COMMUNICATION AND PROBLEM-SOLVING ABILITY

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Introduction

"Communication is taken for granted", it says in the best textbook hitherto of communication in construction. "It is unworthy of special attention," the text continues. No one addresses the issue, even if all are agreed on its importance. Yes, the authors declare, it is important – so much so that good communication is the most vital prerequisite of all successful project-based activity (Dainty et al, 2006).

For the construction of a laboratory, 6,099 original documents were produced, 3,569 of which were original drawings. In the course of two years the project group replaced, on average, 140 working documents daily, through closely controlled procedures in the document management system. To this must be added all the informal direct contacts between the project team members by e-mail, SMS, fax, telephone and meetings. For the erection of a university building, 28 different types of meeting were arranged and 15 different management functions were established. From the organisational plan for routine renovation of station platforms on the Stockholm underground, we see that 42 different participants were involved (Wikforss, 2006; Karrbom Gustavsson, 2011). No wonder, then, that the authors of the above quoted textbook observe that building is a complex undertaking and that few other industries can provide it with examples of communication. Building has to find its own forms of communication.

Formal and informal communication

The project manager's first step towards accomplishing the task is to select and combine suitable competences. The project organisation is by definition temporary, consisting of people with different professional and educational backgrounds, coming from different companies with different professional cultures and terminology but also with different support systems. A plan of organisation with clear chains of command is therefore drawn up so as immediately to instil order into the project. A document management system for the exchange of information is chosen for the project and the use of digital models for storing common information is formalised, the aim of all this being to keep the flow of information under control and surveillance.

For every participant taking part, a contract carefully specifying every work input and information delivery is drawn up, following a competitive procurement price in which the lowest price is often a decisive factor. Everything, management and communication included, is procured and contracted for. All "unnecessary" scope is eliminated with a view to cutting costs and production times, while still retaining the quality promised. The relation between

time, cost and quality is optimised. Expressions like “think right from the beginning” and “the right information to the right participant at the right time” illustrate the prevailing mindset.

But the proliferation of contracts also creates boundaries between the participants and a need for checkpoints. Every participant involved has of course to watch over his commitments in the project, keeping an eye on what comes within and lies beyond the work input and supply of information contracted for, so as to accomplish his own assignment in a businesslike manner. Project meetings therefore tend to assume the character of continuous negotiations. And negotiations, as we all know, are won by the party who is best informed. So the smart thing may be not to tell all, to keep information to oneself up to the point when it will favour one’s own company. This impedes communication and the joint solution of problems. Communication becomes a contest in a world procured (Söderholm, 2006).

But there can also develop a professional contest and a safeguarding of one’s own professional domain which are detrimental to communication. Different professional groups, therefore, occupy positions of differing strength at different stages of the process. Knowledge of design holds a strong position in the early stages, knowledge of production in the late ones. Then there is a risk of the basic ideas not being fulfilled in production and of production know-how not being utilised in planning. One can also observe a tension between scientifically based professions on the one hand and design-based professions on the other. The notion of “this is how things are” comes up against the notion of “this is what things could be like”. The “are” notion occupies a strong, dominant position in our culture, whereas the “ought to be” figure threatens the status quo, excites opposition and is found troublesome (Edeholt, 2004).

It is at this point that the partnership manager crops up in the construction process, as one more type of manager in addition to the fifteen in the example we began with (Kadefors, 2011). The partnership manager is expected to act as coach in order to built bridge, getting the different players to interact and co-operate better. Often this happens without any change being made to the forms of contract or the business models, which makes for a difficult task. The project manager divests himself of a pivotal communication task. When this happens, there is a risk of growing confusion as to who is actually running the project.

To counteract this, the arsenal of tools which present-day project management can offer is resorted to. This takes the form of certified working methods and checklists aimed at handling, administering, timetabling, minimising, monitoring, checking, revising, securing and reporting back. The project manager gives a regular account, in lengthy progress reports to the steering group, of how work is proceeding. One observation made is that the project management system to a great extent supports management, not leadership. Project originally meant an idea, developing something new, taking a risk in order to turn a profit. Project management nowadays is viewed more as the everyday implementation of something that has been worked out by others.

Problem-solving capacity

Despite all these efforts to control the flow of information and steer it in keeping with the chain of command, information often finds other paths. Expressions like the organisation "leaking like a sieve" and "information being like water", getting through just everywhere, to and fro between the players, amply illustrate this point. This apparent chaos can be daunting at first sight, not least considering the great complexity of building and the huge amounts at stake. But on closer inspection this informal communication is seen to be the oil in the machinery that keeps the project organisation working.

The reason for this lies in the answer to the question: how are problems solved?

In "Genom huvudet. Problemlösningens socialpsykologi" (2002), social psychologist Johan Asplund writes that we conceive of thought and problem solving as being attached to the individual and occurring "in the head and nowhere else". He illustrates this notion of ours by expressions like "a head for reading", "head screwed on right" and "browbeating", adding that the Swedish expression (literally translated) "putting/banging their wise heads together" conveys a better idea of what problem solving is all about. Asplund shows that the process of problem solving is built up of verbal exchanges and that this dialogue model is present in all problem solving. Problem solving equals communication. Even in solitude, thinking silently, we think in dialogue, not monologue. We talk to ourselves when we are thinking, playing one-man chess with a virtual opponent, encounter the image of the sketched solution on paper or on the screen in front of us, and adjust it step by step as in a verbal exchange.

If the problem-solving process is built up of verbal exchanges, the quality of the built outcome will hinge on the quality of project communication. Project communication, thus defined, amounts to the project's problem-solving ability – it's intelligence, we might say. This being so, communication cannot be taken for granted and considered "unworthy of attention". Instead communication becomes the vital issue for the project management to resolve, and it thought-provokingly shifts the focus of attention from the project manager to the members of the project team. Everything stands or falls by their capacity for building up verbal exchanges and contributing knowledge through communication.

This is one of the very greatest capacities of building: interactive problem solving with mutual trust between representatives of different professions and competences. Paradoxically, this capacity is not accommodated in formal organisation charts. It is applied informally, but very forcefully. To aid this communication, use is made of building's finest technology: the model and the image of what has yet to be built.

Visual thinking

In his "Arkitektur som kunskap" (1998), the architectural historian Björn Linn writes: "Architecture has broken away from ancient, craft-based building knowhow by developing a method: studying notional objects, originally buildings, in models made visible and working

on the problems of design in this model form before the objects are realised full scale and in all dimensions. A special technique has formed the framework for the expansion of a comprehensive knowledge permeating the whole of society."

The first drawing may perhaps have been made, in clay which dried in the sun, by the architect Imhotep, who built the Sakkara Pyramid, south of Cairo, 4,650 years ago at the behest of Pharaoh Zoser. The first building of dressed stone. The drawing represented something which had not yet been built, using a different scale and a portable medium. A remarkable invention. We know of the subsequent development from drawings on wood coated with stucco and on costly parchment to the Renaissance deepening of calculation and drawing and its introduction of scientific perspective and from there to the advanced digital models of our own time (Pugh, 1987).

Methods which have made it possible to converse about what has not yet been built in order to successively sharpen the solving of problems and reduce uncertainties to the point where model and drawings are clear enough to be handed over for production. The point here is that we are liable to underrate the importance of the drawing, the perspective, the model and the prototype, taking this technology as self-evident and failing to realise what it means for building's special problem-solving capacity.

The model is the artefact round which the different competences congregate. With it one can handle complexity so as to make it surveyable and intelligible. The model enables one to conceive of the as yet unbuilt in order to deepen one's own understanding, but also to communicate with others. Understanding concerns both the deepening of problem statement and possible solutions. Through the dissolution of problems, the original task is reformulated and can thus be viewed in a new light. Not infrequently, it is by querying the task and its problem formulation that new solutions have been created and great values added for the clients.

The architect Jonas Elding, who worked for the world-famous SANAA practice in Tokyo when it was designing the New Museum in New York, illuminated this point in an interview: "If you create new problems there is a chance of finding solutions you have never seen. If you only solve old problems one more time, this doesn't happen. Here concepts which seem impossible at first becoming a sport of taming into a functioning whole. The process is admittedly hugely difficult, but it is real fun." And, concerning co-operation with other competences: "We need engineers who think like designers. Here the engineers are full of inspiration, stars of the architectural firmament." John Asplund would have called it constructing a new conundrum.

The model also plays an especially important part in making professional knowledge explicit and possible to share. Professionally skilled practitioners bear within them a silent knowledge: they know how to go about things but cannot properly explain why (Liedman, 2001). The knowledge that used to be explicit has sunk in, becoming part of their professional repertoire. The reflective practitioner bears within him a repertoire of solutions to apply to a given

situation, Donald Schön (1983) writes. Not infrequently, the solution precedes the problem and the assignment. The skilled practitioner recognises a problem statement and knows which solution can be suitable, and in this way the design process becomes a dialogue between an ideal solution and a given situation; what is built becomes a unique adaptation of the ideal solution to given conditions (Stolterman, 1991).

Part of this design dialogue takes place in images, not words. Visual thinking is a sine qua non of viable architecture and engineering. One needs, not least, to be able to envisage a structure and to evaluate and judge whether it is workable and safe or not and whether it can be built or not (Ferguson, 1997).

The final evaluation of buildability takes place on the construction site when the construction workers are required, under strenuous conditions, to interpret the drawings and translate them into practical action. Experienced planners know that they have to keep in close touch with the construction workers, to "make sure they don't build past the drawing", but also to learn from their viewpoints. It may be that the drawing solution is unpractical, out of touch with reality. In the working team's dialogue, the drawings are massacred without anyone objecting. If you build past the drawing, then after a few days you will already be hard put to it convincing the site management of the necessity of pulling down and rebuilding. So it is better to be proactive and present, so that what was intended actually gets built.

It was no mere whim that everyone building the Florentine Cathedral of Santa Maria del Fiore, with its massive dome by Filippo Brunelleschi, had to swear, hand on Bible, to build after the drawing and nothing but the drawing.

Personal communication

The project manager's tool for checking communication deals with information. The verbal exchanges of problem solving, on the other hand, are a matter of building up knowledge through conversations and direct personal contact.

The Shannon-Weaver Mathematical Model of Communication, published in 1948, has achieved widespread impact, which perhaps accounts for the often rather four-square manner in which person-to-person communication is described. The model, it will be recalled, contains an active transmitter and a passive receiver. The transmitter produces a message which the transmitter converts into a signal which is transmitted through a chosen channel to the receiver, who in turn decodes the signal into a message before, as the next step, himself assuming the role of transmitter. Communication viewed as an asynchronous process of stimulus and response. The model has led us to speak of communication in quantitative terms, e.g. concerning the amount of information transmissible through a certain type of channel. Channel and transmission are pivotal concepts here (Segerstedt, 2002). Web-based document management systems and formalised information modeling, with its rules for deliveries of information, builds on this way of thinking.

The cognition researcher Peter Gärdenfors (1996) juxtaposes the channel metaphor with other conceivable ways of describing how knowledge can grow between two people communicating with each other. "An alternative way of viewing information says that the receiver can acquire new knowledge by entering into a state of resonance with the transmitter. The receiver can be said to be 'attuned' to the transmitter and to 'resound'." Communication is here described as a form of musicality. Getting into a good conversational stride with someone means a constant alternation between the roles of transmitter and receiver. The conversation oscillates to and fro between two equal parties whose knowledge grows in step with the conversation's development. The moment you begin speaking, the listener reacts with a facial expression or a question which affects what you were on the point of saying. Synchronous communication makes the roles of transmitter and receiver irrelevant concepts.

Conversation and meeting are the basic form of communication in a construction process, all other aids notwithstanding. It is the conversations at the drawing board, via the computers, at the project meetings, in the builders' huts and out in the field. This is a never-ending small talk, a babble of voices, in which those taking part share ideas as a necessary foundation for everyday co-operation without any unnecessary uncertainty. Conversations, according to Tina Karrbom Gustavsson (2005) in "Det tillfälligas praktik", serve as stabilisation points. Taken together, continuous conversations and meetings can be described as a kind of action network or a culture bearing with it notions, values, knowledge and experience which are more enduring than the people who happen to be there (Gustafsson, 1995). People come and go in projects and business undertakings. Action networks, corporate culture and project culture in building are more durable. Efficient when it comes to facilitating quick definitions of standpoint and decision-making by the individual, but slow to change for anyone in search of renewal (Ekman, 2003).

Document management and building information modeling

The industrialisation of building has been at the centre of attention in recent years, and examples for its organisation and management have been taken from other industry. The overarching concern has been with rational principles of management and control, with special emphasis on the development and implementation of systems for the exchange of information between the different participants, using a variety of IT systems. Two conspicuous examples of this are the introduction of document management systems for project networks and building information modeling, BIM.

Document management in project networks is based on the idea that documents can be shared by more people if they are published in a web-based database. But experience has shown that users find these systems time-consuming and awkward. They are perceived as document pools for storing finished documents, not as dynamic communication networks to support interactive problem solving. Parallel to project networks, therefore, the users employ another information technique for direct contact with each other, beyond the project management's control (Löfgren, 2006). The alternative social media have achieved a very great impact and may come to play an important role in future communication in building.

The introduction of CAD in the 70s caught on rapidly, and the technique was commonly accepted by the end of the 80s. The rapidity with which the drawing-oriented 2D CAD systems could be introduced was due in part to the possibility of still retaining the traditional working procedures. Manually drawn documents were simply replaced with computer-drawn ones, while the firmly rooted processes of communication and problem solving remained unaltered. The next step, from CAD to BIM, is a good deal bigger. Now we are talking about sharing information stored in a common model or in several models organised in accordance with jointly agreed principle. In order, then, for full use to be made of the potential of BIM, working procedures have to be developed which will also affect areas of responsibility and boundaries between different participants.

Whereas CAD could be introduced quickly, BIM has gained ground a lot more slowly. For example, an advanced object-oriented modeling system, called RUCAPS, was already being used for practical planning in Sweden in 1981. But still today, some 30 years on, its de facto impact on building as a whole remains slight, according to the IT Barometer, which is the most comprehensive mapping of IT use in Sweden and has been conducted four times, namely in 1998, 2002, 2007 and 2011 (Samuelsson, 2010, 2011). Because there has been no significant development of work procedures, one can see how, parallel to modeling, the users try to make up for this by communicating corresponding information through other media, resulting in extensive unnecessary duplication and a risk of errors (Moum, 2008).

On explanation for BIM getting off to such a slow start is that it has been so strongly tied to the notion of form communication and of communication as an exchange of information between machines. The importance of information communication and problem-solving ability has been disregarded. It is not included in the strategies for introducing the new technology. Great hopes are now being pinned on BIM accomplishing the industrialisation of building in one fell swoop. Market activities are numerous, and reports of successful implementation in limited parts of the building process are coming thick and fast. But there is reason to stop and think and to caution against exaggerated belief in this, especially if one believes that modeling is destined to replace informal communication. In that case there will be a risk of BIM also joining the many failures paving the road to building's industrialisation.

Lessons to be learned from previous failures are among other things concerned with the allocation of roles between user and developer. Someone develops things which other people are to use, without being fully apprised of the intended users' professional skills. Without knowledge of professional skills, new techniques and processes are left hanging in midair. User-friendly interfaces are not enough. The technology must be genuinely serviceable and meaningful to the professionals. Professional skill is situation-related and new technology must therefore be appropriately contextualised (Wenger, 1998). Another explanation may be found in the notion of being able, with the new technology, to make a clean sweep of every conceivable problem and defect in one go. "Radical change" is the name of this approach, and it seldom meets with success. Much is being committed to the new technology, little to its implementation. One useful lesson to be learned is that success can instead be achieved if

development and implementation merge into a continuous process (Dahlbom & Mathiassen, 1993; Löfgren, 2008).

Conclusion

In this essay I have tried to show that one of the special capabilities of building is its problem-solving capacity, with different competences interacting through intensive communication so as to tailor a solution to the specific terms of the individual project. At the centre of this communication we have the model and the image of what has yet to be built. It is vitally important for this capacity to be sustained in the future organisation of building.

Communication in building can no longer be taken for granted. New forms of interaction, and in particular the introduction of BIM, are confronting building with two different views of the way in which communication and problem solving should be organised in future.

Either through hierarchic organisation in a tree structure, with formal communication in accordance with predefined chains of command, allocation of tasks through procurement and contract, quality assurance and project management through checklists and with communication as a controlled exchange of documents and standardised information modeling.

Or through reliance and trust with a network-like organisation for interaction and informal communication, quality assurance through commitment, knowledge and assumption of responsibility, and interactive communication round models for successive reduction of uncertainties by using social media.

My conclusion is that not until we have the understanding to combine these two views of formal and informal communication can BIM really come into its own. This can have the same revolutionary import for architecture and building as drawing did five thousand years ago and the scientific perspective six hundred years ago. This is a revolution by many small steps and with numerous modifications of both technology and working procedures. Communication and problem-solving capacity will continue to be based on the human dialogue round the model and the image of what has yet to be built. But the model has found a new form. There is no either/or, instead it is a case of both/and.

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