor to carry out the tasks involved in constructing their design as well as maintaining the building later on. Another means by which a designer can identify risks and hazards and communicate H&S information effectively is to make frequent site visits. According to the participants, regular site visits can add to the team members’ understanding of the project.

From both the preliminary and focus groups, the principal contractors’ early involvement is highly appreciated by the other team members at the design stage. According to them, the principal contractors can aid the design in terms of recognizing the risks and hazards and offer solutions to the issues. Designers
and the principal contractor exchange a lot of H&S information at this stage. They must agree on the finalised design, because the contractors, through their experience and skill, may add considerations for safe methods of carrying out the construction of the project.

However, in certain cases, the clients do not agree with this idea, because they have to spend more money to hire the principal contractor for a longer period. CDMCs face the same situation in certain cases. Their early involvement can be seen as a burden to the construction budget. However, the client should see the benefit of their early involvement such as avoiding accidents, which could save them money and preserve the image of the company. The designers could be the party who persuade the clients to appoint a principal contractor and CDMC from the very beginning of the project.

In H&S communication in Phase 2, the CDMC is the person assigned to coordinate H&S information, as stated in the revised version of CDM 2007. It is very important that the CDMCs are actively involved in the design development process. Although the CDMC’s role and responsibilities are clearly outlined in CDM 2007, some of the participants in the focus groups mentioned that they have difficulty liaising with the CDMC, as they are invisible. Some CDMCs are involved in several projects at a time. The time that can be spent on each project is limited. However, some of the CDMCs who took part in the interviews said that they are not appointed at the early stage of design development. This limits their communication with other team members, even though their role as H&S coordinator is seen as beneficial. In order to overcome this issue, the client should ensure that a CDMC is appointed from the beginning of the project.

In construction H&S communication in Phase 2, quantity surveyors and suppliers are involved in the design stage in terms of producing design information and design costing. The client is expected to be actively involved in this stage. According to the findings from the focus groups, in some cases the clients
appoint representatives for them. Although they have to spend money to appoint consultants to deal with H&S, some critical decisions must be made by the clients, such as budget approval for H&S facilities, changes in design and so on. The communication in Phase 2 is illustrated in Figure 6.5.

Figure 6.5: H&S Construction Communication Phase 2: Designers’ team

Figure 6.6 presents the main hindrances to and facilitators of good H&S communication in this phase.

Figure 6.6: Main hindrances to and facilitators of good H&S communication in Phase 2
Figure 6.7 shows the frequency of communication between the architect and the other parties in this phase, along with the main methods of communication, based on the combination of data from the preliminary interviews.

**Figure 6.7: Frequency and main methods of communication between the architect and other parties at Phase 2**

### 6.6 H&S Communication Phase 3: Designers and the Other Team Members

Communication of H&S information continues to Phase 3, which mainly focuses on designers and the other team members, including contractors, during the tender stages. A contractor is involved if they are appointed at this point. Apart from the CDMC, the designers also hold the responsibility of sharing H&S information with all parties involved in the project. As discussed in Chapter 4, H&S communication and practices expand as the project moves towards the construction phase.

The contractor’s early involvement is very much demanded by the other team members, as discovered from the feedback from the industry, as they are
perceived as having a great impact on construction H&S. Contractors are responsible for the other parties down the line such as subcontractors, site staff and labourers. It is critically important that contractors ensure that the people on site get the same H&S information and communicate with them effectively.

H&S communication in this phase is via meetings, drawings, telephone calls, emails and faxes. Some of the construction companies in the UK establish intra- and extra-networking systems to aid communication. Meetings are the most essential methods by which the project team members can address and solve risk and hazard issues. Other than meetings, the actors at this stage communicate H&S information via drawings. The focus groups confirmed that drawings are the best way to highlight risks and hazards rather than using documentation. According to the participants, tender documents and H&S files are very thick. It is human nature to avoid reading such documents. Notes, colours and symbols on drawings are the media used to communicate H&S information effectively to people involved in a project and is done from the design phases. The symbols and different colours used to highlight risks and hazards on the drawings are easily identified by any of the team members as well as the site staff and labourers as areas where they should take precautionary steps. The notes on the drawings help them to understand the risks and act accordingly.

Although, traditionally, designers are not actively involved at the construction stage, according to the participants of the preliminary interviews, their role in terms of H&S should continue until construction completion. In the construction stage, the designers must communicate with the contractor’s team if there are any changes or alterations to the design. According to one of the focus group participants, as the coordinator of H&S information, the CDMC should be available to the contractors at all times to ensure that the contractor obtains the relevant H&S information to be passed down to the people on site. It was highlighted in the focus groups that the clients are also responsible for monitoring the work on site and undertaking an active role in advising the contractor when
they see any tasks that would endanger the labourers on site. One client who participated in the focus groups mentioned that he had started to have conversations with people on site. In Chapter 5, the fact that the contractors’ attitude can sometimes be a big barrier to H&S communication between themselves and the designers was discussed. Some contractors have a ‘can do’ attitude. Some contractors refuse to take on board the designers’ suggestions for carrying out a task in a safer way, resulting in less discussion in terms of finding ways to solve H&S issues.

Figure 6.8: H&S Construction Communication Phase 3: Designers and the other Team Members
Figure 6.9 presents the main hindrances to and facilitators of good H&S communication in this phase.

**HINDRANCES**
- Contractors’ ‘can do’ attitude prevents H&S communication
- Some contractors refuse to take designers’ suggestions.

**FACILITATORS**
- Contractor’s early involvement
- Contractors should ensure that people on site get appropriate H&S information
- Some companies establish intra- and extra-networking to aid communication between team members
- Drawings are very effective to communicate H&S info
- CDMC must be available until project completion

*Figure 6.9: Main hindrances to and facilitators of good H&S communication in Phase 3*

Figure 6.10 shows the frequency of communication between the architect and the other parties in this phase, along with the main methods of communication, based on the combination of data from the preliminary interviews.

*Figure 6.10: Frequency and main methods of communication between the architect and other parties at Phase 3 (Tender)*
6.7 Conclusion

The client plays a very important role in creating an H&S culture in any project and initiating H&S communication from the primary design development stage (H&S communication Phase 1). The designers also contribute hugely to effective H&S communication by producing a safe design (H&S communication Phase 2). H&S information can be communicated during design development via meetings with project team members, as well as by including notes, symbols and highlighting to indicate risks and hazards on the drawings.

The involvement of the CDMC and contractor from an early stage of the design would assist the designers to produce a safe design. Contractors, through their skill and experience, can add additional H&S considerations into the design. The CDMC, on the other hand, can help by coordinating H&S information and ensuring that all parties involved in the project get the same H&S information.

During the tender phase (H&S communication Phase 3), the designers should liaise with the other team members regarding H&S. Should there be any changes or alteration to the design, the designers must ensure that all of the team members including contractors (if appointed at this point) are aware of the changes and take appropriate steps to act accordingly. The contractors must have the initiative to discuss problems of construction with the designers. Despite the fact that the contractors are in control of the construction stage, they should not ignore other actors' opinions on resolving risks and hazards on site.

Effective communication between team members from the start of the project until construction completion would ensure that all of the relevant H&S information is transferred to and referred to by all of the players in the construction project. Retaining the correct and appropriate H&S information would help the team members carry out their responsibilities in the correct manner.
Accidents could be avoided by eliminating the risks and hazards earlier in the design stage. If there are any risks and hazards that cannot be avoided, then these should be reduced and must be communicated to the appropriate team members. Lastly, if risks and hazards still exist, the contractor should be able to control them with adequate preparation and the cooperation of the clients, designers, CDMC and people on site.

The summary of these phases can be referred to Figure 6.11.
Communication of Construction H&S Information in Design

**HINDRANCES**
- Clients don't understand construction
- Clients not interested in H&S
- Clients abrogate responsibility & pass it to an agent
- H&S culture embedded in work environment
- Risks/hazards identified early
- Client has frequent contact with others
- Clients make H&S a top priority
- CDMC & contractor appointed early
- Adequate budget allocation for H&S
- H&S considered right from the project start

**FACILITATORS**
- Client has frequent contact with others
- Clients make H&S a top priority
- CDMC & contractor appointed early
- Adequate budget allocation for H&S
- H&S considered right from the project start

---

**KEY:**
- **Informal:**
  - Client
  - Design
  - Contractor
  - Sub-contractor
  - Site Staff/Workers

- **Formal/recorded:**
  - Architect
  - Engineers
  - CDMC
  - QS

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**Figure 6.11:** Summary of Communication Methods, Actors and Factors that Affect the Communication of Construction H&S Information in Phases 1, 2 and 3.
CHAPTER 7

DEVELOPMENT & EVALUATION

OF THE H&S COMMUNICATION MODEL

7.1 Introduction

Following the analysis of the findings from the industry, this chapter will focus on the development of the model. As stated in Chapter 3 Methodology, this research uses qualitative methods – literature reviews, preliminary interviews and focus group secondary data analysis. Based on the data gathered from the literature searches and fieldwork as well as the analysis process, the Model of Communication of Construction H&S Information in Design had been developed and validated. The development of the model is also based on the HSE guidance for designers which can be referred and available online at http://www.hse.gov.uk/construction/healthrisks/designers.htm, which introduces the concept of ‘Eliminating, Reducing, Informing and Controlling’ H&S risks and hazards (ERIC).

The introduction of ERIC helps the designers to address risks and hazards in their design process. Through discussions with other team members, the risks and hazards can be highlighted either verbally, in writing, or on the drawings to remind each other to include H&S considerations in their design. Extra information can be included as notes attached to the design documents, including tender documents and drawings that will be passed down to the contractor’s team.

During the focus group sessions, it was found that many designers lack construction and buildability knowledge. Therefore, some might not be aware of
the risks and hazards that might occur in their design, or how to deal with the risks and hazards even if they are aware of their existence. To improve this situation, the designers can use ERIC to help them deal with H&S issues in order to identify and react accordingly. The four stages of ERIC are: 1) Eliminate; 2) Reduce; 3) Inform; and 4) Control. These four stages will be elaborated upon in this chapter.

The findings from the industry have shown that risks and hazards can and should be eliminated, or at least reduced, as early as possible. It is understood that H&S is the responsibility of everyone involved in the project. The traditional view that the contractor is responsible for H&S matters is no longer valid. In the construction industry today, the client and designer in particular, plus the other team members such as the sub-contractors, suppliers and quantity surveyor are also responsible for the safety of others. Hence, the study focuses on the design phase of a construction project as well as considering the context of the entire construction process.

The conceptual model is based on the communication process of construction H&S information in design and was developed in a hierarchical manner. This chapter will explain how the model relates to practice and the benefits that will be gained.

### 7.2 Objectives of the Model

The model aims to illustrate the effective process of H&S communication in construction, mainly in the design stage. In order to meet the fifth objective of this research, which is ‘To develop and validate an integrated model for communication of construction H&S information in design’, a model was developed and validated. The objectives of the model are:
1. To demonstrate the flow of risk and hazard elimination by different processes – eliminate, reduce, inform and control.

2. To identify which actors in each process are the key personnel for effective H&S communication.

3. To determine which of the existing methods of H&S communication are the most commonly used and the most important.

4. To contribute a model to the industry that will aid designers and other construction practitioners in terms of H&S communication to identify risks and hazards and to deal with these issues.

7.3 Background and Development of the Model

Early design decisions such as the choice of materials, construction methods, work programme etc. influence H&S implementation in construction projects. Therefore, it is crucial to identify and eliminate the risks and hazards from the earliest point of the construction project. Apart from the client, the designers, as the group of professionals primarily involved in a construction project, bear the responsibility of creating an environment which prioritises H&S matters. This is to enable the constructors to carry out the construction safely. H&S information should be highlighted and communicated from the client’s team and cascaded down to the designer’s team, the contractor’s team and all other parties involved in a particular project.

The issues surrounding the communication of construction H&S information in design have been discussed in Chapters 4 and 5. The development of the model of the H&S Communication Process in Construction focuses on the actors and methods used to communicate H&S information from the appraisal stage to the construction stage (refer to the RIBA Plan of Work). The application of ERIC in the development of the model is also explained further.
Stage 1: Eliminate

According to the HSE (Health and Safety Executive, UK), occupational health or H&S should be an integral part of the design process in construction. During design development, risks and hazards should be identified in order to eliminate them. To do so, the designers should first have knowledge of H&S, construction and buildability. As discussed in previous chapters, it is crucial that a construction team member, regardless of position, has appropriate H&S knowledge and skills to design for H&S. It has been identified that without appropriate H&S knowledge, team members are not able to communicate H&S information to others. H&S knowledge and skills can be obtained via experience in the construction industry, site visits, training courses and education. Communication of H&S information also initiates knowledge sharing among team members.

The findings from the industry show that it is very important for H&S communication to be initiated from an early point in the design stage. Communication allows the design team members to collaborate in order to identify and eliminate risks and hazards.

Stage 2: Reduce

After the elimination of risks and hazards during the design stage, in many cases there can still be some risks and hazards that are impossible to avoid. Because of this, the designers should be aware that they have to reduce the impact of the risks and hazards, especially those derived from their design. In order to find alternatives or solutions to H&S buildability issues, designers should communicate with other team members who are expert in terms of construction, such as contractors and specialist sub-contractors.
Stage 3: Inform

After eliminating or reducing hazards wherever possible, if any risks or hazards remain, the designers must inform the other team members, especially the contractor’s team. The designer must be able to prepare documents or drawings that contain information about the residual risks and hazards which still exist in their design.

Stage 4: Control

At the control stage, the contractor is responsible for risk and hazard management. The site staff and labourers are exposed to the risks and hazards that still exist despite the efforts made to eliminate or reduce their impact. At this stage, although the contractor bears the main responsibility regarding site activities, the designers and clients should also be part of the construction process.
7.5 Model of Communication of Construction H&S Information in Design

Figure 7.1: Model of Communication of Construction H&S Information in Design
<table>
<thead>
<tr>
<th>RIBA Plan of Work</th>
<th>Levels of H&amp;S Communication</th>
<th>ERIC</th>
<th>Level of Risk (a)</th>
<th>Communication Process (b)</th>
<th>Potential Outcome (c)</th>
</tr>
</thead>
</table>
|                • Appraisal  
                • Strategic brief  
                • Product information | Phase 1 – Client’s team and designers  
  *(The CDM Regulations 2007 state that the clients must provide information to the designers, appoint competent team members and provide information related to H&S file to the CDMC. On the other hand, designers are responsible to ensure that client is aware of their duties and that a CDMC has been appointed).* | ELIMINATE | | | • Knowledge sharing  
• Lessons learnt  
• Documentation |
| | | | | | |
|                • Proposal stages – outline, detail and final  
                • Tender stages – document and action | Phase 2 – Designer’s team  
  *(CDM Regulations 2007 state that designers must seek to eliminate or reduce hazards where possible during design, provide information about remaining risks and provide information for the H&S file.)* | REDUCE | | | • Prefabrication  
• Knowledge sharing  
• Brief to team members |
| Construction stages – mobilization, construction and completion | Phase 3 – Designers and contractor’s team | INFORM & CONTROL | INFORM:  
- Regular meetings with contractors  
- Permanent H&S information on site  
- Use signage  
- Long-lasting material  
- Prefabrication system  
- PPE |
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<tbody>
<tr>
<td>(The CDM Regulations 2007 state that designers must provide information about remaining risks and the principal contractor, among other responsibilities, must liaise with the CDMC regarding design.)</td>
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**Table 7.1: Main components for Model of Communication of Construction H&S Information**
7.5.1 Communication of Construction H&S Information Process

Eliminate

As illustrated in the model (Figure 7.1), a construction project proposed by the client will have risks, hazards and other H&S issues. These issues have to be dealt with by the construction team members, based on their roles and responsibilities for construction H&S. The focus of the model is to look at the communication of construction H&S information processes, methods and key personnel to eliminate, reduce, inform and control the risks and hazards.

The elimination process is the first step to identifying and removing risks and hazards as much as possible. According to the RIBA Plan of Work, the early stages include the appraisal, strategic brief and product information stages. As discussed in Chapter 6, the first level of Construction H&S Communication is between the client’s team and the designers. Although the process to eliminate, reduce, inform and control the risks and hazards are repetitious throughout the project until completion, the model categorises the communication processes involved in order to determine the actors, methods and the outcomes that are expected from each of the ERIC stages.

In the early stages of design development, the clients play an active role in H&S communication. From Table 7.1, it can be seen that it is during communication level one, clients’ team and designers that the risks and hazards are most eliminated. The wavy line in the model between the ‘Eliminate’ and ‘Reduce’ processes indicates that these processes overlap and are addressed concurrently for each risk. It is hard to determine where exactly the elimination process stops and the reduce process starts due to the nature of the design development process, which is a complex procedure with a lot of changes and alterations.
The actors that are mainly involved in eliminating risks and hazards at the design stage are the clients, designers and the CDMC. They have regular meetings to outline the design concept. The clients are expected to be involved actively and provide any H&S information needed by the designers, such as the condition of the construction site they propose, the topography and the existence of chemical substances (amongst others). As found from the feedback from the industry, at this stage the client must also allocate a budget for H&S implementation.

Similarly, at this point the designers play an important role related to H&S issues. Designers should anticipate or identify the risks and hazards that are likely to exist in their design. It is easier to make changes and alterations to the design to eliminate the risks and hazards at this stage. The designers must communicate with the client any changes to the design that result from eliminating H&S issues. The designers must also ensure that the elimination of risks and hazards does not create new risks and hazards. This is where communication among the team members is highly important at the first level of communication. They must share their knowledge and experience to prevent risks and hazards emanating from their design.

As the person whose main responsibility is to coordinate H&S communication, the CDMC must ensure that H&S issues are highlighted and recorded. Although some of the risks and hazards are eliminated, the CDMC and other members should record H&S information for future reference and for knowledge sharing. Not only can the documentation be referred to later in the design development processes or during construction, but it can also be referred to in other projects that face a similar situation.

Reduce
As indicated in the model, the red triangle shows that risks and hazards decrease as the design development moves on to the construction stage. After the
elimination process, it is expected that some risks and hazards will still exist in the design and cannot be avoided. These risks and hazards must be dealt with in a way that reduces their impact.

At this stage, it is assumed that the primary design and concept has been finalized. Communication at this stage mainly involves the designers. In order to finalize the design, the designers communicate with all the team members regularly and the meetings are now more formal. H&S information is recorded and updated from time to time. Based on feedback from the industry, although the most appreciated method of communication is via meetings, in some situations, information is required urgently. This is when telephone conversations, emails and faxes are used.

Some organizations create an intra- and extra-net to share and update the latest project developments that can be accessed by all the people involved.

As a result of this, documentation will be produced derived from meetings and knowledge sharing about reducing the risks and hazards in the design. Nowadays, prefabrication is one of the most popular solutions to reduce risks and hazards on site.

Inform and Control
After the process of eliminating or reducing the impact of risks and hazards, the designers must inform the contractor about the remaining risks and hazards that exist in their design. At this stage, communication of H&S information is between the designers and the contractor’s team. The designers need to provide information about the risks and hazards that have been identified but cannot be avoided in the project. The designers should also provide the contractor with potential solutions to these H&S issues, although the contractor may choose alternative solutions.
Construction H&S information can be communicated via meetings and by training team members as well as site workers, as agreed by the focus group participants:

“You see now that health and safety generally people will say it should be agenda item number one [in all meetings] and most of the time it is.” (N3-29d)

“I run health and safety courses; I find that they’re generally well received because it strikes me that people who are intelligent, which almost all of our colleagues are, I find that a lot of them are actually quite interested in health and safety…” (N4-42a)

Permanent signage where needed on site is also recommended. From the focus groups it was found that the designers wish that H&S professionals would be more ‘friendly’ to the project team members, particularly those on sites. Instead of acting like police, they would appreciate it if the H&S professionals were more approachable to ask for advice about the dos and don’ts regarding H&S matters.

The contractors are the experts mainly responsible for controlling risks and hazards as well as other H&S issues during construction. At this stage, according to HSE (2011), the contractor must ensure that the site is safe for construction activities. To control the H&S risk and hazard impact, HSE has outlined three related aspects:

1. Engineering Control – the use of equipment or other measures to prevent falls for works at height.
2. Administrative Control – procedures to work safely, such as reducing the time the worker is exposed to risks and hazards by job rotation, prohibiting mobile phones in hazardous areas and performing risks assessments.
3. Personal protective clothes and equipment – this measure will take place when all other measures have been tried and found to be ineffective. For example, in a situation where the risk of falling cannot be eliminated, other work
equipment or other measures must be utilised to minimise the distance between the worker and the edge of the building to thus minimise the consequences of a fall. Workers must also be trained to use PPE.

Although the designers, client, CDMC and the other team members are not directly involved in the construction stage, communication of H&S information must be continued. Any design changes or alterations must be shared and discussed with the contractor to ensure that the people on site are aware of any new risks or hazards that might exist due to the changes.

7.6 Validation of the Communication Model

Data validation can be defined as ‘a systematic process that compares a body of data to the requirements in a set of documented acceptance criteria (Paul, 2000). Acceptance criteria are designed in a manner that allows the data user to recognise if the data meets the intended purpose. Validation of research data is essential in a research study, not only to establish the research findings, but also to suggest changes in questionnaires or any survey procedures that could improve the data quality (Citro et al., 1998). Validation of the proposed model was intended to improve the effectiveness of communication of H&S information between all parties involved in a construction project, particularly at the design phase.

7.6.1 Objectives

1. To confirm whether the parties involved in the design process agree with the flow of risk and hazard elimination by different process – eliminate, reduce, inform and control.
2. To confirm with the construction practitioner that the actors suggested in each process are the key personnel for effective H&S communication.
3. To confirm with the construction practitioner that the methods of H&S communication are the most commonly used and the most important.
4. To confirm with the construction practitioner that the model is complete in terms of H&S communication, identifying risks and hazards and dealing with the issues.
5. To gain views and opinions for improvement and the practicality of the model.

7.6.2 Methods

Validation involved interview sessions with the participants that were interviewed for the research study. The interviewees were contacted via telephone or email to determine their willingness to be involved in the model validation process. Once they agreed to be involved, the date and venue for the validation process were confirmed. The validation process took around one hour. The participants were asked about:

- Their overall assessment of the model
- H&S communication components
- The completeness of the model
- Suggestions for improvements to the model, and
- The practicality of the model.

7.6.3 Summary of Findings

The proposed communication model was validated using structured interviews with six construction professionals. The professionals included architects, engineers and a quantity surveyor representing a contractor’s company. The
targeted participants for the validation process included construction professionals involved in design as well as construction.

Table 7.2: Background of the participants

<table>
<thead>
<tr>
<th>ORGANISATION TYPE</th>
<th>PROFESSIONAL BACKGROUND</th>
<th>PARTICIPANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consultant</td>
<td>Architect</td>
<td>A</td>
</tr>
<tr>
<td>Consultant</td>
<td>Architect</td>
<td>B</td>
</tr>
<tr>
<td>Contractor</td>
<td>Architect</td>
<td>C</td>
</tr>
<tr>
<td>Consultant</td>
<td>Engineer</td>
<td>D</td>
</tr>
<tr>
<td>Contractor</td>
<td>Engineer</td>
<td>E</td>
</tr>
<tr>
<td>Contractor</td>
<td>Quantity Surveyor</td>
<td>F</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
<td></td>
</tr>
</tbody>
</table>

The participants were asked 12 questions divided into four different categories: 1) overall assessment of the model; 2) H&S communication components; 3) completeness of the model; and 4) suggestions for improvement and practicality.

In general, all participants found the model to be very practical and applicable to address and communicate construction H&S information in design. The result of the validation process is attached in Appendix 7.1: Validation Finding. The validation process of the model can be concluded as follows.

1. **Overall assessment of the model**

The model has been verified as a tool to decrease H&S risks and hazards in the design stage. The model shows who the key person most responsible at certain stages should be in design and construction. The key person should communicate and collaborate with the other teams in order to identify the risks and hazards, eliminate them in the design, reduce their impact and inform the contractors/site staff of any unavoidable risks and hazards so they can control them.
All the participants agree that the use of ERIC in the model would benefit the communication of construction H&S information. The processes demonstrate the consequent steps in dealing with risks and hazards as well as the outcome after each process. Therefore, the user will anticipate the result in the application of the model.

2. H&S communication components

All the participants agree that the model shows the key person for H&S communication in the ERIC stages. H&S information varies from discipline to discipline at different times and locations. It really depends on the professional’s interest, area of specialty and knowledge as well as on their attitude to and awareness of H&S matters.

All the participants agree that meetings are the best way to communicate construction H&S information. This is due to the effectiveness of verbal and formal communication among the team members. Many issues related to H&S can be discussed and solved in a meeting. Meetings attended by different professionals from various backgrounds allow the participants to share knowledge or seek advice and opinions. Furthermore, in meetings, the minutes will be recorded. Therefore, H&S information will be documented for reference and future use. In terms of H&S communication to site staff or workers, the best method is via project briefings and drawings. They always refer to drawings and notes attached to the drawings for H&S information. Permanent signage on site is also very useful; it reminds the workers and constructors of the dos and don’ts on site.

Formal meetings are agreed to be the most effective means of communicating H&S information. This is due to the fact that the information is documented and shared with team members. In meetings, many parties are involved. Therefore, issues arising in regards to H&S can be highlighted and knowledge can be shared. H&S communication via drawings is also very beneficial. Communication
that involves images is clearer and can be directly understood. Notes attached to the drawings help the user to further understand the information highlighted in the drawings.

3. Completeness of the model
All the participants agree that the model demonstrates the key person to communicate H&S information. All of the participants agree that the model is applicable to their work scope.

4. Suggestions for improvement and practicality of the model
In general, all the participants agree that the model is practical and acceptable. However, a few amendments are required to improve the model. All the participants agree that the model is practical. However, some additional suggestions and remarks were given by the participants to improve the model such as:

- The outcome of the model should be elaborated further. The participants believe that positive outcomes will result from the use of the ERIC concept.

- The model should illustrate all of the methods being used for communication amongst the team members, not only the most effective methods. This is due to the fact that the usage frequency of each method varies from one company or organization to another.

- Many construction companies use IT. Although traditional methods of
communication are still actively used, it is undeniable that IT has an impact on construction communication. Therefore, the methods of communication in the model should demonstrate the use of IT.

The improved model is shown in Figure 7.6.4.
7.6.4 Revised Model of Communication of Construction H&S Information in Design

- **Knowledge sharing**
  - The H&S risks and hazards eliminated can be documented and referred by team members in the later stages or for future projects.
  - Lessons learnt
  - Shared H&S information creates awareness among team members of managing H&S issues at early stage.
  - Documentation
  - For reference and knowledge sharing.

- **Lessons learnt**
  - Shared H&S information creates awareness among team members of managing H&S issues at early stage.

- **Documentation**
  - For reference and knowledge sharing.

- **Prefabrication**
  - Alternative for less work on site and effectively reduce labour cost and time.
  - Knowledge sharing
  - The reduced risk will be identified and documented for reference.
  - Brief to team members
  - Reduced risks and hazards will be highlighted to team members partially to create awareness of H&S issues in design.

- **Regular meeting with contractors**
  - To ensure the contractors aware of the remaining risks and hazards.
  - Permanent H&S information on site
  - Place signage to ensure awareness of the risks and hazards.
  - Training
  - Workers must have appropriate training to handle the remaining risks and hazards.

- **Long lasting material**
  - Prefabrication system
  - PPE
  - etc

---

**Figure 7.2: Revised Model of Communication of Construction H&S Information in Design**
7.7 Conclusion
This chapter has successfully explained the development of the model and the validation process. The combination of the literature search and data from interviews has been fully utilized to develop the model. The roles and responsibilities for H&S matters of each actor participating in a project have been elaborated. The means of communication of construction H&S information have been explored and identified. The model is considered to be 'practical' by the interviewees in the validation process, though some amendments are needed to improve the model. The next chapter will conclude the research study and highlight its contribution to knowledge in this area.
CHAPTER 8

CONCLUSION, CONTRIBUTION TO KNOWLEDGE AND FURTHER RESEARCH

8.1 Summary of Findings

The primary aim of this research as indicated in Chapter 1 is:

‘To investigate and model the content, processes, methods and effectiveness of the communication of H&S information between all parties involved in a construction project, particularly during the design phase.’

The research began with an extensive literature review based on the key words Construction, H&S Information, Design Process and Construction Management. The research design was developed to refine the research process, as indicated in Chapter 3 Methodology. The fieldwork comprised eight preliminary interviews (Chapter 4) and twelve focus groups (Chapter 5). The findings were incorporated into three phases of H&S Communication in Chapter 6, and a model was developed and evaluated (Chapter 7). This chapter will conclude the research work.

A review of existing challenges to communication of construction H&S information as discussed in Chapter 2 revealed the critical gaps in addressing the risks and hazards from the design phase of a project. The overview of communication of H&S information in construction shows that, due to the complex nature of the construction industry with many people involved in a project, large amounts of knowledge and information to be shared and inadequate communication systems as well as resistance to IT has led to inefficient communication of H&S information.
Construction has always been known as dirty and dangerous. It was found that there are factors that affect the communication of H&S information among team members, and it was discovered that changes made in the design phase could positively influence the whole project’s H&S performance.

The interviews and focus group secondary data analysis identified the flow of H&S communication from the client to the designers, among the designers and from the designers to the contractor’s team. The stages of the RIBA Plan of Work framework has been used to highlight the barriers and challenges and the improvements that can be made in the design phase in terms of H&S communication.

A communication model was developed as a result of the analysis of the findings from the industry with the aim to eliminate risks and hazards. The research finally concludes in this chapter, which covers the study’s contribution to knowledge, its limitations and directions for further research.

8.2 Achievement of Objectives

1. To review communication theories and explore their applicability to the communication of H&S information in construction.

The literature review began with a search for communication definitions and elements. Communication models were used to demonstrate how communication between two individuals occurs. Communication models have been utilized to demonstrate the communication between construction team members in a project.

The communication definitions, elements and processes helped in identifying the factors that affect communication effectiveness. Through the literature reviews on
communication theories, it was found that the effectiveness of communication relies on many factors such as the effectiveness of encoding and transmitting information, suitability of communication systems, channel and network reaction of receiver, abilities to control noise and so on. These factors were exploited in order to explore and understand the communication of construction H&S information in design.

2. To investigate current H&S communication methods and strategies implemented for new build projects at the design stage.

This objective was aiming at identifying the gaps in existing knowledge to determine the problem areas. The investigation of the H&S communication methods and strategies was conducted by literature reviews and preliminary interviews. As stated previously, other than exploring the communication theories and elements, the literature review focused on construction, H&S information and construction management. At this stage, the existing communication methods and the influence of IT and ICT on communication processes in construction was determined.

Detailed literature reviews of the H&S communication methods and strategies implemented at the design stage revealed that H&S information in design has been communicated either formally or informal, which is in verbal such as meetings and non-verbal such as through drawings and documents. The literature reviews also revealed that there are challenges and barriers to communicating H&S information in construction such as the complex, highly fragmented nature of the industry, the involvement of multidisciplinary team members, the client and designers' motivation, and resistance to IT and information management. The literature review showed that prevention through design would reduce the risks and hazards in the construction phase, thus reducing the injuries and fatalities on site.
Findings from the preliminary interviews found that the designers communicate H&S information using both formal and informal methods such as meetings, drawings, documents, telephone conversation, fax and email. It was also found that there are many factors that affect the efficiency of H&S communication in construction, such as the fact that the key actors do not know their roles and responsibilities in H&S matters, too much documentation, dispersed geographical locations and so on. Although geographic location remains an important barrier to good communication, but contemporary communication technologies such as video conferencing are not being used to address this. Effective communication among all team members is essential and remains a significant challenge.

Through the literature reviews and the findings from the industry, it has been found that H&S performance in construction can be influenced positively if the risks and hazards are identified and eliminated in the design phase. Many previous studies of prevention through design show that the elimination of risks and hazards in the design stage effectively reduces the number of accidents and fatalities later in the construction phase.

3. To determine the main H&S contents to be communicated and the context in which such information needs to be communicated in design.

The main H&S information was determined from the interview and focus group secondary data analysis. There is a lot of H&S information being communicated in a project, starting from the appraisal stage until the project completion and post construction completion, since H&S is one of the most critical aspects in construction. In order to highlight the most relevant H&S information being communicated, the key persons for each stage of the design processes were identified. Clients are the key person to initiate H&S communication from the beginning of the project. The client’s attitude to H&S issues influences vastly the other team members. The designers, on the other hand, must also collaborate
with the client and CDMC in order to highlight the risks and hazards that exist as a result of their design. As discovered in the findings from the industry, the CDMC is expected to be more active and always available to the team members in order to coordinate the H&S information. Although a contractor’s responsibilities are on site and the construction work, the industry wants to see the contractors’ involvement in the design process at an early point to share their knowledge of H&S matters.

It was also found that the lack of construction knowledge and expertise amongst clients, their agents, design teams and CDMCs was seen as a major challenge to be overcome to achieve effective H&S communication. Timely appointments of competent and experienced designers, CDMCs and contractors was seen to be an essential precursor to effective H&S communication along with working hard to facilitate effective interaction between all the main players throughout the design process and through construction. Various methods of communication were discussed by the focus groups. Verbal communication includes both informal discussions and formal communication, typically in meetings and the use of formal training sessions.

4. To investigate the potential for the use of various communication methods in the development of H&S communication systems.

To convey H&S information in all stages of a construction project, there has to be a medium of communication. The media to communicate H&S information in construction can vary, being verbal or non-verbal, formal or informal. From the interviews and secondary data analysis, it was found that meetings and drawings are among the most important methods. Through meetings, in all levels of communication H&S in construction design, the H&S issues, risks and hazards can be identified and eliminated at an early stage. Another effective method of communicating H&S information in construction is via drawings. Drawings prepared by the designers can be used by all the team members. H&S
information can be included in the drawings by highlighting the risks and hazards that cannot be eliminated by using colour codes or symbols on the drawings. H&S information can also be included as notes on the drawings. ‘New’ technologies such as the intranet, video-conferencing, film-based training and Internet access can facilitate more effective communication of H&S information in construction. These methods can be exploited and applied to aid the communication of H&S information in construction, particularly in design.

5. **To develop and validate an integrated model for communication of construction H&S information in design.**

The development of the Communication of Construction H&S Information in Design Model was to aid designers to eliminate the risks and hazards that they have foreseen in their design, and was based on the HSE guidance for designers – Eliminate, Reduce, Inform and Control (ERIC). The risks and hazards that are not possible to eliminate by the designers should be reduced and residual risks conveyed to the contractor’s team. The contractor’s role is to control the impact of the risks and hazards on site. It was found that the participants of the validation process have verified the model as a tool to decrease H&S risks and hazards in the design stage and very useful to benefit the communication of construction H&S information.

8.3 **Limitations of the Research & Direction for Future Research**

There were a number of limitations and challenges during the execution of this research study. The limitations and direction for future research are discussed below:

- During the fieldwork, some potential companies or specific construction practitioners were ‘unresponsive’. They would agree to be interviewed but cancelled the appointment at the last minute either due to a change in
their decision, work commitments or because they thought that it was better not to discuss H&S issues with an outsider.

- Some construction practitioners interviewed were reluctant to give details and information related to H&S in construction. A few interviewees admitted that H&S is a sensitive topic, because some companies might have experienced an accident where there was a fatality or injured workers.

- The findings cannot guarantee that they represent the entire construction design. This is due to the relatively small numbers of designers interviewed. In order to get an unbiased, clear picture of communication of construction H&S information in design, the number of designers from each discipline should be similar. However, due to time constraints and limited accessibility to the respondents, this was impossible to achieve. As mentioned previously, some interviewees were unresponsive due to the sensitivity of H&S issues in construction.

- Communication studies in construction proved to be very challenging. The complex and fragmented nature of construction caused difficulties in observing communication among team members. The data collection was mainly based on the interviewees’ experiences. The interviewees had to recall the processes that they went through in a construction project based on experience. Projects are unique and different one to another. Therefore, it was difficult to determine the specific construction H&S information being communicated between members in certain phases.

- The main research aim is to investigate and improve the effectiveness of communication of H&S information between all parties involved in a construction project, particularly in the design phase. As explained in section 4.6, there are many procurement methods that determine the involvement of construction players in a project. Perhaps, in the future, investigation of communication of construction H&S information may be conducted in each of the procurement methods. Therefore, the flow of
communication could be determined specifically for different types of projects.

- Due to the limitation of finishing this research within the timeframe given by the sponsors, the model was validated by a relatively small number of practitioners. Perhaps, in the future, the model and findings could be further validated by using quantitative methods on a larger number of respondents.

### 8.4 Concluding Remarks and Contributions to Knowledge

As discussed in Chapter 1, the construction industry is complex, fragmented and many professionals and organizations are involved in a construction project. Due to this nature, communication has become one of its many challenges and obstacles. This research study has made a significant contribution to the knowledge to increase the effectiveness of communication of construction H&S information in design through:

- A better understanding of the complexity of construction H&S communication with respect to the parties involved, methods used, hindrances and facilitators of effective communication.
- A better understanding of the parties involved in design and the phases of H&S communication in design. These phases of H&S communication (phase 1, 2 and 3) also clearly showed the methods, challenges and factors from improvements faced by the designers to communicate H&S issues to the client, between designers themselves and to the other team members including the contractor’s team.
- Results from the interviews and focus group secondary data analysis have shown the feedback and views from actors that involved directly and indirectly in a construction project such as clients, architects, engineers, health and safety advisor, contractors, CDMCs, lawyers and construction academics. The knowledge sharing from these actors established further
understanding about the issues of communication of H&S information in design and suggestions for improvement from all aspects.

- This study has investigated the barriers and challenges of communication of construction H&S information, particularly in the design stage. The main barriers and challenges are highly fragmented non-collaborative and complex nature of the construction industry, multidisciplinary team members, low motivation of the team members in terms of H&S issues, inefficient information management, lack of attitudes and knowledge about H&S in construction and resistant to new information and communication technologies. By identifying these factors, solutions for issues in communication of construction H&S information in design can be determined.

- This study has also shown that early prevention through design can positively influence the H&S performance on site, thus decrease the number of accidents and fatality. This has been achieved by extensive literature reviews and by getting feedback and opinion from the industry.

- Based on the results of the study, a model of communication of construction H&S information in design was developed. The model consists of four stages to decrease and remove risks and hazards in design. Through the four stages – eliminate, reduce, inform and control - the workers’ exposure to risks and hazards will decrease.

- This model, based on the findings through the validation process, is verified as a tool to decrease H&S risks and hazards in the design stage.

The communication of construction H&S information in design is associated with several problems due to the nature of the construction industry and the attitudes of the actors involved in the design process towards construction H&S issues. Too many parties involve and massive of information to handle result in H&S information being overlooked and not well managed. It has been found that H&S performance in construction can be influenced positively if the risks and hazards are identified and eliminated in the design phase.
This study has made a significant contribution by developing Model of Communication of Construction H&S Information in Design. This model illustrates the effective process of H&S communication in construction, mainly in the design stage. This model demonstrates the consequent steps, key person and methods to communicate H&S information in order to deal with risks and hazards as well as the outcome after each process.

This chapter has outlined the summary of each chapter representing the achievement of this study. The aims and objectives were met, and this study has made significant contributions to the construction industry as well as to knowledge in general. The limitations occurring during the execution of this research have been explained. These limitations can be a guide for future work in construction communication, in particular communication of construction H&S in design.
REFERENCES


design for safety regulations, *CIB W099 International Conference, Melbourne, Australia*.


APPENDIX 3.1: Interview Questions Stage 1

Communication of Health and Safety Information in Construction

PRELIMINARY INTERVIEW

<table>
<thead>
<tr>
<th>Name and Address of company</th>
<th>Date and Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Prepared by:

Norhidayah Md Ulang
PhD Researcher
Civil And Building Engineering Department
Loughborough University
Loughborough
Leicestershire LE11 3TU
## INTERVIEW QUESTIONS STAGE 1

<table>
<thead>
<tr>
<th>Interview Questions</th>
<th>Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Responsibilities and Background</td>
<td></td>
</tr>
<tr>
<td>1. Please tell me briefly about yourself.</td>
<td>- personal background</td>
</tr>
<tr>
<td></td>
<td>- education background</td>
</tr>
<tr>
<td></td>
<td>- roles and positions in the company/organization</td>
</tr>
<tr>
<td></td>
<td>- length of experience</td>
</tr>
<tr>
<td>2. What is your role and responsibilities in construction project?</td>
<td>- roles and responsibilities particularly in H&amp;S matters.</td>
</tr>
<tr>
<td>3. Who are the parties involve in this project?</td>
<td>- that dealt with especially for communicating H&amp;S issues.</td>
</tr>
<tr>
<td>4. Could you describe the communication chain in this project particularly in health</td>
<td>- from and to whom you get and give health and safety information /</td>
</tr>
<tr>
<td>and safety aspects?</td>
<td>file / document)</td>
</tr>
<tr>
<td></td>
<td>- please show the communication chain by drawing lines on the</td>
</tr>
<tr>
<td></td>
<td>diagram attached.</td>
</tr>
<tr>
<td>Q.</td>
<td>A.</td>
</tr>
<tr>
<td>------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5. What systems and/or processes that you use in managing H&amp;S</td>
<td>- for example risk assessment form, software, drawing or appoint H&amp;S consultant.</td>
</tr>
<tr>
<td>information and documentation in a project? Is there one or many systems?</td>
<td></td>
</tr>
<tr>
<td>6. How does the system work?</td>
<td>- how information is being delivered? i.e. Clients have specific order on health and safety aspects to ensure safe construction and designers</td>
</tr>
<tr>
<td>7. What are the health and safety data and information needed for the system?</td>
<td></td>
</tr>
<tr>
<td>8. Where did you obtain the health and safety information</td>
<td>- drawing? H&amp;S file? contract document? - may I see / have a copy of the source of information?</td>
</tr>
<tr>
<td>9. What would you say is the most important element / aspect of health and safety information for this construction project?</td>
<td>(Mechanism of sending, sharing and receiving H&amp;S information – diagram of information flows)</td>
</tr>
<tr>
<td>10. What does the cycle of H&amp;S information in the system look like?</td>
<td>From contractual requirement – design stage – construction phase.</td>
</tr>
<tr>
<td>11. What sort of H&amp;S information being communicated / processed?</td>
<td></td>
</tr>
</tbody>
</table>
12. Who is the person responsible to control the flow of H&S information? - to make sure that all parties involve get the same information) for the organization or the project.

13. How do you capture the H&S information in each construction stage (at procurement, design and construction phase) and further use that information?

Towards Improving Communication of Health and Safety Information in Construction

14. In your opinion, what are the flaws in the H&S information in the system at the moment? - need more data? special specification? Improvements?

15. What challenges do you face in managing this construction project? - in any construction project to apply the maximum H&S practice

16. What are your suggestions to improve the communication / management of H&S information? - law, training, courses etc.
APPENDIX 3.2: Interview Question Stage 2

Research project: Communication of Health and Safety Information in Construction

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<thead>
<tr>
<th>No.</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Interviewee:</td>
</tr>
<tr>
<td></td>
<td>Company Name &amp; Address:</td>
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<tr>
<td></td>
<td>Date:</td>
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<td></td>
<td>Venue:</td>
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<td></td>
<td>Title of the Project:</td>
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<td>Procurement Type:</td>
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<td></td>
<td>Name of the Client:</td>
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cvnbm@lboro.ac.uk

Supervisors: i) Prof. Alistair G. Gibb
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ii) Prof. Chimay J. Anumba
Department of Architectural Engineering, The Pennsylvania State University, University Park, PA 16801, USA
APPRAISAL

Communication Strength

5  Very Frequent
4  Frequent
3  Often
2  Seldom
1  Very Seldom

Communication Media

a  Verbal
b  Written
c  Graphic / Visual
d  Software
e  Other
Communication of Construction H&S Information in Design

STRATEGIC BRIEF

Communication Strength

<table>
<thead>
<tr>
<th>Rating</th>
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<tbody>
<tr>
<td>5</td>
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<tr>
<td>4</td>
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<tr>
<td>3</td>
<td>Often</td>
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<tr>
<td>2</td>
<td>Seldom</td>
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<tr>
<td>1</td>
<td>Very Seldom</td>
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Communication Media

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<td>e</td>
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</table>

Very Frequent
Written
Graphic / Visual
Software
Other
Communication of Construction H&S Information in Design

OUTLINE PROPOSAL

Communication Strength

<table>
<thead>
<tr>
<th></th>
<th>Very Frequent</th>
<th></th>
<th>Frequent</th>
<th></th>
<th>Often</th>
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<th>Seldom</th>
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<tr>
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<td>4</td>
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Communication Media

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<th>Graphic / Visual</th>
<th></th>
<th>Software</th>
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<th>Other</th>
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<tbody>
<tr>
<td>a</td>
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<td>d</td>
<td></td>
<td>e</td>
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</tr>
</tbody>
</table>
Communication of Construction H&S Information in Design

DETAILED PROPOSAL

Communication Strength

<table>
<thead>
<tr>
<th>Rating</th>
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</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Very Frequent</td>
</tr>
<tr>
<td>4</td>
<td>Frequent</td>
</tr>
<tr>
<td>3</td>
<td>Often</td>
</tr>
<tr>
<td>2</td>
<td>Seldom</td>
</tr>
<tr>
<td>1</td>
<td>Very Seldom</td>
</tr>
</tbody>
</table>

Communication Media

<table>
<thead>
<tr>
<th>Letter</th>
<th>Media Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Verbal</td>
</tr>
<tr>
<td>b</td>
<td>Written</td>
</tr>
<tr>
<td>c</td>
<td>Graphic / Visual</td>
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<tr>
<td>d</td>
<td>Software</td>
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<tr>
<td>e</td>
<td>Other</td>
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</tbody>
</table>
Communication of Construction H&S Information in Design

FINAL PROPOSAL

Communication Strength

<table>
<thead>
<tr>
<th>Strength</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Frequent</td>
<td>5</td>
</tr>
<tr>
<td>Frequent</td>
<td>4</td>
</tr>
<tr>
<td>Often</td>
<td>3</td>
</tr>
<tr>
<td>Seldom</td>
<td>2</td>
</tr>
<tr>
<td>Very Seldom</td>
<td>1</td>
</tr>
</tbody>
</table>

Communication Media

<table>
<thead>
<tr>
<th>Media</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>a</td>
</tr>
<tr>
<td>Written</td>
<td>b</td>
</tr>
<tr>
<td>Graphic / Visual</td>
<td>c</td>
</tr>
<tr>
<td>Software</td>
<td>d</td>
</tr>
<tr>
<td>Other</td>
<td>e</td>
</tr>
</tbody>
</table>
Communication of Construction H&S Information in Design

PRODUCTION INFORMATION

Communication Strength

Very Frequent 5
Frequent 4
Often 3
Seldom 2
Very Seldom 1

Communication Media

Verbal a
Written b
Graphic / Visual c
Software d
Other e
Communication of Construction H&S Information in Design

TENDER DOCUMENTS

Communication Strength

<table>
<thead>
<tr>
<th>Communication Strength</th>
<th>Communication Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Frequent</td>
<td>Verbal</td>
</tr>
<tr>
<td>Frequent</td>
<td>Written</td>
</tr>
<tr>
<td>Often</td>
<td>Graphic / Visual</td>
</tr>
<tr>
<td>Seldom</td>
<td>Software</td>
</tr>
<tr>
<td>Very Seldom</td>
<td>Other</td>
</tr>
</tbody>
</table>

Very Frequent
Frequent
Often
Seldom
Very Seldom
Communication of Construction H&S Information in Design

TENDER ACTION

CLIENT

QS

SUPPLIERS

MECHANICAL / ELECTRICAL ENGINEER

STRUCTURAL ENGINEER

ARCHITECT / DESIGNER

CDM COORDINATOR

CONTRACTOR

SITE STAFF / WORKERS

SUB-CONTRACTOR

Communication Strength

5  Very Frequent
4  Frequent
3  Often
2  Seldom
1  Very Seldom

Communication Media

a  Verbal
b  Written
c  Graphic / Visual
d  Software
e  Other
MOBILISATION

Communication Strength

5 Very Frequent
4 Frequent
3 Often
2 Seldom
1 Very Seldom

Communication Media

a Verbal
b Written
c Graphic / Visual
d Software
e Other
CONSTRUCTION TO PRACTICAL COMPLETION

Communication Strength

| 5 | Very Frequent |
| 4 | Frequent      |
| 3 | Often         |
| 2 | Seldom        |
| 1 | Very Seldom   |

Communication Media

| a | Verbal        |
| b | Written       |
| c | Graphic / Visual |
| d | Software      |
| e | Other         |
AFTER PRACTICAL COMPLETION

**Communication Strength**

<table>
<thead>
<tr>
<th></th>
<th>Communication Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Very Frequent</td>
</tr>
<tr>
<td>4</td>
<td>Frequent</td>
</tr>
<tr>
<td>3</td>
<td>Often</td>
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<tr>
<td>2</td>
<td>Seldom</td>
</tr>
<tr>
<td>1</td>
<td>Very Seldom</td>
</tr>
</tbody>
</table>

**Communication Media**

<table>
<thead>
<tr>
<th></th>
<th>Communication Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Verbal</td>
</tr>
<tr>
<td>b</td>
<td>Written</td>
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<tr>
<td>c</td>
<td>Graphic / Visual</td>
</tr>
<tr>
<td>d</td>
<td>Software</td>
</tr>
<tr>
<td>e</td>
<td>Other</td>
</tr>
</tbody>
</table>
## Interview Questions

<table>
<thead>
<tr>
<th>A. Background and responsibilities</th>
<th>Probe</th>
</tr>
</thead>
</table>
| 1. Please tell me briefly about yourself. | - personal background  
- education background  
- roles and positions in the company/organization  
- length of experience |
| 2. What is your role and responsibilities in a construction project? | - roles and responsibilities particularly in H&S matters |

<table>
<thead>
<tr>
<th>B. Systems used for communicating Health and Safety information at each construction stage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3. How do you involve in this construction stage?</td>
<td>- main responsibility, area of expertise</td>
</tr>
<tr>
<td>4. Who are the other parties involve in this stage?</td>
<td>- that dealt with you (especially for communicating H&amp;S issues).</td>
</tr>
</tbody>
</table>
| 5. Could you please show me the communication chain at this stage? | - from and to whom you get and give information – general and H&S.  
- please show the communication chain by drawing lines on the diagram attached. (11 stages of construction). |
| 6. What are the methods of giving and sharing information at this stage? | (Mechanism of sending, sharing and receiving H&S information – meetings, drawings, email, faxes etc) |
7. What are the output / information from this stage?

From contractual requirement – design stage – construction phase.

8. What is the H&S content that you obtain from this stage?

- may I see / have a copy of the source of information?

9. What would you say is the most important element / aspect of health and safety information for this construction project?

Towards Improving Communication of Health and Safety Information in Construction

10. In your opinion, what are the flaws in the H&S information in the system at the moment?

- need more data? special specification? Improvements?

11. What challenges do you face in managing a construction project?

- in any construction project to apply the maximum H&S practice

12. What are your suggestions to improve the communication / management of H&S information?

- law, training, courses etc.

Thank you.
APPENDIX 3.3: Example of Data Classification and Coding

**TRANSCRIBE N3**

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>CODE</th>
<th>FINDINGS</th>
<th>CATEGORY</th>
<th>THEME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within all these [practices] or [03:36] we've got what we call a CDM Advisor who is basically a CDM champion who can help the group or the practice when you have issues relating to health and safety risks during design.</td>
<td>N3 -2a</td>
<td>CDM Advisor to aid H&amp;S risks &amp; issues</td>
<td>CDM</td>
<td>Improvement</td>
</tr>
<tr>
<td>there’s lots of mechanical and electrical engineers and they don’t seem to understand CDM as well as civil and structural engineers.</td>
<td>N3 -4a</td>
<td>The engineers do not understand CDM</td>
<td>Engineers</td>
<td>Barrier</td>
</tr>
<tr>
<td>When the regulation came in, that they … the practice sort of kick start to say well yes we know that we’re doing things well but how can we demonstrate that and how we can we communicate that across the firm. Because you know when you’ve got a practice of 50/60 people this is really straightforward but then when you’re talking about thousands it is a completely different kettle of fish.</td>
<td>N3 -10a</td>
<td>Barriers to communicate in large scale construction players</td>
<td>Legislation / CDM</td>
<td>Barrier</td>
</tr>
<tr>
<td>The CDM advisor community was restructured and a bit more focused and now</td>
<td>N3 -11a</td>
<td>CDM meeting more frequent – make design easier</td>
<td>CDM</td>
<td>Improvement</td>
</tr>
</tbody>
</table>

*Communication of Construction H&S Information in Design*
we meet every quarter, or every six months.

Every six months.

Every six months. We rotate in various offices so we can share issues and [Concerns - 25:29].

we've got a fantastic intranet, health and …

I can put it up actually but if you carry on I'll try and start it.

Oh yeah, okay.

Which is divided into three areas, which is safety in the office … which is straightforward and there's nothing to talk about, safety on site and safety in design

A number of networks where our people basically exchange and all topics … you know if you have a problem in design [with kerb] you tap into the system and someone else from New York will help you out and

<table>
<thead>
<tr>
<th>N3 - 11b</th>
<th>Intranet – make H&amp;S design easier</th>
<th>Method</th>
</tr>
</thead>
</table>
| N3 – 11c  | Intranet used as network to exchange information among designers | Method /
|           |                                   | improvement |
stuff like that.

hazard register or hazard log?

Hazard register, yeah.

That is used by designers, for example if you have a specific package or a specific solution, how to record the hazards and the design measures or design changes that have been applied in order to either eliminate or reduce.

<table>
<thead>
<tr>
<th>The register starts off huge and you've got loads of risks in the project and eventually you get to the stage where it should reduce down to just those residual risks that the contractor needs to deal with.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N3 -12a</td>
</tr>
<tr>
<td>Hazard register being used to record hazards, design measures and changes by the designers in order to eliminate or to reduce risks.</td>
</tr>
<tr>
<td>Hazard register</td>
</tr>
<tr>
<td>Method</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No project is the same so there's never a generic document. That's my biggest beef I think …</th>
</tr>
</thead>
<tbody>
<tr>
<td>N3 -13b</td>
</tr>
<tr>
<td>Only residual risks should be highlighted</td>
</tr>
<tr>
<td>Hazard register</td>
</tr>
<tr>
<td>Suggestion</td>
</tr>
</tbody>
</table>

| Each project is unique therefore residual risks need to be highlighted |
| Risks management |
| Perception |
I've seen register done by, either by Ben or by other colleagues and they are really, really good. You can still discuss about that but they’re really, really good. The other practices out there, they don’t even know where to start.

<table>
<thead>
<tr>
<th>N3 -14a</th>
<th>Risks/hazard is a good design risk management tool to help designers to identify risks/hazards in their design</th>
<th>Risks/hazard register</th>
<th>Improvement</th>
</tr>
</thead>
</table>
## APPENDIX 7.1: Validation Finding

### Overall assessment of the model

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
</table>
| Q1: To what extent do you agree that the processes – elimination, reduce, inform and control [ERIC] – would decrease the risks and hazards in the design stage/construction? | A | • Agree.  
• The model would help the designer and other team members to identify the risk and hazards.  
• ERIC is very useful to determine the risks and hazards and deal with them step by step.  
• Elimination of risks and hazards in the design certainly reduces the risks and hazards and is easier to execute rather than later in construction. |
| B | • Agree.  
• The model addresses who the key person is at each ERIC phase to deal with H&S issues.  
• If the key person is recognized, team members would collaborate and react to the person e.g. communicate, discuss and share knowledge.  
• Some construction practitioners are not aware of their roles and responsibilities for H&S; the model has shown that each of the team members has liability for it.  
• If team members are aware of their duty, risks and hazards can be dealt with earlier, therefore reducing the impact on site. |
| C | • Agree.  
• The model is easy to understand.  
• The red triangle demonstrates the reduction in risks and hazards as the process goes on.  
• If ERIC is being applied, then risks and hazards will be decreased. |
### Question 1 Continued...

<table>
<thead>
<tr>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
</table>
| D           | • Agree.  
• If the key person at each stage of the design and construction is highlighted, then the risks and hazards could decrease.  
• Having a person responsible at a time/stage/task will put fewer burdens onto the contractor to deal with all of the H&S issues.  
• Some H&S risks and hazards are derived from bad design.  
• Alerting the designers that they have a certain percentage of H&S responsibility will make them aware of their design impact on people on site. |
| E           | • Agree.  
• Very useful to deal with risks and hazards step by step.  
• The model should include the use of IT.  
• The outcome of each process should be emphasized. |
| F           | • Agree.  
• ERIC helps designers and other team members to deal with risks and hazards accordingly.  
• It is practical to firstly eliminate then reduce the impact, and inform and control the unavoidable risks and hazards on site.  
• Designers with less H&S knowledge would easily understand the purpose of the model in dealing with H&S issues. |

### Conclusion

The model has been verified as a tool to decrease H&S risks and hazards in the design stage. The model shows who the key person most responsible at certain stages should be in design and construction. The key person should communicate and collaborate with the other teams in order to identify the risks and hazards, eliminate them in the design, reduce their impact and inform the contractors/site staff of any unavoidable risks and hazards so they can control them.
<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
</table>
| Q2: In what ways do you find the ERIC processes benefit H&S communication/risk and hazard identification and elimination? | A           | • ERIC processes demonstrate the steps that construction practitioner must take to deal with H&S issues.  
• For example, when a designer comes up with a design, there are risks and hazards.  
• Instead of putting the entire burden onto the contractor, the designer must be able to identify the consequences of his/her design and find alternatives to eliminate any risks or hazards.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                                                         | B           | • In terms of communicating H&S information, ERIC shows the key person at each level. As discussed with the interviewer, the stages are defined by using the RIBA Plan of Work. Therefore, it is very clear to whom the practitioner must refer or where to share H&S knowledge and opinions.  
• However, the model must be seen as a dynamic tool, because in a project, many people come and go at certain point depending on their contribution to the project.  
• ERIC processes can be repeated in different tasks and/or by different professionals.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                         | C           | • It is very useful to understand how risks and hazards can be dealt with successfully.  
• There are many models, frameworks, tools and software for risk and hazard management. In terms of identifying risks and hazards, ERIC mainly focuses on the client and designers.  
• Therefore, it is beneficial if the clients and designers are aware of their responsibilities for H&S matters.  
• Communication between the clients and designers in terms of eliminating risks and hazards is crucial. Without agreement and approval from the client's side, many decisions to alter the design to make the construction safer cannot be done.                                                                                                                                                                                                                                                                                                                                                   |
<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
</table>
| Q2 cont.... | D | • The model illustrates risk and hazard reduction via the processes. It will be very beneficial if the actors shown in the model really communicate among each other when dealing with risks and hazards.  
• For example, in eliminating risks and hazards, as seen in the model, the clients, the CDMC and designers must take action. If this happens, then risks and hazards can be largely eliminated.  
• But in many cases, clients do not communicate with designers about these matters. |
| | E | • The model shows the actors who should highlight the H&S issues and which parties are involved at each stage. ERIC benefits the industry in terms of spreading the H&S responsibilities to all team members. Traditionally, H&S issues were mainly the responsibility of the contractor. |
| | F | • ERIC would benefit H&S communication greatly at the design stage. As far as interviewee F is concerned, many designers are not aware of the impact of their design.  
• The communication of H&S information at an earlier stage in construction would result in alterations or design changes before construction execution. Therefore, cost and time will be saved. |
| Conclusion | All of the participants agree that the use of ERIC in the model would benefit the communication of construction H&S information. The processes demonstrate the consequent steps in dealing with risks and hazards as well as the outcome after each process. Therefore, the user will anticipate the result in the application of the model. |
### H&S Communication Components

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Do you agree that the actors shown in each of the processes are the key person who should communicate H&amp;S information effectively/actively?</td>
<td>A</td>
<td>● Yes</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>● Yes</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>● Yes</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>● Yes</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>● Yes</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>● Yes</td>
</tr>
</tbody>
</table>

#### Conclusion

All of the participants agree that the model shows the key person for H&S communication in the ERIC stages.

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2: Based on your experience, what is the H&amp;S information that would be communicated at each stage?</td>
<td>A</td>
<td>● There is a lot of information. It is very hard to identify the specific H&amp;S information at each stage. The communication of H&amp;S issues, risks and hazards will be about everything that the actors feel relevant and needs to be communicated at the time.</td>
</tr>
</tbody>
</table>
|                                                                           | B           | ● For elimination, the main focus will be to produce a design that does not need too many workers or specialists and less work on high platforms, or prefabrication will be used as much as possible. This is to decrease possible exposure to risks and any H&S issue for constructors.  
  To reduce risks and hazards, if, for example, the design is for a high-rise building, the designers, the client and sometimes the contractor would meet to find the safest and most cost effective method to construct the design.  
  If after the H&S assessment is done there are still unavoidable risks and hazards, we will hold a meeting to inform the contractor’s team.  
  Basically, H&S information or content is communicated all the time and the content varies depending on the task, the stage and the professionals. |
<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
</table>
| Q2 cont.....  | C           | • Obviously, in the design stage, the designers discuss the impact of their design. For example, for rooftops, do they have to put handrails or plants at the edge or just put signage that prevents the public from going up there? So, the implications of the design will be considered.  
• Another example is the location of a water tank. If the designers want to avoid construction or maintenance people going to the rooftop, then the tank will have to be on the ground. But installing a water pump will add to the cost. In general, H&S information will be communicated to predict the consequence of any decision taken.  
• If there are any changes, the impact of the design will again be looked at and discussed.                                                                                               |
|               | D           | • Interviewee D has the same opinion about this matter as interviewee A. It is somehow impossible to determine what kind of information should be communicated at each stage.  
• Some tasks are sometimes repeated during the process. Therefore, communication of some information is done repeatedly.  
• In practice, H&S information that the team members consider to be very important or unusual (not basic or general risks and hazards) is recorded and the information is passed to the other parties involved in the project. |
<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
</table>
| Q2 cont.... | E           | • It depends on the professional dealing with the task. The designer will communicate the impact of their design.  
• The supplier will communicate the strength and quality of their products so as not to endanger the people who use them.  
• The client and the quantity surveyor communicate H&S implementation in regards to cost and time.  
• The contractor communicates H&S information to the designers to share knowledge and opinions on certain matters. They also communicate H&S information to the team members such as sub-contractors, workers and other specialists regarding unusual risks and hazards or any information being cascaded down by other team members. |
|          | F           | • Interviewee F’s involvement is mainly in costing for a construction project.  
• From the beginning, any H&S implementation or costs of safety practices are recorded and counted. Although H&S is not a major consideration in the project cost calculation, it is taken into consideration. Therefore, H&S information is communicated accordingly from the beginning.  
• The specific topic would be related to the comparison of costs if certain methods of construction were used rather than others. For example, for a high-rise building, the cost and impact of risks and hazards will be compared if the design requires the use of scaffolding, a crane or a cherry picker. |
<p>| Conclusion |             | H&amp;S information varies from discipline to discipline at different times and locations. It really depends on the professional’s interest, area of specialty and knowledge as well as on their attitude to and awareness of H&amp;S matters. |</p>
<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3: Based on your experience, which of the methods shown in each stage are the most effective?</td>
<td>A</td>
<td>• Meetings</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>• Meetings and drawings</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>• Meetings, drawings and project briefings</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>• Meetings and project briefs</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>• Meetings and drawings</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>• Meetings</td>
</tr>
</tbody>
</table>

**Conclusion**

All of the participants agree that meetings are the best way to communicate construction H&S information. This is due to the effectiveness of verbal and formal communication among the team members. Many issues related to H&S can be discussed and solved in a meeting. Meetings attended by different professionals from various backgrounds allow the participants to share knowledge or seek advice and opinions. Furthermore, in meetings, the minutes will be recorded. Therefore, H&S information will be documented for reference and future use. In terms of H&S communication to site staff or workers, the best method is via project briefings and drawings. They always refer to drawings and notes attached to the drawings for H&S information. Permanent signage on site is also very useful. It reminds the workers and constructors of the dos and don'ts on site.
<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4: To what extent would you use the methods in terms of H&amp;S communication with the other project team members?</td>
<td>A</td>
<td>• In terms of communication of construction H&amp;S information, the issues are normally raised in meetings. There is always a session in a meeting dedicated to H&amp;S. Nowadays, H&amp;S is not only about saving people’s lives but also the company’s image. Therefore, H&amp;S is at the top of the list.</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>• Interviewee B agreed on all methods but he suggested that some of the construction companies may use IT to store and update H&amp;S information. Some companies also use the inter- and intra-net for inter- and intra-organizational communication. However, interviewee B agreed that meetings and drawings are the most effective means to communicate H&amp;S information.</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>• Communication of H&amp;S information in construction is continuous from the proposal, the design phase, construction execution until maintenance. It can be either formal or informal. For formal communication with the other team members, H&amp;S information is largely communicated in meetings. The meetings are normally attended by two or three professionals from different backgrounds. This is where risks and hazards are discussed and solutions sought. Informal communication can occur between professionals from the same or different backgrounds. This normally happens when someone needs advice or a quick discussion about an issue. Drawings can be used as a means of communication as well, especially to deliver H&amp;S messages further down the line, such as the contractor's team, sub-contractor and workers.</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>• In the model, meetings are shown to be the main method of communication. All of the methods are actually used repeatedly.</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>• H&amp;S information is communicated in all ways. It is communicated in formal and informal meetings, via email, telephone calls and by fax as well as through drawings and notes.</td>
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<td></td>
<td></td>
<td>• It depends on when and where the information needs to be shared, passed on or requested.</td>
</tr>
<tr>
<td>Question</td>
<td>Participant</td>
<td>Response</td>
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<td>------------</td>
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<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tbody>
</table>
| Q4 cont... | F           | • As a quantity surveyor, interviewee F works closely with the budget. Usually, he is involved in H&S communication and budgeting during meetings with the client, designers and contractors. Meetings are very important to get agreement from all team members, especially the client, to release a budget for H&S implementation.  
• Knowledge sharing happens at times like this because whoever comes up with any suggestion for H&S has to justify it and show evidence to support the importance of implementing H&S into the design to persuade the client to consider other people’s safety. |
|            |             | Conclusion                                                                                                                                                                                                                                                                                                                                 |
|            |             | Formal meetings are agreed to be the most effective means of communicating H&S information. This is due to the fact that the information is documented and shared with team members. In meetings, many parties are involved. Therefore, issues arising in regards to H&S can be highlighted and knowledge can be shared. H&S communication via drawings is also very beneficial. Communication that involves images is clearer and can be directly understood. Notes attached to the drawings help the user to further understand the information highlighted in the drawings. |
## Completeness of model

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Do you find the model helpful in your work scope (to communicate H&amp;S information with the right person at different stages)?</td>
<td>A</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>• Yes</td>
</tr>
<tr>
<td>Conclusion</td>
<td>All of the participants agree that the model demonstrates the key person to communicate H&amp;S information.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2: Do you find the model applicable in terms of reducing risks and hazards in the design stage/in a project?</td>
<td>A</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>• Yes</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>• Yes</td>
</tr>
<tr>
<td>Conclusion</td>
<td>All of the participants agree that the model is applicable to their work scope.</td>
<td></td>
</tr>
</tbody>
</table>
**Suggestion for improvement and practicality of the model**

<table>
<thead>
<tr>
<th>Question</th>
<th>Participant</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Do you have any suggestions to improve the model?</td>
<td>A</td>
<td>• Overall, the model can be applied. The ERIC concept is very useful and clear.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• For improvement, the outcome of the model should be elaborated further.</td>
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<td></td>
<td>B</td>
<td>• The model is practical.</td>
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<td>• The introduction of ERIC gives a better idea when dealing with H&amp;S issues.</td>
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<td></td>
<td></td>
<td>• The outcome of each process should be emphasized.</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>• It should demonstrate more methods rather than the main/most effective.</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>• It should demonstrate more methods rather than the main/most effective.</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>• The repetitious process illustrated in the red triangle should be written.</td>
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<td></td>
<td></td>
<td>• Many construction companies now use IT. Although this is not the main study,</td>
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<td></td>
<td></td>
<td>it’s worth mentioning in the model, as it is can be considered to be widely used nowadays.</td>
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<tr>
<td></td>
<td>F</td>
<td>• It is practical and can be applied.</td>
</tr>
<tr>
<td>Conclusion</td>
<td></td>
<td>In general, all of the participants agree that the model is practical and acceptable.</td>
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<td></td>
<td></td>
<td>However, there a few amendments are required to improve the model.</td>
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</tbody>
</table>

| Q2: Do you find the model practical to use? Do you have any suggestions to improve the practicality of the model? | A           | • Yes                                                                                           |
|                                                                 | B           | • Yes                                                                                           |
|                                                                 | C           | • Yes                                                                                           |
|                                                                 | D           | • Yes                                                                                           |
|                                                                 | E           | • Yes                                                                                           |
|                                                                 | F           | • Yes                                                                                           |

Conclusion: All of the participants agree that the model is practical.