

PROBLEM SOLVING AND APPROPRIATE COMMUNICATION MEDIUM

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Many of the problems that occur during the construction phase require the involvement of design and management professionals. As problems develop, construction professionals need to use effective communication to enable a timely problem resolution. An essential aspect of effective communication is the selection of the communication medium that is best suited to resolving the problem. Communication medium in this study represents textual, verbal and graphical transmissions and is linked to information that is presented by the social and physical environment in which communication manifests. This paper discusses the findings of an extensive questionnaire, interviews and case studies that sought to investigate this little-researched area. The findings indicate that construction and design problems are taking longer to resolve because the communication medium is often selected to defend one's own organization at the expense of the mutual project goals. The paper concludes with suggestions for improving communication between designer and construction manager.

Keywords: communication, problem solving, construction management.

INTRODUCTION

The construction industry has a significant history of communication problems (Higgin and Jessop 1965, Latham 1994, Phillips 1950, Egan 1998), many of the problems developing at the interface between key specialists. All stages of construction rely on professionals transferring appropriate and relevant information to develop a buildable design that meets the client's requirements. As the project unfolds and the design is realized, information, drawings, specifications and construction methods must be communicated from one expert to another. Information must be transferred and understood so that the various aspects of the building can be assembled realising the design. The design of a building is rarely complete before the construction phase commences therefore, as the building develops and grows so does the design and requests for information. Common fast track construction practices means that detail designs are being completed whilst the construction process is underway. In theory the details for the relevant components are completed with just enough time to check, revise, redraw and specify correctly before all necessary ordering and organization commences for that specific site operation. With tight time constraints it is essential that design and construction problems are recognized and revised as quickly as possible. A delay in recognizing that information is missing, incorrect or conflicting will either cause a delay, adjustment of resources and/or require alteration to incorrectly constructed components. It is essential that communication is effective, ensuring information is understood and processed correctly if the process is to run smoothly.

Each construction specialist will require different information at different times. Some specialists will be able to visualize aspects of the building with a high degree of accuracy, possibly with little information, whilst other aspects of the building will hold little relevance unless the information is conveyed in a way which allows them to develop an understanding (mental model). Use of appropriate communication and communication medium to resolve construction and design problems is essential. The problem faced is: how should you communicate with other specialists?

The modelling of communication has developed dramatically over recent years to reflect the complexity of the process. Models such as Shannon and Weaver (1949), Gerbner (1956) and Lasswell (1960) have been criticized for their linear nature and have largely given way to more complex and non-linear models such as Rogers and Kincaid (1981), and Sperber and Wilson's (1986) Relevance Theory.

Whilst the earlier models may have identified significant players and factors in the communication they did not adequately explore the interplay between occurrences and processes which manifest to achieve successful communication. Relevance theory has made major steps towards a greater understanding of cognition and information from others, the physical environment in which communication manifests, past and present experience, future expectations, and their influence on successful communication. For successful communication to take place it is necessary *to have the communicators informative intention recognized by the audience* (Sperber and Wilson 1986: 161). The use of communication medium, environment and behaviour, at a specific time, will have an effect on the ability to process the information and the degree of relevance the information holds for the individual.

The context of communication is essential to the comprehension process. During discourse the receiver processes information against a number of assumptions. These assumptions provide a gradually changing background of assumption upon which new information is processed. The interpretation of the information involves not only working out the content, it involves the consequences of adding the new assumption to a set of assumptions that have already been processed (Sperber and Wilson 1996)

This paper builds on existing studies (Emmitt and Gorse 1998, Gorse and Emmitt 1998, Gorse, Sturges and Emmitt 1999, Gorse and Emmitt 1999) providing a summary of ongoing research specifically addressing the effectiveness of different communication media and behaviour, conveyed in different social and physical environments at different times.

The research sought to identify the strengths and weakness of interpersonal communication methods and behaviour, between designers and contractors during construction projects. As most problems and conflicts manifest themselves during construction (Melvin 1979), the research reported here is focused on the construction phase, arguably one of the most confrontational stages in construction.

METHODOLOGY

A systematic study was undertaken, first using questionnaires, then semi-structured interviews and finally case studies to collect and build data on communication problems. This method provided the issues, an appreciation of the context and finally an opportunity to observe these issues within the building context and any associated occurrences. Of 600 questionnaires posted to construction professionals, 162 were returned giving a response rate of 27%, of which 40% were architects, 42% were contractors and 18% were others. The questionnaires were distributed to members of

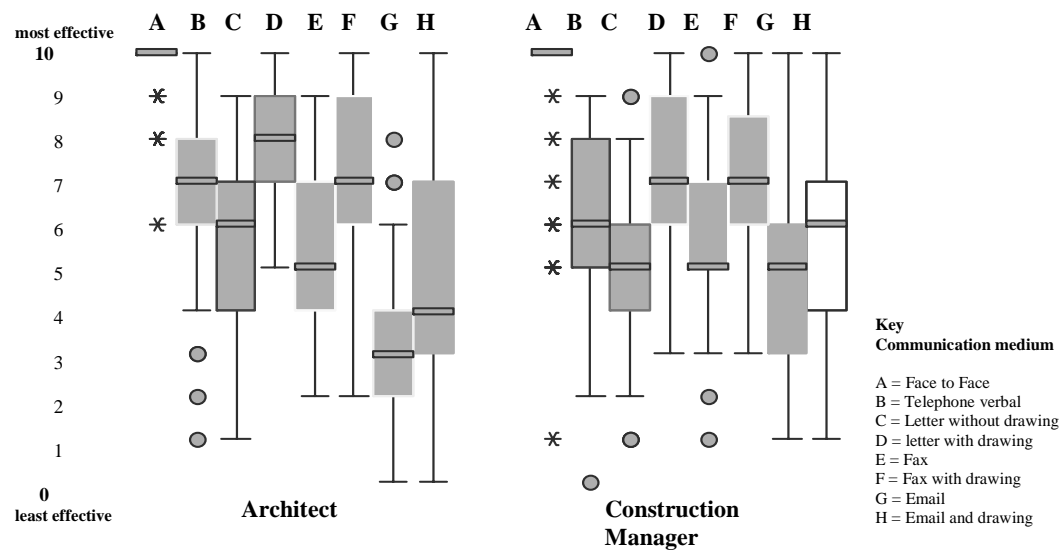


Figure 1: Box and whisker plot, comparing the distribution of results for the most effective communication medium as perceived by architects and construction managers

the RIBA (Royal Institution of British Architects) and CIOB (Chartered Institute of Building).

To measure (rate) the perceptions of effectiveness of communication medium the questionnaire used a visual analogue scale ranging from 10 (most effective) to 1 (least effective). Using this method increases confidence that the intervals of the scale are more equal than would be if each level of the scale is named (e.g. Excellent, very good, good, poor, very poor). It is noted that both methods are a form of ordinal attitude scales. It cannot be said with confidence that the interval between each rating is the same size for different people only that order is maintained (Marchant and Rai 1997).

As a follow up to the questionnaire 10 structured interviews were carried out with design and management professionals. Finally 4 longitudinal case studies were undertaken over periods ranging from 6 months to 12 months, observing communication behaviour associated with problem solving.

RESULTS

Previous research suggested that the way the architect and construction manager have been educated and trained could mean that their perceptions of the effectiveness of communication mediums are different (Gorse and Emmitt 1998). Using the Mann-Whitney Non-parametric, test results showed no significant difference in the perceptions of architects and construction managers in regards to the effectiveness of face to face ($P= 0.5622$), written posted letter without drawings ($P= 0.8847$), written posted letter with drawings ($P=0.6497$), written fax ($P=0.2149$), fax with drawings ($P=0.7381$) and email with drawings ($P=0.0961$). A significant difference was found, between the architects and construction managers perception in verbal communication over the telephone ($P= 0.0335$) and email ($P= 0.0224$). The difference can be seen in the following box plot.

Figure 1 shows the distribution of the variables in the form of a box plot diagram. It is clear from that both architects and contractors believe face to face communication is

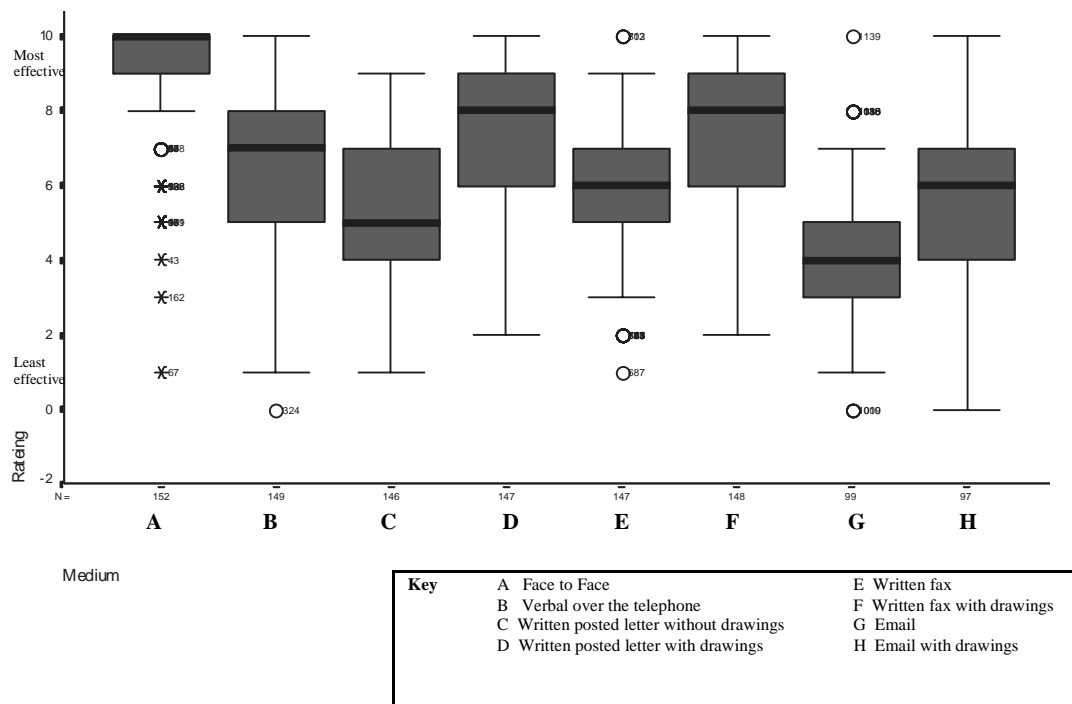


Figure 2: Rating of communication media by construction professionals

the most effective method of communicating. The box for this question (effectiveness of face to face communication) is so tight that no upper or lower limit to either the box or whisker can be seen, the markers for the 0-25, 25-50, 50-75 and 75-100th percentile fall on the median. Only a few outliers or extremes can be seen. From this and the following results, face to face interaction is perceived as the most effective form of communication.

The distribution of the effectiveness of communication medium, as perceived by all participants, can be seen in the box plot shown in Figure 2. The means of the results can be used to rank the effectiveness of the communication medium. To ensure that order is only shown where a significant difference exists the Mann-Whitney test was used. The following order of perceived effectiveness was found: 1- face to face (most effective), 2 (joint)- written letter with drawings, and written fax with drawings, 3 (joint) - verbal over the telephone, and written fax, 4 - written posted letter without drawings and email with drawings and 5 - email (least effective).

CASE STUDIES AND DISCUSSIONS

A weakness of electronic forms of communication (email) in construction observed during case studies is that many sites do not have on line computer terminals, and due to the industries late adoption of information technology many of the professionals are not experienced in the use of this type of equipment. None of the sites visited had email facilities. Whilst email is not widespread throughout the construction industry the use of faxes is commonplace. All of the sites visited made great use of the fax to transfer last minute information and record verbal instructions. Whilst faxes with drawings received a high rating, co-ordination problems were experienced when this medium of communication became a major method of communicating.

Both our quantitative and qualitative research suggested that drawings held a significant importance when resolving construction problems. Written information supported by drawings received a higher mean value than writing alone, a significant difference between the two perceptions was identified. During all of the case studies problems were observed with drawings.

A number of our case studies revealed problems where information produced digitally was difficult to read and interpret when printed out on paper to standard scales. Creators of the digital CAD drawings were able to add considerable detail to the drawings and read the information on computer screens, by magnifying sections. Site based professionals, interpreting and assembling the same information did not have access to computer terminals and would only have the printed version. The printed versions were often difficult to read. Finite detail caused confusion; it was difficult to interpret which dimension or description belonged to which line. Whilst additional information was supplied by phone (verbally), or fax, on at least two occasions incorrect interpretation of some of the initial information led to abortive work with considerable costs.

It is common practice to use faxes to confirm details, provide instructions, and amend details or instructions. Faxes are fast and effective when communicating textural or graphical information that would otherwise be supplied by post. Case studies showed that whilst faxes were an important medium of communication, being used on every site they often contributed to problems, some of which had major implications.

A small but significant problem of the fax is that information is only supplied in A4 width. When drawings are updated or amended and the information supplied by fax it will normally be a part of the original drawing. Whilst the small amount of time required to send a fax is an advantage, it is impossible to update all other related project documents and distribute to relevant parties within the same time frame, using the fax. To overcome immediate minor problems, information sent by fax did not appear to cause any significant problems. Problems did arise when faxes were used as a method of updating and amending many of the changes to project documents. Whilst the fax enabled immediate problems to be overcome, if original project documentation was not updated and distributed then different specialists, not party to the faxed communication, would be working off incorrect drawings. On a number of sites the fax had become a major element of communication. Where the designer (not necessarily architect) had managed to resolve a problem using the fax, little consideration was given to other parties who required the revised information (other designer, fabricators etc.). In one case study faxes were used to communicate changes but were not integrated into the project documents. Although members of the contracting team had been party to discussions, the contractor built work incorrectly, not realizing that the project documents had been updated. This resulted in additional work with a cost in excess of £40,000.

A difficulty observed was the ability (or inability) to describe the exact nature of the problem, so that the other person recognizes the associated issues. One method used to overcome this problem was a face to face meeting where a physical problem exists. This situational approach was often supported with other mediums of communication. Clearly this option is only available where the situation supports it, for instance where the physical situation (structure / building etc.) provides supporting evidence or information to the problem. The strength of this situation approach would support the

use of the video type of conferencing. Although this may reduce the effectiveness of face to face meetings, it may save time, travelling to meetings etc.

As well as communication medium, the questionnaire showed a difference in the effectiveness of communication in different social environments. Formal environments were not perceived to be as effective as informal environments. During case studies the majority of problems were discussed and resolved through informal interaction, being confirmed following informal discourse.

Our initial research indicated that communication problems developed as communication became more formal. For example, in one case where problems had developed and formal letters were used, in an attempt to both solve the problem and state who was responsible, the communication behaviour on both sides became very defensive. It would seem that formal communication, from one party, suggesting blame initiates a reciprocal behaviour by the other party. As one person used very formal language and content, making reference to contract and costs, the other would respond in a very similar way. As such behaviour developed both parties became defensive, the focus shifting from solving the problem to identifying who caused the problem. In one case study that was traced over a full year the defensive behaviour led to the involvement of legal representatives on both sides, with threats of legal action only to be resolved by the directors of the two companies in a face to face meeting.

The results, from the questionnaire and case studies, show a clear difference in the perceived effectiveness of communication medium. Whilst the questionnaire showed face to face communication to be most effective, in some of the cases observed professional neglected to meet face to face to solve problems. This action did seem to prolong problem solving. The selection of communication media will be dependent on factors such as the individuals' willingness to communicate using a particular medium, individual's objective (or organizations objective) and type of information required.

The importance of face to face communication identified in this study has also been found in other studies (Di Salvo 1980). Face to face communication provides meta-communication; communication about communication. If one specialist is trying to explain a problem, s/he may be able to see that the other person does not understand due to their facial expression. Without an explicit verbal statement the person attempting to understand the information shows they require more information to understand the senders intentions. When information is sent via a coded communication e.g. textual and graphical via post, fax or email, there are no visual clues for checking understanding. This may lead to uncertainty, misunderstanding or error. A lack of feedback reduces the potential to recognize and identify communication problems quickly.

Messages may be misinterpreted (lacking congruent understanding). Individuals may have different interpretations of why another person communicated using a certain medium, and what was meant by the content. The advantage of face to face interaction is that we are able to constantly calibrate our understanding, adjusting our interpretations (mental model) to what is being said, correcting subtle miscommunications by visual and verbal questioning (Goleman 1997: 155–156). The effectiveness of face to face communication is well known yet, it would seem, is neglected in practice.

Even though most drawings are relatively easy to read, with little training, they can be ambiguous (Pentland and Williams 1998), meaning more to the creator than the receiver (Pietroforte 1996). The development of new technology and a current lack of integration poses potential problems for understanding of graphical information. The usefulness of three-dimensional drawings and virtual reality models in representing future physical environments has been questioned (Mahdjoubi and Wiltshire 1996). At a more fundamental level, two-dimensional drawings produced on CAD systems can pose problems on site when they are only available in printed format.

CONCLUSION

The selection of communication method and behaviour will have an effect on the response and may have positive or negative effects on the ability to solve construction problems. For selection of the most appropriate communication medium and behaviour, communicators will need to decide what information the other party requires and what will be the best way to support relevant parties understanding of the information. The physical and social environment in which communication takes place is clearly important. Formal communication, whilst sometimes considered necessary, presents barriers and is not as effective as an informal environment. Using supportive communication medium and behaviour is seen as an essential aspect of project co-ordination and understanding. Continued investigation will be carried out in this area.

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