A Research Model for Architectural Meetings to Support the Implementation of New Building Technologies through Collaboration of Brainpower

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Abstract

Implementing new technologies in the domain of "Robotics and Automation in Construction" is necessary to enhance the values for clients and society. The technologies are available but implementing them is the coming challenge.

Building technologies are not used exhaustively or intelligently. In the manufacturing industry of complex products collaboration of brainpower through involvement of all stakeholders has resulted in a major enhancement of the values mentioned. Making the experiences of the involved professionals collaboratively explicit by well-prepared meetings can be a success factor to implement new building technologies. The aim of this paper is to develop a successful approach for organizing collaborative architectural meetings of the bonding type. This study has been divided into three phases: (i) getting insight in the relevant factors of a successful collaborative architectural meeting (desk research), (ii) analyzing case studies, and (iii) developing a meeting model for further research. The following parameters can describe an architectural meeting: (i) system variables, (ii) input variables, (iii) leading variables, (iv) participant variables, (v) tool variables, and (vi) outcome variables. These are included in a meeting model for further study to facilitate the collaboration of brainpower for enhancing the values for clients and society during the construction and use of buildings objects.

Keywords: building technologies, architectural meetings, collaborative brainpower

Introduction

Currently required values for clients of building projects include short building time and little waste, while values for society include safe working conditions and (social) sustainability. New building technologies to enhance these values for clients and society, such as automation and robotics, do exist, but are not implemented as quickly as desired (Hasegawa, 2006). Individual problem solvers, such as architects or building engineers, fall short in delivering these new values (Bennis and Biederman, 1997). To implement productively new building technologies in the architectural, engineering and construction industry specific management and social competences are needed and have to be learned. This could be reached by collaboration of brainpower. During architectural meetings collaborative involvement of all stakeholders is needed.

In other domains, such as the manufacturing industry of complex products (planes, computers, pharmaceutics), collaborative involvement of all stakeholders has resulted in a major enhancement of the values mentioned above (Sonnenberg, 2004). The ideas and concepts for these products were generated during creative meetings, involving all relevant professionals and even clients. Applying creative problem solving techniques (Osborn, 1963), energizing minds by engaging the senses (Roos, 2006) and team dynamics insights (Seagal et al, 2006) are proven instruments for successful implementation of innovative products.

Today's processes to create new products in the construction industry differ from those of the manufacturing industry by adherence to craft traditions based on time tested experience (Kvan, 2000). In addition, the various building professionals have their own language, symbols, unwritten rules, tools and paradigms (Buciarelli, 2002). Team forming is considered impossible because of a large turnover of labor. Professionals in building are rather solution driven and not problem driven, and show poor socio-emotional skills in their work (Zou et al., 2006; Glunk et al., 2008). These special aspects have to be considered by attempting to organize collaborative architectural meetings.

In 2006 Keursten et al. published a frame work for the building domain with elements that play a role in developing and using knowledge based on the "Corporate Curriculum" of Kessels (1996) that was highlighted in 16 case studies. But their approach did hardly realize the collaboration of brainpower during architectural face-to-face meetings.

Architectural meetings are a forum for reviewing functions, discussing unsolved issues, making decision, monitoring, and communicating decisions to those who need to know. Emmitt (2007) distinguishes five types of meetings: (i) controlling, (ii) coordinating, (iii) appraising, (iv) bonding, and (v) resolving.

In this paper we focus on the bonding type: "… meetings that fulfill a fundamental human need to communicate and bond, and hence foster team relationships. They create a sense of belonging and reflect the collective and cultural values of the temporary project organization" (Emmitt, 2007, p 17). The aim of this paper is to develop a successful approach for organizing collaborative architectural meetings of the bonding type.

Methodology

Our study has been divided into three phases: (i) getting insight in the relevant factors of a successful collaborative architectural meeting (desk research), (ii) analyzing case studies, and (ii) developing a research model for meetings.

The literature survey on collaborative brainpower as applied to the building process concerned (i) successful meeting types, (ii) their possible outcome, (iii) useful collaborative insights, (iv) reported success factors. In addition to searching literature databases (Webspirs, Web-of-Science, Scopus), the following journals were studied (1995-2007): Automation in Construction, Creative Problem Solving, Creativity and Innovation Management, Journal of Learning and Intellectual Capital, CoDesign, International Journal of CoCreation in Design and the Arts, Architectural Engineering and Design Management. Search key words used, included Creative Problem Solving (CPS), Collaborative design, Meetings, Creative thinking, Architectural management, and Meeting dynamics.

The collected information was structured according to Sebastian (2007) who developed a model for collaborating design-actors creating design-solutions. It involves three kinds of frames: (i) social (social environment, team work, behavior), (ii) cognitive (creativity, knowledge, decision), and (iii) project oriented (goal, vision, constraint, result).

In the second phase of the study a total of 15 meetings, organized by the first author, were studied by observation. In 12 of the 15 meetings analyzed the first author facilitated and the participants were mostly experts. The following parameters were assessed during observation: input, outcomes, control and mechanism of the activity meeting. The notation of the Systematic Analytical and Design Techniques was used (SADT, 2008). The aim of the meeting is considered the input variable. In 6 meetings the aim was "introduction in skills", in 7 meetings "vision building", and in 2 "vision implementation".

Two groups of interventions are distinguished: organizational interventions (1=not applied, 2=hardly applied, 3=strongly applied), and special interventions to explicate the experiences of the participants (0=not applied, 1=applied).

Rating of the outcomes of the meetings included providing, sharing and developing new knowledge (1=hardly any result, 2=mediocre result, 3=good result). However, the rate of developing new knowledge could not be analyzed because of too many missing data.

In the third phase the obtained data were structured and analyzed to support an iterative process leading to a collaborative architectural meeting research model.

Results

Relevant factors and insights

Successful bonding meetings appear to be a result of awareness, formulation and state of the needs of the (end) user and society (Kjølle 2005). Three types of outcome are distinguished after Bloom (2008) with the participants (i) knowing more and able to recall data or information, (ii) acquiring more skills, and (iii) developing the attitude to act as an expert. During architectural meetings cognitive processes take place: "To the thinking and interactive skills of design like the perceptive, the creative, the communicational, the learning and also the emotional and the teamwork processes" (Tschimmel, 2004). Relevant factors are

numerous (Table 1), and form a source of inspirations cq interventions for the organizer to prepare an architectural face-tot-face meeting with a desired outcome.

Table 1. Insights in meeting processes, sorted according to the frame work of Sebastian (2007)

Frames	Relevant factors and insights
Social (social environment, team work, behavior)	- Socialization and externalization of implicit knowledge (Nonaka and Takeuchi, 1995) - To obtain desired interactions, the group had to work alternately in a generative and focusing mode (Hohn, 1996). - There are some studies about organizing architectural meetings. Gorse (2002) measured by the method of Bales the interpersonal communication and group interaction during construction management and design team meetings. Successful project outcomes were from groups who use a broader range of communication acts. "The level of positive emotion (agreeing and being supportive) is greater in successful teams".
Cognitive (creativity, knowledge, decision	- Learning styles and the circle of learning: concrete experience, observation and reflection, forming abstract concepts and testing situations (Kolb, 1983). These styles are incorporated in the tools variables of the meeting research model. See *Figure 1*. - Designing is learning (Dorst, 1997). - Unconscious thinking, rituals and creativity (Dijksterhuis, 2007). - Specific activity rhythm of divers personality dynamic during a face-to-face meeting (Seagal and Horne, 2006)
Project (goal, vision, constraint, result).	- The essence of collaborative design: collaboration from cooperation and coordination as a closely coupled design processes (Kvan, 2000). - Systematic Inventive Techniques (SIT) (Horowitz & Maimon, 1997). - The dialogue between intuitive thinking and the rational, logic thinking is the engine for the creative process (Groeneveld, 2008). - Reformulating the problem definition (Basadur, 2002). What is the real problem of the (end) user and what problem is interesting to solve? - A model with the following activities: formulating, representing, moving, bring problems and solutions together, evaluating and reflecting (Lawson, 2006). - The design process can divided in sub-processes as naming, framing, moving and reflecting (Valkenburg, 2000). - The development of a group to a team by passing trough the phases of forming, storming, norming, performing and adjourning (Robbins, 2002). - Van Gassel (2005) did experiments on the subject collaborative design by constructing metaphoric objects. The designers in this experiment were more involved but to a certain extent. To get the designers more involved in the design process tactical activities has to be added such story telling and recording on video to hold the ideas and make them communicable.

Case analysis

During the meetings a number of control activities and mechanism activities took place and were rated by the extent of its use (Table 2).

As to outcomes (rated 1 to 3), the mean for providing knowledge was 2.7, and for sharing knowledge 2.4. The lowest outcome (1=hardly any result) occurred in one out of the 15 cases analyzed.

To get some more insight in the cases two of them are described below.

Case "Awareness"

Participants: About 20 professionals as directors, designers, planning engineers, purchasers and project managers from the domains civil, road-building, housing and installing.

Description: To get more assignments a contractor needs a better dialogue with the client to create innovative bidding proposals. The management is not aware of the needed competences of brainpower development. A skills-learning meeting with the professionals was the aim to enhance more awareness, experience the required creativity skills and the creativity techniques that can be used for a certain outcome. Result: a number of professionals want to enhance their competences on brainpower development.

Assessment: this case obtained a rating of 3 for its outcome

Case "London Eye"

Participants: A group of 12 experts such as architects, project managers, cost accountants, facility managers and design managers.

Description: A Dutch contractor has been invited by the government to participate in a PPP bidding process for building a reception centre for asylum seekers at the airport of Schiphol. The contractor manager of the bidding activities wanted the participated professionals to focus on the client's wishes and dreams by using a metaphor. This metaphor has been developed during a day meeting. The meeting consisted of the system activities, and the tools brain writing, storytelling, selection techniques, making image boards of metaphors, reflection on the participant's contribution, etc. The activities were done in groups of two persons and plenary.

Table 2. Intervention scores during the 15 architectural meetings and the extent of their use. The organizational interventions were rated as: 1=Not applied, 2=Hardly applied, 3=Strongly applied. The special interventions were rated as: 0=Not applied, 1=Applied

Interventions		**n**	**Intervention scores**		
			Min	**Max**	**Mean**
Organizational activities	Socializing	14	1	3	1.7
	Acting	15	1	3	2.3
	Perceiving	15	1	3	2.1
	Incubation	15	1	3	1.5
	Reacting	15	1	3	1.8
	Receiving Feedback	14	1	3	1.8
	Imaging Problem	14	1	3	2.3
	Reformulating Problem	14	1	3	1.9
	Diverging	15	2	3	2.8
	Clustering	14	1	3	2.4
	Converging	14	1	3	2.1
Special activities to explicate the experience of the participants	Time out	15	0	1	0.1
	Splitting group	15	0	1	0.7
	Individual work	15	0	1	0.1
	Failures	15	0	1	0.1
	Rules	15	0	1	0.3
	Simulation	15	0	1	0.1
	Constructing	15	0	1	0.3
	Reflecting	15	0	1	0.1
	Serious Play	15	0	1	0.3
	Energizer	15	0	1	0.3

Result: the metaphor "London Eye" that describes the required values e.g. proud, identification, international, simplicity, daring en vision, and that is successfully used in the kick-of meeting.

Assessment: this case obtained a rating of 3 for its outcome

Towards a meeting model for further research

Tabel 2 shows us that organizational interventions were applied frequently and that these could be considered as system variables. In addition, Table 2 shows that special interventions were used incidentally and are considered by us as tool variables.

Based on both the literature survey and the case studies, the following variables appear to be most relevant for describing the activities of an architectural meeting.

(i) System variables (imaging the aim, reformulating the problem/question, diverging, clustering and converging);
(ii) Input variables (the aim of the meeting);
(iii) Leading variables (type of leader and time span);
(iv) Participants' variables (type of participants); and
(v) Tools variables (rational thinking, intuitive thinking, doing, dreaming, reflecting with an individual, small group and plenary appeal) , and
(vi) Outcomes variables (knowledge, skills and attitude).

Based on the results in Table 1 the variables are split up into sub-variables.

In Figure 1 these variables are depicted following the SADT notation and form together the meeting research model.

Discussion

The research model is restricted to meetings in the beginning phases of the building process under the architectural circumstances of the Netherlands, since the developed approach is based on a number of special preconditions of architectural meetings:

(i) Only meetings in the beginning of the building process are included; here there is more need to find the required client values than to find solutions.
(ii) Face-to-face meetings with widely divergent building experts.
(iii) Considerable turnover of participants in meetings. Long term team building is no issue.

In addition our approach has elements that deliver new knowledge about architectural meetings after validation:

(i) A well-founded organization of the meeting is an approach to get a better productivity of collaborative brainpower.
(ii) Defines minimal system activities for a meeting.
(iii) Uses well chosen tools to reach specific outcome.
(iv) Uses well chosen tools to anticipate on the specific contribution of the expert and ongoing meeting process.
(v) Is based on the process of experiential learning.

Keursten et al. (2006) found the following development principles for the support of learning processes leading to improvement and innovation, among other, enhance reciprocal appeal, search for passion, and temping towards knowledge productivity . Also some of his 10 design principles have a relation with our tool variables: formulating urgent and fascinating questions, and creative learning: knowledge developing by collaborative constructing.

The study resulted in an architectural meeting model of the bonding type with a set of variables describing input and outcome, as an useful structure for further observation and analysis to deliver syntax relations supporting the organizer of an architectural meeting to successfully set a meeting to deliver specific outcomes.

Based on our results we can formulate the following successful approach. An architectural meeting needs a minimal system configuration of the activities (i) imaging the aim, (ii) reformulating the question, (iii) diverging, (iv) clustering and (v) converging, and an alternating and a well-balanced variety of tools such as rational and intuitive thinking, doing, dreaming, reflecting and involvement of the whole group.

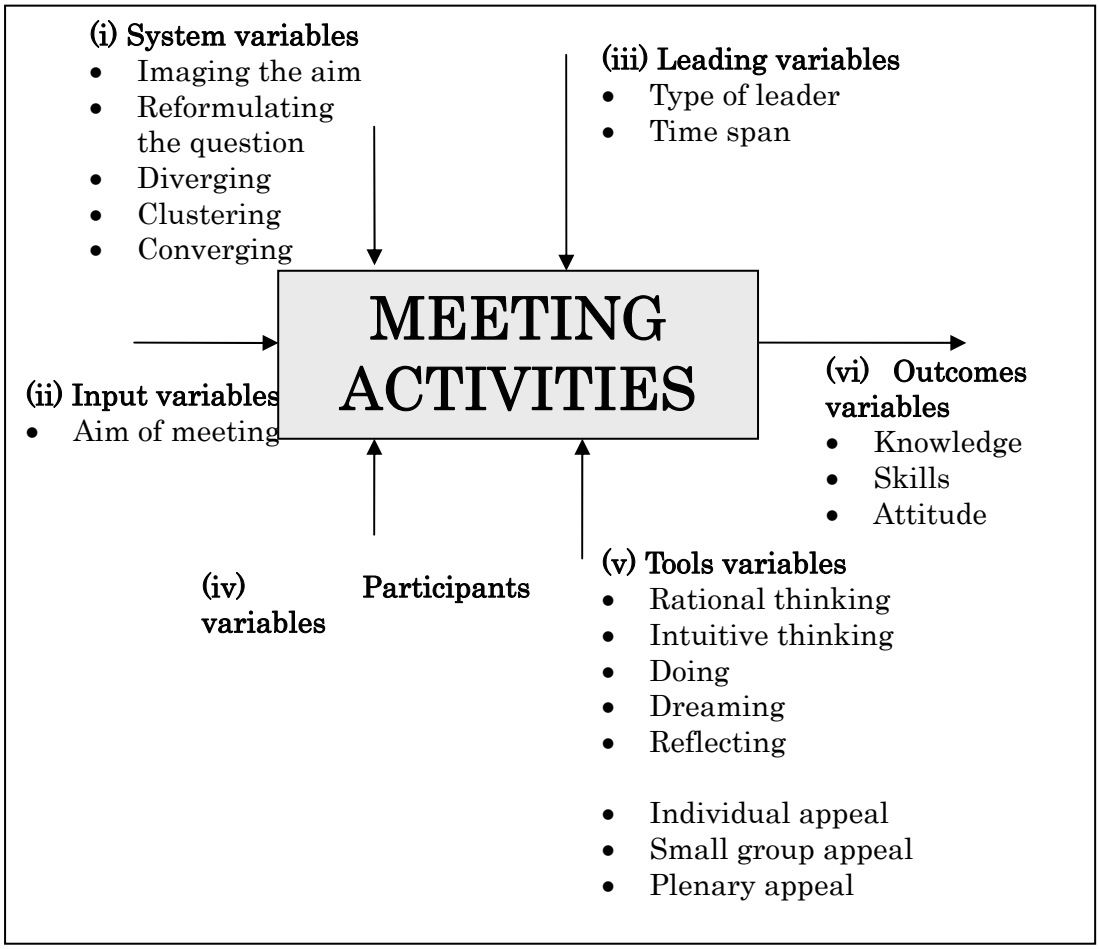

Figure 1. An architectural meeting model for further research as presented in SADT (2008) notation

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