A SURVEY OF COMMUNICATION ISSUES IN CONSTRUCTION DESIGN

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Communication, including the integration of specialised knowledge and negotiation of differences between team members, is a vital process for collaborative design. This paper describes a questionnaire survey which was conducted to confirm the communication issues and problems, highlighted from a literature review, in current construction design. A number of organisations, all involved in construction design, were identified and questionnaires were distributed to personnel frequently involved in internal or external communication during the design process. The results of the survey confirmed the importance of communications to design outcomes and highlighted that communications between design participants suffer from a number of common problems. Further research is needed to help improve the communication processes and hence construction design itself.

Keywords: collaborative design, communication, information technology.

INTRODUCTION

Construction design has become an increasingly complex activity and there is an increasing awareness of the need for better design management in the construction industry (Baldwin *et al.*, 1998). This is due in part to meeting greater demands by clients in terms of technology, performance, economy, justification, and speed of design and construction. Often the processes of design and construction are conducted in parallel to fast-track the project (Austin *et al.,* 1996)**.** Fast-track construction has been described as the compression of project duration achieved by overlapping the design and construction of individual work packages (Newton, 1995)**.** This increases the pressure put on designers to ensure that the design deliverables are fully co-ordinated, accurate and issued on time. Increasing dependence on sub-contractors further increases the complexity, as noted by Baldwin *et al* (1998), necessitating design input from an increasing range of specialist sub-contractors. Different forms of procurement have also meant that the design work, and the deliverables of the design process, must be linked to the letting of the work packages to these sub-contractors.

These developments make managing construction design processes and co-ordinating the multi-team involvement a significant challenge. Sonnenwald (1996) suggests that communication is a vital process for collaborative design. Communication systems are the central nervous systems which make it possible for hundreds of people to do dozens of tasks integrally and orderly, and to coordinate their efforts and skills towards a common goal (Guevara and Boyer, 1981). This is particularly true in the construction industry (Anumba and Evbumwan, 1999). The research of Knoop et al (1996) and Thomas et al (1998) has confirmed the importance of communication to the design process and clearly indicated the positive relationship between communication and design success. This research aims to investigate how

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construction design can be made more effective through a comprehensive study of design communication issues and problems.

METHODOLOGY

To form the underlying basis for the research, a literature review was undertaken. This review covered relevant areas of design and communication, which were employed to establish the aspects to be investigated in current construction design. Parthe (1993) argues that a single approach on its own may not provide an in-depth understanding of the issues in organisations. The application of multiple methods often proves to be more powerful than one single research method. In this research, multiple methods are being used to identify the communication issues and problems. Firstly, a questionnaire survey was conducted to confirm the communication issues and problems highlighted from the literature review. To gain further insights, multiple case studies will be undertaken.

This paper describes the findings from the first stage of this research - the questionnaire survey.

Questionaire Survey

The questionnaire comprises two sections: section A is designed to obtain general information about the participants and their companies; and Section B to ascertain the current status of communication issues and problems in construction design. A number of organisations involved in construction design were identified from New Civil Engineer (1999) and Consultants file (1998). The survey targeted the following organisations: main-contractors; sub-contractors; client's representative; and design companies. 100 copies of the questionnaire were distributed in the organisations to staff who are frequently involved in internal or external communication within the design process. 50 responses were returned. Two software packages, SPSS and Excel, were employed to analyse the returned data. The Statistical Package for Social Scientists (SPSS) version 8.0 was used for statistical analysis, such as frequency distribution and ranking. Excel was used to present the results.

Characteristics of respondents

52% of the respondents were from main-contractors and 48% from design organisations. These companies are generally involved in building (30%), civil engineering (18%), civil and building engineering (50%). The forms of procurement on which they usually take/let work are traditional (76%), design and build (72%), management contracting (38%), and others (22%). 68% of the responding companies have turnovers of more than £50 million. Respondents were design managers, project managers, architects, quantity surveyors, principal engineers, and planners. They had experience in both internal and external communications during construction design.

General issues of communication

The survey shows that effective communication is very important in the both design and construction process.

When asked "*To what extent does the procurement route affect the communication process?"* over half the respondents (51%) indicated that the influence is significant or highly significant for internal communication. For external communication, most (80%) indicated that the influence is highly significant or significant, as illustrated in

Table1. It was concluded that the procurement route has a major impact on the communication process, especially external communication.

Table 1: Percentages of respondents considering the influence

Influence / Aspect	Significance					Total (%)
	Highly	Significant	Somewhat	Not too	Not at all	
Internal Communication	18	33	22	18	8	100
External Communication	51	29	12	4	4	100

Responses to issues related to communication problems show that the large majority of the respondents (68%) always or usually experience the problems. 31% of the respondents believe that the problems are serious or very serious and 48% somewhat serious in their impact on the design and construction process. When asked at which level or stage of the design/construction process these problems occur, half respondents (50%) indicated that problems appear in both internal and external communication. They occur more often in the stages of detail design, operations on site and completion, and scheme design (Figure 1).

Communication facets

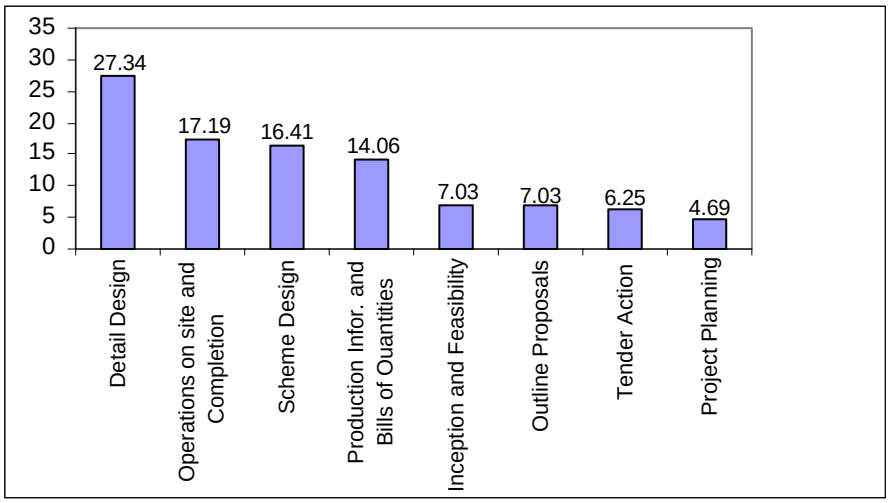


Figure 1: Percentages of respondents showing the stages where communication problems occur.

A clear understanding of communication facets is vital for effective communication (Anumba and Evbuomwan, 1999). Research has already been undertaken on the human, organisational and technological dimensions of communication in the domain of construction and general design. In particular, Guevara and Boyer's (1981) study on information flow gave an organisational dimension, and the Construction Industry Institute's research (Thomas *et al*, 1998) on communication variables gave a humanistic viewpoint. Information technology (IT) also plays a very important role in the communication process of construction design (Anumba and Evbuomwan, 1999), and has been taken into account in this study. This survey thus focused on the three facets: communication variables; information flow; and IT to investigate the communication status in current construction design. The findings are presented in detail below.

Communication variables

Thamhain (1992) argued that the five categorized problems contributing to poor project performance have one thing in common: they all stem from humanistic issues. Language is often the most common barrier to effective communication (Sigband and Bell, 1989). The CII research (Thomas *et al.,* 1998) identifies communication variables contributing to effective communication from human issues through a large sample questionnaire survey of engineering and construction projects. These variables were accuracy, procedures, barriers, understanding, timeliness, and completeness. It has been assumed here that these variables are also important in construction design. In addition, the respondents were asked to add more variables which they believe important.

When asked to rank the communication variables in order to their importance for successful communication in design, the rankings from individual responses yielded a mean score that was used to achieve an overall ranking, as shown in Table 2, which represents the first six important variables. The larger the figure, the more important the factor to the communication processes.

Table 2: Communication variable ranking

Variable	Accuracy	Completeness	Timeliness	Understanding	Barriers	Procedures
Rank	4.94	4.75	4.60	4.15	2.85	2.72

The results show clearly that accuracy and completeness of information are the two most important. Timeliness and understanding have scores somewhat lower than accuracy and completeness. Barriers and procedures are seemingly less important. All the six variables listed are however similar, according to the multiple mean comparison using inferential statistics. This confirms that the six variables represent effective communication variables in construction design.

Following this question, several questions were posed to identify communication problems in relation to these variables, except completeness categorized with information underload which will be discussed in the section of information flow.

Communication skills are as important to the professional engineer as technical and scientific skills. Accurate information must be provided at all stages of the design activity (Hamilton *et al.,* 1997). Thomas *et al.,* (1998) and Newton (1995) claim that a lot of inaccurate information in construction design arise from poor co-ordination, conflicting and poor communication skills. According to Higgin and Jessop (1965), Guevara and Boyer (1981), Newton(1995) and Thomas *et al*(1998), information required by the design participants, relating to the changes in requirement, design, schedules, regulations and technology, is often not available in time. Delays in disseminating the information could be caused by administration, information distribution, information prioritisation, communication channel, communication link, organisation structure, and knowledge about the period of information flow.

The results of the survey revealed that most of respondents (80%) and their organisations experienced the problem of inaccurate information. 90% of the respondents and their organisations often receive information too late in the design process. On a scale of 0-3 in Table 3 and 4, where 0 represent never and 3 usually, the problem of inaccurate information is mainly caused by the lack of co-ordination, the average score being 2.83. Information relating to the changes in requirement and design is often (score 2.75) not obtained in time. The two most common causes of the delay are administration and information prioritisation (Table 5).

Table 3: Means of frequency for the causes of inaccurate information

Cause	Lack of co-ordination	Conflicting Information	Poor communication Skill
Mean	2.83	2.38	2.18

Table 4: Means of frequency in the aspects of late information

Aspect	Change in				
	Requirement	Design	Schedule	Regulation	technology
Mean	2.75	2.75	2.32	1.25	1.23

Table 5: Causes of the delay considered by respondents (%)

Causes of Delay	%
Administration	20.74
Information prioritisation	15.56
Organisational structure	14.81
Information distribution	14.07
Communication channel	12.59
Communication link	11.11
Known the period	9.63
Others	1.49

It is essential that design team members know how others use cross-team information and how, and in what form, they require it to be structured (Newton, 1995). The survey results indicate that 56% of companies have adopted formal procedures for their work scope and most of them (73%) believe that these procedures are effective or very effective. All of these respondents hold positive attitudes for the procedures. When asked if staff understand their roles and responsibilities, most of respondents gave positive answer. It appears that there are no particular problems in this area.

Barriers are the aspects which restrict communication flow. There are many organisational issues that can become barriers in the communication process. When asked *"how easy do you think it is to communicate with staff internally and externally about design? Which of the facts listed do you think are barriers to the communication process?"* most of the respondents found it easy to communicate each other. Respondents also highlighted the barriers, as shown in Table 6, the three main barriers being organisational structure/ climate (66.67%), interpersonal relationship (62.96%), and the power difference (59.26%).

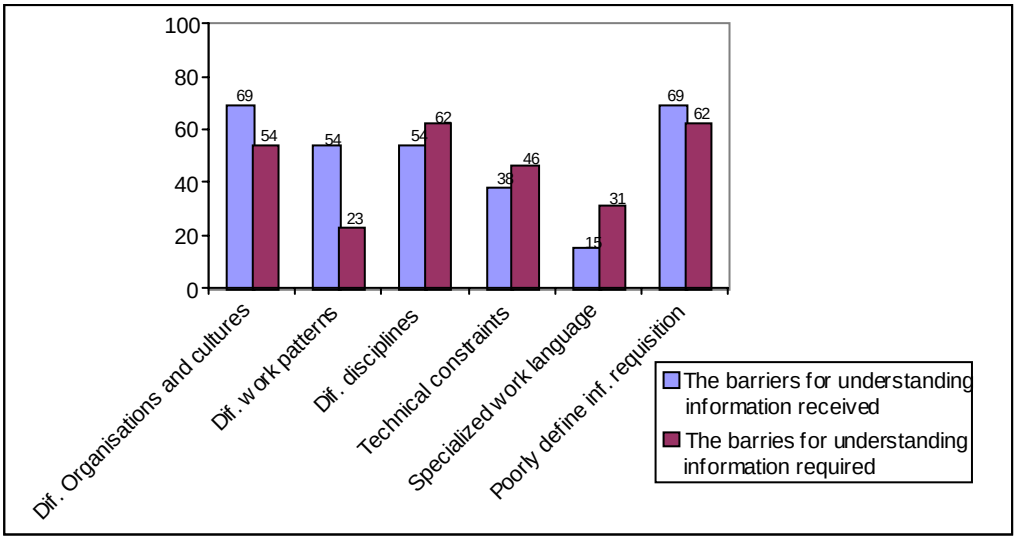
Table 6: Barriers considered by respondents (%)

Barriers	%
Organisational structure/climate	66.67
Interpersonal relationship	62.96
Power difference	59.26
Accessibility	44.44
Common goal	29.63
Profit distribution	29.63
Others	14.81

Through his research on the communication processes of the building design team, Wallace (1987) suggests that construction design is a typical interaction process of multidisciplinary teams. In order to create innovative and competitive artefacts and reduce design and development costs, construction design teams increasingly includes participants from different domains (specialists). These participants are from different disciplines, organisations and cultures. They may not work in one company or country. Sonnenwald (1996) suggests that these participants come to the design

situation with pre-existing patterns of work activities, specialised work language, and technical constraints, and different expectations and perceptions of quality and success, and different organisational constraints and priorities. Obviously, these participants need to become accustomed with each other's work practices, otherwise they may misunderstand each other, which could have a negative impact on both the work of other members and on the artefact as a whole.

In response to the questions "How well do you usually understand the information received or required from other people? What are the main causes for the misunderstanding?" over half of the participants answered "very well" or "well".



Barriers identified to understanding are shown in Figure 2.

Figure 2: Barriers for understanding considered by respondents (%)

The barriers for understanding information received are mainly different organisations and cultures (69%), and poorly defined information requisition (69%). The barriers for understanding information required are mainly different disciplines (62%) and poorly defined information requisition (62%).

As described above, for questions of communicating or understanding each other or giving assessment of others, most of the answers are positive. It seems that there are few problems in these areas. However, from the literature review, these appear to be main communication problems in multi-team design processes, especially the shared understanding between the participants. Further research is therefore required to determine the extent of these problems and whether new technologies have reduced them.

Information flow

Mead (1999) notes that identifying communication problems on construction projects requires an understanding of information flow. Guevara and Boyer (1981) investigated the causes of poor communication in nine construction companies. Their research highlighted four problems with information flow - distortion, gatekeeping, overload, and underload.

Through the review of team communication process in construction projects, Higgin and Jessop (1965), and Wallace (1987) suggest that communication is inadequate and lacks continuous interaction between the participants in the early stages of design. This early lack information is a primary source of design team-related conflict in the subsequent stages of design. Communication in organisations should provide the information to all members who need it. This assumes that neither too much nor too little information is in the system (Parker, 1980). The question, "*How frequently do you/your companies get more or less information than is needed?"* was designed to see if there are problems relating to information overload or underload, which occur during the construction design process. As shown in Table 7, some respondents (28%) encounter the problem of information overload frequently or very frequently, while 50% encounter the problem rarely or not at all. For the problem of information underload, 48% of the respondents encounter it frequently or very frequently, 44% sometimes, and 6% rarely. The results indicated that information underload is more prevalent than information overload in construction design. The responses were very different to the questions of information overload or underload, even if respondents work in the same company, which indicate that working either in different areas or design stages has met different problems.

Table 7: The frequency of problems

Problem	Frequency (%)					Total (%)
	Very	Frequently	Sometimes	Rarely	Not at all	
Information Overload	8	20	22	44	6	100
Information Underload	20	28	44	6	0	100

When asked "*How importance is the gatekeeper?*" all of the respondents gave positive responses. Over half (52%) of the respondents believed the role to be critical, 38% very important, and 6% important. This suggests that the problems with information flow will appear if no one assumes the role of 'gatekeeper'. The role of 'gatekeeper' hence needs further research.

Distortion in communication means that the information received or sent is changed in meaning or some content is lost during its dissemination. Most of the respondents do not encounter this problem, which indicates that distortion of information is not a major issue in these companies.

Information technology

Information technology plays a very important part in the communication of design information (Anumba and Evbuomwan, 1999). Bowles (1994) identified the primary objectives for information technology (IT) and communication to support concurrent engineering, which is particularly useful for multi-team construction design.

The questions**,** "What kind of information technology do you use? How much of the design communication uses these technologies (as opposed to traditional one)?" were designed to investigate the application of IT on current construction design. As shown in Figure 3, all the companies investigated use E-mail, 90% CAD, a similar percentage for intranet (84%), document control system (80%), local and wide area networks (78%), cost management system (74%), and 58% videoconference. Only a small percentage use CAE (24%). The survey also indicates that the majority of the responding companies (85%) have used IT over 40% for design communication. All of the respondents believe that IT is very useful for the construction design. This survey shows clearly that IT has been used in a significant proportion of design

communication, and increased usage is expected. In order to apply IT more effectively, effort is needed to investigate the issues or problems associated with IT for design and specifically design team interaction.

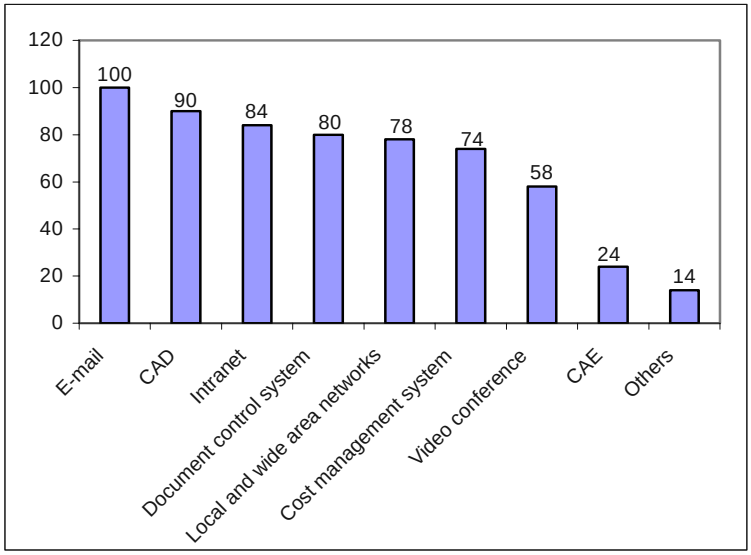


Figure 3: Percentages of responding companies using IT

The survey has provided a picture of the communication status on current construction design, especially in the three communication facets: communication variables, information flow, and IT. This will provide a platform for future research.

CONCLUSIONS AND FUTURE WORK

This survey was conducted to investigate the communication issues and problems during construction design. Main findings of the survey can be summarised as follows:

Effective communication in design plays a very important role in both design and construction processes. The communication process, especially external communication, is significantly affected by the procurement route.

Most respondents experience communication problems, which appear frequently in both internal and external communication processes. These problems could seriously impact on the construction design, and occur more often at certain stages of the design and construction processes.

Inaccurate information, late information and information underload are prevalent in construction design. The probable causes have been identified for some of major communication problems.

IT has been extensively used in design communication, and it is moving towards an increased usage.

This study demonstrates that there are a number of common issues and problems in communication between those involved in the design process, and some of which remain unsolved. Of particular importance is the difference of view between the survey respondents and previous researchers, for example, in understanding the information received or required. These require further exploration using case studies which will form the next stage of this research.

Case studies are often useful for providing an understanding of organisation functioning, which would not yield meaningful results if investigated by means of a minimal contact strategy such as questionnaires (Bryman, 1989). Case studies are also useful for studying phenomena that are experiencing rapid change like information technologies (Mead, 1999). Through the application of multiple approaches, a model that characterises communication problems among the participants will be developed throughout the design process, which will suggest strategies that may help participants communicate more effectively and ultimately improve the quality of construction design outcomes.

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