

COMMUNICATION IN BUILDING DESIGN MANAGEMENT: A COMPARATIVE STUDY OF NORWAY AND GERMANY

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ABSTRACT

First-rate communication between design and construction site teams is imperative for the successful completion of architecture, engineering and construction (AEC) projects. Still, research carried out in Norwegian and German industry has identified a lack of literature and qualitative research in this area. Equally, there seems to be a tendency to underestimate the correlation between communication and efficiency in most construction projects.

By addressing different factors affecting communication, reasons for communication, communication networks, communication channels and future needs in a comparative way, this paper aims to increase knowledge about and understanding of communication in the design-construction interface. An extensive literature review, a document study and in-depth interviews were carried out, according to a qualitative approach. The findings are limited to the investigated cases. However, they do imply that there is a need for a better understanding of communication both in Norway and in Germany. Additionally, the research revealed a lack of knowledge and training in the use of ICT tools and team frameworks. By increasing the awareness of the communication challenges that exists, this study can help AEC practitioners and academics to solve communication problems between design and construction site teams.

KEYWORDS

Communication, Design, Production, Collaboration, Flow.

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INTRODUCTION

It is a common apprehension that the overall performance of the architecture, engineering and construction (AEC) industry has declined compared to that of others (Egan 1998; Love and Li 2000). This is typically considered a result of the industry's increased complexity and rapid growth, in response to the more rigid environmental, financial and social goals of stakeholders (Grey and Hughes 2001). A major challenge in modern construction seems to be lack of integration and effective communication between design and construction site teams. Even when participants make significant effort working together, communication difficulties will occur (Pietroforte 1997). Such problems tend to hinder cooperation and learning between actors. Further, problems in the design phase are often seen to cause problems on site, e.g. as poor design quality or lack of constructability (Alarcón and Mardones 1998). This influences the whole project negatively, in terms of increased costs and reduced productivity (Baldwin et al. 1999). Hence, improvement of the design-construction interface can be seen crucial for enhancing total industry efficiency.

Wikforss and Löfgren (2007) stress the need for rapid access to information in both design and construction processes, in order to achieve project success. In building design, this is especially important (and difficult), because it includes several mutually dependent decisions. Moreover, Flager et al. (2009) show that members of the design team spend as much as 58% of their time managing information. With a more efficient information management system, this time can be reduced and used in more value creating activities. Koskela (2000) presented the TFV (Transformation-Flow-Value) concept in construction. As construction processes are reliant on accurate and timely information, it becomes clear how information flow is one that drastically affects all other resource flows by introducing the aspect of flow in building design. Further, the flow view aims to reduce waste in construction processes and thus is especially important to manage from a Lean perspective.

A number of researchers have emphasised effective communication as a means to overcome the problems of the contemporary AEC industry (e.g. Ballard and Koskela 1998; Bowen and Edwards 1996; Dainty et al. 2006; Grey and Hughes 2001). However, despite this being widely acknowledged as one of the main challenges in construction, little progress has been made towards improving communication effectiveness in project teams. Therefore, the research questions addressed in this paper are:

- How does communication take place between design and construction teams?
- What communication challenges exist in the interface between design and construction?
- What can the Norwegian AEC industry learn from communication in the design-construction interface in the German industry and conversely?

A pilot study by the main author showed that poor and missing communication cause many problems in Norwegian industry. A comparative method was chosen to see what, if anything can be learned from Germany, as one of the world's largest construction markets.

RESEARCH METHODOLOGY

The comparative analysis presented in this paper is based on a multiple case-study approach. According to Flyvbjerg (2006), case-study research is a method appropriate for

gaining context-dependent knowledge about complex issues. The research includes an extensive literature review, a study of internal documents and semi-structured, in-depth interviews. The literature review focused on communication in building design and was carried out in accordance with the procedures described by Blumberg et al. (2011). Keywords were searched for in research databases (Scopus, Compendex, IGLC Papers and Google Scholar) and library databases. Useful sources were also found in the references of reviewed articles. The review provided a foundation for the identification of general communication success factors and issues. The document study consisted of documents received from respondents, mainly project presentations, schedule plans and organisation maps. These provided details that corroborated information from the interviews (Yin 2014).

A total of 20 interviews in Norway (9) and Germany (11) were conducted, in line with the recommendations of Yin (2014). The Norwegian interviewees represented three different project teams in the same company, and were selected on the basis of experience from previous summer internships. The German cases were chosen in order to gain a better insight into general trends of common industry practice. Therefore, project teams from three different companies were interviewed. By interviewing architects, building design managers, project managers, site managers and foremen, different perspectives were accounted for. The limited sample size of the study does not permit for generalising the results. However, as pointed out by Flyvbjerg (2006), even a small and limited amount of interviews can constitute an influential source of information to generate new knowledge.

THEORETICAL FRAMEWORK

BUILDING DESIGN MANAGEMENT AND COMMUNICATION IN IT

Communication in building design is a wide-ranging area, including formal and controlled exchange of information, just as informal and interactive interaction. Nonetheless, it can be separated into two main groups: synchronous and asynchronous (Emmitt and Gorse 2003). Synchronous communication is direct in-time information flow, by means of verbal channels like meetings and telephone. Conversely, asynchronous communication takes place distant in time and space, through written channels such as e-mails and drawings. Synchronous communication is defined as richer and more effective than asynchronous communication, in accordance with Figure 1. In this context, *richness* refers to the information volume and content complexity a channel successfully can manage. In general, oral channels are richer than written ones, because they also convey non-verbal communication like gestures and tone of voice (Kaufmann and Kaufmann 1998). Effective design teams typically use a balanced mix of synchronous and asynchronous communication (Emmitt and Gorse 2007). Dainty et al. (2006) states that traditional channels such as drawings, meetings and telephone, remain the ones most frequently used in construction. Use of ICT (Information and Communication Technology) tools has, however, increased rapidly in recent years (Wikforss and Löfgren 2007). If implemented the right way, project teams can derive huge benefits from the use of these.

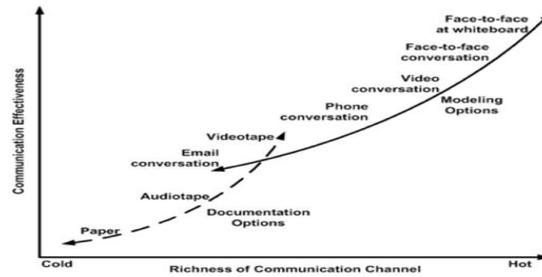


Figure 1: Richness of communication channels (Ambler 2002)

The AEC industry operates in a dynamic and fragmented environment, with temporary project teams made up of ad-hoc combinations of different specialists. Further, the onset of global construction markets leads to challenges related to social and cultural differences. Due to these features, actors interact in a complex environment in which different barriers combine to prevent straightforward information flow (Dainty et al. 2006). At the heart of successful projects lies the design teams' ability to communicate abstract ideas to site and the ability of those on site to translate this into physical artefact (Emmitt and Gorse 2003). Information is required and produced all the way from inception to completion, and many decisions are mutually dependent (Bowen and Edwards 1996). The mutual dependency serves as the glue holding the fragmented organisation together, but also place high demands on the actors' ability to collaborate. As Dainty et al. (2007) point out; building design is dependent on the combined effort of many individuals, their diverse skills and knowledge. Thus, their ability to work together as a team is decisive for the overall industry effectivity. Svalestuen et al. (2015) emphasise the importance of high levels of trust, project commitment and involvement in the goal-setting process as the key factors for successful teamwork. It is therefore essential to strive for these qualities in every project organisation.

Busby (2001) found that errors in actor interaction is the most common failing in building design. In this regard, absence of information and the issue of noise are of huge importance. These matters can impact the clarity of messages relayed between actors, regardless of how suitable and rich the chosen channel are (Dainty et al. 2006). Together, they constitute the major causes of communication failures in construction. Rothwell (2010) defines four types of noise: physical, psychological, physiological and semantic. Physical noise is noise in the literal sense, i.e. sounds from machinery on site. Such noise is hard to control because it is caused by people or the surrounding environment. In contrast, the other types of noise can be controlled. They solely exist in a person's mind and arise in coding and decoding of messages, for example as varying frames of reference.

Reinertsen (1997) argues that facilitating effective communication requires a reduction of current information flow. When too much information simultaneously circulates, it is difficult to separate what is important from what is not. Pietroforte (1997) further claims that an understanding of the organisational structure is essential, as this impacts upon how patterns of communication will develop. In addition, the implementation of modern tools like Last Planner® System (LPS) and Building Information Modelling (BIM) can help to overcome some of the current barriers to effective communication. Research has shown that they contribute to increased process transparency, project commitment and

collaboration, which further facilitate streamline information flow (Al Hattab and Hamzeh 2013). Equally, by take into effect building design as a flow of information in accordance with the TFV model (Koskela 2000), time spent waiting for, inspecting, reworking and moving information is minimised. This results in better coordination of interdependent flows and a stronger integration of design and construction. The literature review revealed a gap between current knowledge of team communication and how this is practiced in construction. A lack of qualitative research on this area was also identified. Effective communication is repeatedly regarded as the key to success in AEC projects. It is thus vital to continue to study this field, in order to increase the understanding of the current issues and potentially avoid these in the future.

FINDINGS AND DISCUSSIONS

COMMUNICATION PATTERNS

The analysis of the communication patterns in the German and Norwegian project teams indicated that the choice of project delivery method affects how communication takes place in the organisation. The research revealed that conventional procurement methods like Design-Bid-Build (DBB) are widely used in German industry, while it in Norway is becoming more common with Design-build (DB) contracts. By using DBB, the client is at the centre of the information flow. Unfortunately, clients often lack the experience and skills necessary to effectively manage and coordinate project teams. This may result in an absence of communication between design and construction. In contrast, the DB method organisationally integrates the design and construction processes. Additionally, with DB, the Building Design Manager becomes accountable for managing existing interfaces. Both German and Norwegian practitioners expressed that this was a huge advantage, as the design managers are more likely to be in possession of the appropriate qualifications.

In the German organisations, it was observed a more palpable organisational hierarchy in comparison to what was seen in Norway. German actors also seemed to have a great respect for roles and responsibilities as defined in the Responsibility Assignment Matrix (RAM), leading to an inherent confidence about their own and other actors' role in the team. Contrastingly, in Norway the informants described an unstructured situation with actors often feeling unsure about their place in the organisation. Additionally, the responsibilities in the execution phase often differed from what was defined in early-phase. This raises question as to whether the RAM has been clearly communicated to participants or simply been forgotten.

In both countries, face-to-face contact was defined as the most common communication channel and essential for project success. By enabling immediate feedback and transfer of rich information, it makes it easier to detect and avoid misinterpretations and ambiguities. In addition, the channel was defined as important for reducing organisational fragmentation, as it helps to strengthen the relationship between the different actors, disciplines and phases involved. The research further revealed that use of e-mail, telephone and tablets is common in both Norway and Germany. ICT tools like project intranets and BIM are commonly used by Norwegian actors, but rare in the German industry. Moreover, the findings implied that ICT tools used in both countries (e.g. applications for registering

errors and deficiencies) are better developed and integrated Norway. The respondents described many of the same reasons for one team member to contact another, including to plan, coordinate and schedule work, to give/receive information, to give/receive information because of changes and to request late/missing information. In both countries, respondents wished to communicate more with the purpose of sharing knowledge and to determine level of ambition (e.g. cost, time and quality level). This indicates that important teamwork principles, such as definition of a common goal and application of positive and negative sanctions, often are overlooked or underestimated in AEC projects. These are important value creating activities, contributing to a successful final product. Therefore, when they are not prioritised, the probability of rework, delays, cost overruns, etc. will increase, further affecting the overall performance of the project team.

COMMUNICATION CHALLENGES

A common perception among practitioners in both countries is that most project teams underrate the need for communication. Additionally, the pre-construction time is typically found to be too short. The majority of the practitioners had experienced a need for more extensive communication and planning than what was originally scheduled. When enough time for up-front planning is not allocated, the frequency of conflicts regarding time, cost and quality requirements increases. Further, the pre-construction stage is a good arena for project participants to get to know each other and identify each other's strengths and weaknesses. Both German and Norwegian practitioners underlined the importance of good interpersonal relations and trust. Even more than in other industries, human factors seem to determine whether construction projects develop in a good way or not. The respondents maintained that when there is a good "chemistry" in the project team, project dedication and collaboration are strong, and planning, coordination and information flow usually run smooth. Unfortunately, as a consequence of the industry's project based and fragmented environment, these properties are often difficult to establish.

Several challenges related to the use of e-mail were described, in spite of its important role when sharing project information. Firstly, there are often too many recipients, resulting in an information overload and actors overlooking information. Secondly, as a consequence of their low information richness, long e-mails with complex information are often misunderstood. The respondents also explained that e-mails often result in project information becoming disorganised and information getting lost. This issue concerns how actors can provide the right information to the right team member at the right time, rather than opposing the different communication channels. Hence, a pre-set framework describing where and when to use the available communication channels is important to ensure a smooth flow of information throughout the project.

The analysis of the German industry indicated that many communication challenges arise as a result of the procurement method they use. The DBB method allows for many actors taking part in decision-making, and thus leads to an increased complexity. Project participants also expressed that cooperation problems often occur between the client, contractor and architect, for example as a result of competing interests or different jargons. This shows once again the importance of establishing a common set of team rules. German actors also explained that they have a great pride in their work, which sometimes make

them incapable of receiving help from others. Many of the challenges described in Norway are considered a result of organisational culture, e.g. unclear roles and responsibility, lack of initiative and motivation and too much informal communication. These issues result in a confusing information flow, giving rise to uncertainty and decreased productivity. The findings also indicate that the vast focus on organisational decentralisation in Norwegian industry during the last few decades has come at the expense of an organisational structure with clear roles and responsibilities. Unfortunately, effective communication seems difficult (maybe even impossible) to establish and maintain without a distinct system.

LEARNING BETWEEN NORWAY AND GERMANY

From the study of the Norwegian and German AEC industries, several initiatives to facilitate effective communication in the design-construction interface emerged. Among others, Norwegian project teams had implemented parts of the LPS, which had increased project commitment and feeling of responsibility for the final product. Moreover, the use of ICT tools has evolved rapidly in Norway in recent years. Project intranets provide all team members immediate access to project information, thus speeding up information flow. Video conferences makes it easier to communicate with other participants, even over long distances. Yet, it was implied that the use of these tools can be troublesome and also reduce the overall understanding of the project. For example, when all participants have access to all information at any time, it is hard to control who receives what and when. In worst case, this can result in actors making their own “image” of the project, which however might not always correspond to the overall project objectives.

The comparative analysis indicated that Norwegian and German actors have different views on how organisations should be structured in order to best facilitate for effective communication. In Norway, it is a strong focus on the flat organisational structure. Advantages of this approach include open and more effective communication, decision-making and collaboration. On the other hand, a flat structure may foster role confusion and thus hinder employee’s motivation. As opposed to the Norwegian actors, German actors emphasised the importance of maintaining a certain degree of organisational hierarchy. The research showed that this approach results in clearer reporting lines and chains of command, which further ensure clear division of roles. Moreover, German actors stressed the importance of project participants being motivated and well prepared for the work. This was defined as easier to achieve when all actors have a clear picture of their responsibilities. However, there are disadvantages of using relatively rigid hierarchical structures, such as less effective decision-making and communication flow, which arise as a result of increased bureaucracy. Further, hierarchical organisations are known for being slow to react upon new opportunities, which makes it hard to survive in today’s rapidly changing environment. This may help to explain why German industry seems to be slower to adopt new technology and work methods.

One respondent who had worked several years in both the German and the Norwegian AEC industry made an interesting point. He claimed that the right balance between a hierarchal and a flat approach is necessary to create effective communication in the design-construction interface. The case studies implied that one of the German companies had achieved exactly this. By basing their work on standardisation, pre-fabrication and the

supply of a total design-build service they had succeeded in safeguarding a distinct structure, while at the same time allowing for an increased involvement in decision-making, as well as the adaption and development of new work methods and technologies. The interviews clearly indicated that this increased the effectivity of communication in the organisation, which in turn led to an improved performance. However, it is important to point out that not all organisations have the opportunity to structure their practice this way.

CONCLUSIONS

The German AEC industry is generally characterised by the use of traditional work methods, reflected in the prevalence of conventional procurement methods and the limited use of ICT tools. The communication patterns developing in the project team are clearly influenced by the use of traditional methods, among others there was seen a lack of communication between design and construction teams in German project teams. On the other hand, the Norwegian industry looks for constant development, illustrated by their extensive use of modern tools like the LPS, project intranets and BIM. From a communicative perspective, this helps project teams to increase their efficiency

Table 1: Challenges of Communication in Germany and Norway

Both countries	Germany	Norway
Underrated communication need	Client "in charge"	Unclear roles and responsibility
Short pre-construction	Competing interests	Need to request information
Information overload	Different jargons	Lack of motivation and initiative
Unstructured information	Averse to receive help	Much informal communication
Interpersonal relations and trust		

At the same time, the comparative analysis showed that there is a need for improvement of communication in Norway, just as it is in Germany. Table 1 depicts the identified communication challenges identified in this study.

The German and the Norwegian AEC industry represent different views on how to best facilitate for effective communication. In Germany, a hierarchical approach is typically used, while a network-like structure is most common in Norway. The study implied that a flat structure has several benefits. It can, however, result in a chaotic project environment because of too much independency and a weak structure. The hierarchical approach, on the other hand, typically maintains the structure, but decreases the effectivity of information flow and prevents the organisation from developing. Thus, when alone, none of these methods are capable of improving the current situation. However, in exploring theory and practice, it has been found that from a communicative perspective there is no *either-or*, but rather a *both* on this matter. By balancing the Norwegian and German approaches, companies can benefit from the current strengths of both countries as presented in Table 2. In combination, these two approaches to effective communication can help to solve some of the challenges of contemporary AEC industry, which became further apparent from the research done German industry. These findings revealed that companies exist that have achieved to maintain a distinct structure, while also keeping pace with the industry's

continual development. However, this structure is not feasible for most firms because of the way it limits the range of projects, while also requiring a certain organisation size.

Table 2: Strengths of the German and Norwegian approach

Germany	Norway
Clear communication paths	Allows for innovation
Clear chains of command	Simpler and faster decision-making processes
Clearly defined set of responsibilities	Independent employees
Motivated and committed employees	Improved speed of communication flow

Based on the findings from this research, it seems that the methods and technology needed to improve communication between design and construction teams already exists. The question of how these solutions best are combined and implemented, so as to avoid the present negative impacts on the industry, still remains. According to the research presented here, the answer lies in finding the right balance of a hierarchical and a flat structure, the formal and the informal, use of technology and not, and so on. Future research should be dedicated to the development of a strategy for how to best accomplish this in practice. The authors do recommend, however, that project teams have a hierarchical structure in terms of decision-making, which will make the flow of information more structured and easier to control. At the same time, it is important to be critical to adopt new methods and technologies if the advantages that these entail for the project team is not clear. As can be learnt from Norwegian industry, an uncritical implementation of such tools can – in the worst case – reduce the overall performance of project teams.

Summing up, this study has shown that improvement of communication and information exchange in building design management increases the overall effectivity of the construction industry. Further, such an improvement may involve changes in project organisations and work activities. The research is based on a limited number of respondents. This may not make the results 100% applicable to all projects. Hence, in the future, the authors recommend to extend the numbers of respondents. In addition, more research should be done on the relationship between Project Delivery Method and communication.

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