INTERNATIONAL DESIGN CONFERENCE - DESIGN 2004
Dubrovnik, May 18 - 21, 2004.

DESIGN 2004

A CLASSIFICATION SCHEME FOR STRUCTURE AND CONTENT OF DESIGN MEETINGS

G. Huet, S. J. Culley and C. A. McMahon

Keywords: design meeting elements classification, design rationale, design experience, transcript coding scheme

1. Introduction

The meeting has always been both the critical element and the curse of most professional work including engineering. Collaborative design implies that the participants, regardless of their discipline, need to get together and exchange information for the benefit of the design project.
The importance of meetings in the engineering world has increased along with the complexity of the tasks to be achieved and the distribution across the globe of stakeholders involved in a project. New technologies, especially the evolution of IT networks, have expanded the traditional definition of a meeting as a face-to-face situation to an activity distributed in space and time. In other words, participants do not need to be all at the same place at the same time. Nowadays, the word 'meeting' therefore represents a fascinating variety of situations in terms of number of participants, level of structure of the information exchanged and technologies used to communicate. Researchers who have investigated meetings have taken two major approaches namely *trying to understand what goes on during meetings and creating tools to facilitate them.*
It has been widely acknowledged, eg. [Moran 1997], that a great deal of information about the aspects of the product being developed, the progress of the project itself, participants' concerns and problems, previous experiences, decisions, people issues etc. is exchanged during meetings. However, reports that form the formal records of meetings are often limited in the extent to which they capture this information exchange. New means are needed to capture the essential design knowledge, experience and expertise generated during these collaborative situations. Recording and facilitation technologies for meetings are improving but further work is needed to enable efficient capture of knowledge and experience from meeting discourse.
The work reported in this paper is part of the Design Transaction Monitoring project (DTM), exploring how design experience and rationale can be captured from the discourse of design meetings. This paper will present an engineering focussed categorisation of meeting elements used for structure and content analysis of design meeting transcripts. The findings are based on a study of the literature relating to meetings, both from engineering and from cognitive science research. The essential experimental part of the DTM research work will be to record design meetings and then transcribe them manually for subsequent analysis.

2. Review of previous studies on the nature of meetings

Meetings occur in many professional contexts and have therefore often been the subject of study from a number of perspectives. Some of the findings of these various disciplines have been taken into account in the development of collaborative methods and tools. The following sections briefly present

key points made by, amongst others, sociologists and linguists when studying meetings in a working context.

2.1 The study of meetings from a sociological and linguistical point of view

In the specific case of design research and more particularly the DTM project, several topics of investigation from sociology and linguistics have emerged. From these fields insights regarding the relationship between thought and language have been outlined and practical information about transcript conventions reviewed.

2.1.1 The role of language

In linguistic research, views on how language and thought are linked can bring a strong basis for the study of design rationale through discourse analysis. [Chafe 1998] states that: "*Every language provides ways not only of organising sounds, but also thoughts, along with ways of relating theses two disparate phenomena. There are two great benefits. Most obviously, associating thoughts with sounds makes it possible for thoughts to be communicated (…). The other benefit of language lies in the organisation of the thoughts themselves."*

If this first remark is applied to the specific field of current interest, this suggests that there is a close link between how engineers communicate verbally on a project and how their thoughts are sequenced. Thus by capturing interactions between designers collaborating on a project, it would be possible to implicitly capture the design rationale. Making this rationale explicit is one of the biggest challenges that the DTM research has to meet.

Another important point regarding the study of verbal transactions is the affinity that speech has with past experiences. As suggested in a study of American Indian languages [Boas 1911], relevant experiences can be 'fished' out of verbal exchanges between designers and this is an important indicator of what may be possible in a design context..

2.1.2 Transcription conventions

It is common for discourse analysis to transcribe the verbal interactions of the speakers. However, transcription standards do not exist and therefore researchers have adapted various conventions to their specific need.

Throughout the field of linguistic research, transcripts are encoded in a similar way even if they are not formally standardised. Research produced in this discipline often presents a section dedicated to transcription conventions. This encoding is frequently focused on trying to annotate elements of speech that cannot be reproduced by standard written language (accents, intonation, …etc.).

As for other research teams studying verbal interactions between engineers [Robillard 1998], the DTM project is not aiming to analyse linguistic aspects of speech and therefore a more basic convention seems appropriate. The 'raw' transcript will be composed of three elements to answer the questions: when? who? and what? Each transcribed intervention will be preceeded by the name of the speaker and the time at which his or her sentence ended. Before the transcript can be formally analysed, its 'raw' composition will be as outlined in figure 1.

Time when the intervention ended (minutes and seconds)	Identity of the speaker (initials)	Text transcribing speech

Specific textual conventions:

- Words in ***italic*** in the text mean that they have been transcribed approximately.
- **…** in the text marks a pause in the speech (less than 30 seconds)
- **[…]** means that this part has not been transcribed (no speech for more than 30 seconds or irrelevant speech).

Figure 1. DTM transcription convention

2.2 Review of key research on meetings

Most of the research teams presented in this section include a mixture of academic and industrial experts from both engineering science and human science.

The key research teams considered for detailed review include: the CREW laboratory (Collaborative Research in Electronic Work) at the University of Michigan [Olson 1996], Project Nick at MCC (Microelectronics and Computer Technology Corporation) [Cook 1987], Project Eiffel involving a large number of industrial partners and academic collaborations [Robillard 1998], Xerox PARC research centre [Moran 1997], the Knowledge Media institute at the Open University [Selvin 2001] and the International Computer Science Institute at the University of California (Berkeley) [Morgan 2001]. The goals driving these research projects are:

- The creation of collaborative tools to enhance meeting facilities.
- Understanding how designers work/think/operate in a collaborative environment.
- The facilitation of meetings to avoid failure.

These goals are relevant to what is trying to be achieved in the DTM project and furthermore they have been supported by case studies in the software or mechanical engineering design field. Most of the projects reviewed have published detailed methodologies for meeting transcript analysis. These are based on classifying elements of a meeting transcript through pre-defined meeting concepts and sub-concepts. These terms were analysed and brought together to form a classification scheme that could be used in a DTM context, which is presented in the following section of this paper.

3. Categorisation of meeting elements

Before attempting to analyse meeting transcripts it is of importance to adopt a coherent method that can be applied in a systematic way to recordings of design meetings. The essential part of creating this methodology is to determine the criteria under which transcripts will be analysed.

Transcribing discourse in written words is a way to encode a certain event, in this case a meeting. But this first step does not meet the requirements for the transcript to be understood and processed by, for example, an agent software system. The transcript needs to be further formalised so that the information output of the encoding meets the information structure requirements of a ‘meeting model’.

The first step chosen to produce a formal model of a meeting is to try and order hierarchically the pool of concepts, which have a systematic influence in the analysis of the information generated.

Nevertheless the terminology used by the researchers for the analysis of these transcripts is wide-ranging and has considerable redundancy. Therefore a comparative method using relationship matrices was chosen in order to rationalise the extent of the vocabulary used between the different research teams and make it appropriate for the design engineering context. After further analysis, it was decided that all of the concepts fell into two families: the ‘meeting’ family and the ‘meeting elements [Cook 1987]’ family. The two families are simply linked by the fact that ‘meeting’ contains ‘meeting elements’.

If a more formal object orientated language was to be used where concepts are classified in a entity/attribute/type/value model, ‘Meeting’ and ‘Meeting elements’ could be considered as super-entities. In the ‘meeting’ hierarchy, which has not been presented in this paper, only one further level of specialisation composed of the sub-entities ‘location’, ‘synchronicity’ and ‘meeting type’, has been outlined for the moment. Further research will aim to underline relationships between these entities in an attempt to produce an encodable model of transactions that take place during design meetings.

Figure 2 presents the breakdown of the super-entity ‘meeting elements’ into a parent – child entity hierarchy, where two main branches appear: the ‘structure elements’ and the ‘content elements’ branches. ‘Structure elements’ are the entities on which the meeting has been built. These elements are known in advance of the meeting to one or more of the participants. Entities belonging to ‘content elements’ category characterise the content and the nature of the information transactions that take place during a meeting.

It is not in the intent of this paper to present detailed definitions of each one of these entities, nevertheless figures 3 and 4 present the full extent of this preliminary classification scheme by showing the various attributes and types related to each entity in the two branches.

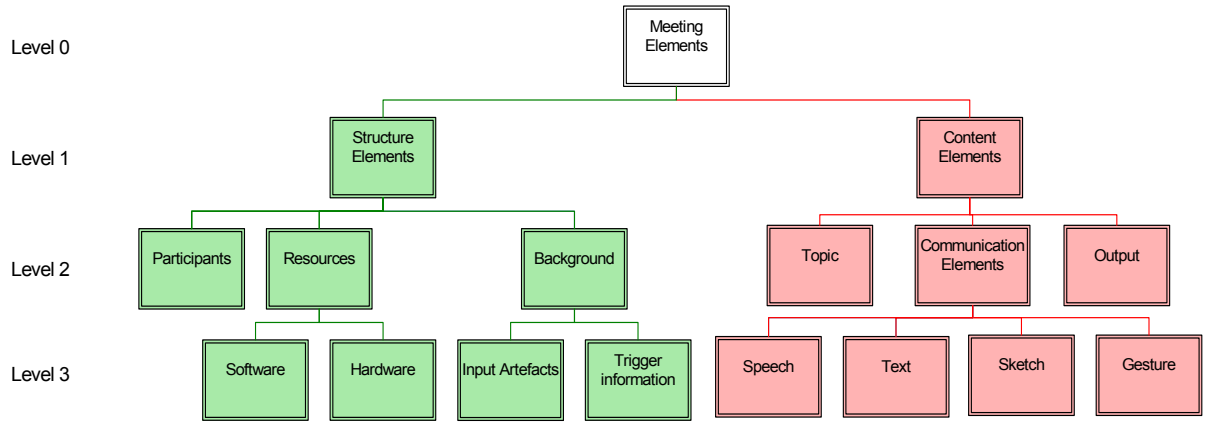

Figure 2. The authors' breakdown of the 'meeting elements' family into a hierarchy of entities

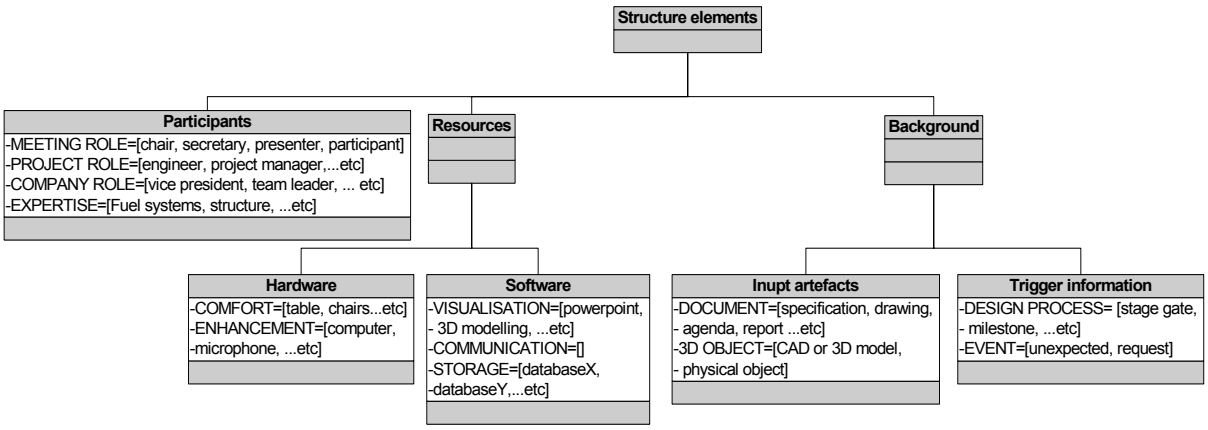

Figure 3. The authors' breakdown of the 'structure elements' hierarchy into entities and related attributes and types [Key: Entities – bold; Attributes – caps; Types – brackets]

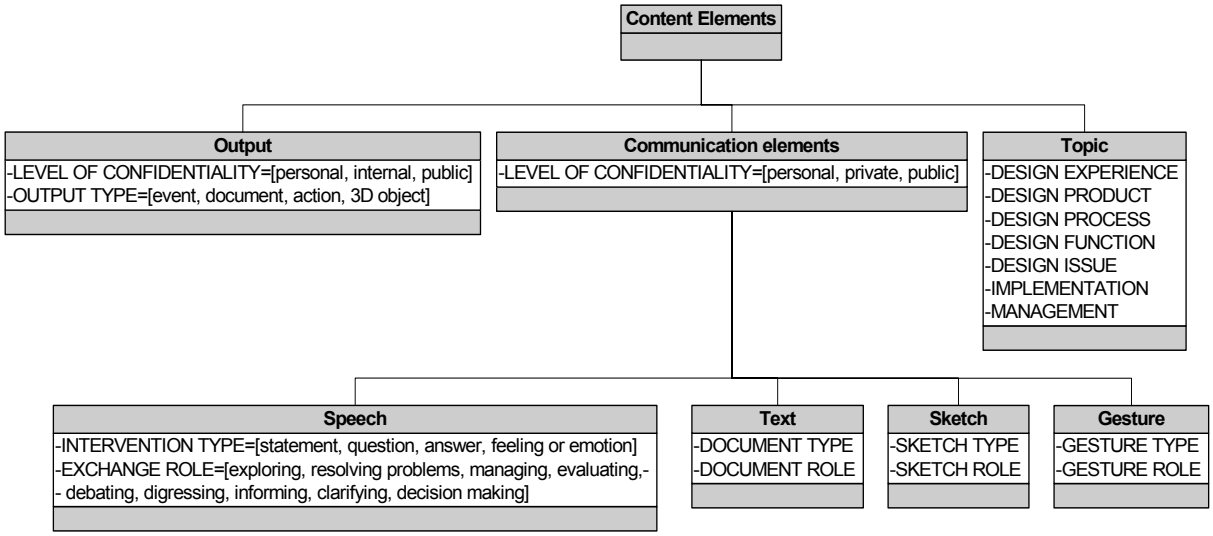

Figure 4. The authors' breakdown of the 'content elements' hierarchy into entities and related attributes and values [Key: Entities – bold; Attributes – caps; Values – brackets]

4. Coding scheme for marking up meeting transcripts

From the preliminary classification of the meeting elements, a draft of an intervention coding scheme, necessary to an organised, structured and systematic coding of meeting transcripts has been created and is presented. A meeting will be codified according to two aspects: a structure record and a content code. The structure record is not based on the transcript, it could be presented as a form where the possible structure elements of a meeting appear, and completed before the meeting in the case where the meeting is not spontaneous.

Robillard proposes a clear and reproducible method for a content coding [Robillard 1998] and the DTM coding will largely be presented in the same format. The coding of the content will rely primarily on the transcript; each intervention will be placed in a table along with the speaker ID, the time when the intervention occurred, the type of intervention, the topic, the role of the exchange it belongs to and the artefact(s) encountered. An example is given in table 1.

Table 1. Example of the Transcript Coding Scheme (TCS) proposal, based on [Robillard 1998]

# or time	Speaker ID	Intervention	Intervention type	Topic	Exchange role	Artefacts
0'46	SJC	"so controlling hydraulics … electronics plus hydraulics"	[Q]	[D Prod] electronic/ hydraulic solution	[EXP]	-
0'49	S3	"yeah, hydraulics with an electronic control."	[A]			

To give the reader a better understanding of the contents of the TCS, the following preliminary list of definitions and related abbreviations are proposed:

Intervention types: statement [S], question [Q], answer [A], feeling or emotion [E]. These basic speech units could be highlighted by specific discourse markers.

Exchange roles: exploring [EXP], resolving problems [RES], managing [MAN], evaluating [EVA], debating [DEB], digressing [DEV], informing [INF], clarifying [CLA] and decision making [DEM].

Topic: this entity is at the centre of the content of a meeting, it defines the topic of the on going information exchanges. A change of topic will be initiated by a new intervention or artefact and will set a new exchange between participants. Of course there are an large number of possible topics that can appear during a meeting, but in the case of the DTM project it should be possible to classify them in generic categories, such as design experience [D EXP], product design [D PROD], design process [D PSS], design function [D FCT], design issue [D ISS], implementation [D IMP] and management [D MGT] for example.

Artefacts: as defined in [Moran 1997], various artefacts can be submitted, created or modified during meetings, such as: documents, sketches, drawings, objects, written notes, annotations through meeting facility tools, recordings of the meeting…etc. These artefacts contain or generate information, and are related to the physical inputs and outputs of the meeting.

The elements of this preliminary classification will be validated and refined by detailed analysis of case studies currently being conducted.

5. Conclusion

The hierarchies presented in the previous sections are the result of analyzing the literature and a collation of the work of a number of research teams from a wide variety of disciplines. Following this work, the DTM research rationale has also made a step forward; from the content analysis, essential points regarding what can be extracted from design meetings at the research partner, Airbus UK, in terms of knowledge and experience will be defined; from the structure analysis, answers to the question "where and when should this capture of experience take place? " will appear.

It is also important to outline the DTM research process, presented in figure 5, towards the creation of an overall capture methodology. Steps (1), (2) and (3) resulted in the fundamental classification of meeting elements and a related transcription coding scheme presented in this paper. This will the basis for the completion of the DTM project.

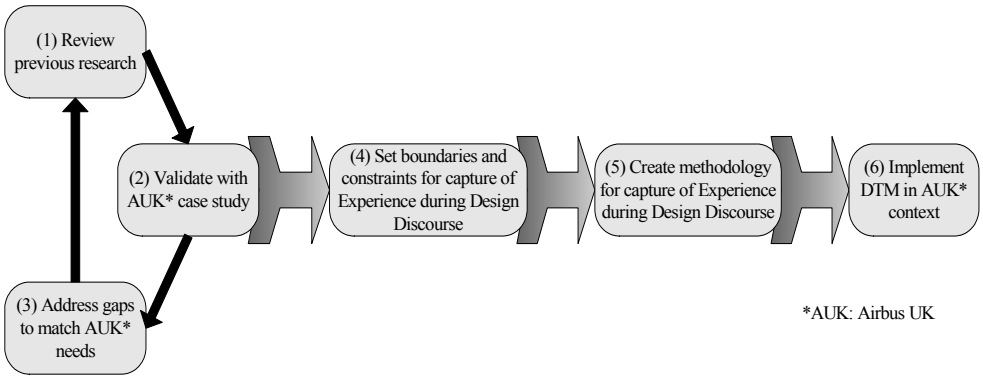

Figure 5. The DTM research process

The remaining stages of this project will deal with the issue of finding the appropriate technology to capture the desired design experience from meetings. It can already be forseen that meeting facilitation tools will have a role to play as their aim is to improve the capture and access of collaborative activities [Ellis 1991]. An important decision will be to decide whether an automatic approach may be taken, most probably through speech recognition [Brown 2001] or if the presence of a human facilitator as used in dialog mapping [Selvin 2001] is a more suitable option for capturing the content of such collaborative activities.

Acknowledgements

This work is jointly funded by the EPSRC and Airbus UK. It is part of the EPSRC Innovative Manufacturing Research Centre (IMRC) at The University of Bath.

References

Boas, F., "Handbook of American Indian languages", U.S. Gov Printing Office Washington DC USA, 1911.

Brown, E.W., Srinivasan, S., Coden, A., Ponceleon, D., Cooper, J.W., Amir, A. "Toward speech as a knowledge resource", IBM Systems Journal, Vol. 40, No. 4, 2001, pp 985-1001.

Chafe, W., "Language and the flow of thought" from Tomasello, M., "The new psychology of language, cognitive and functional approaches to language structure", Lawrence Elbaum New Jersey USA, 1998.

Cook, P., Ellis, C.A., Graf, M., Rein, G.L., and Smith, T., "Project Nick: meetings augmentations and analysis." ACM transactions on office information systems, Vol. 5, No. 2, 1987, pp 132-146.

Ellis, C.A., Gibbs, S.J., and Rein, G.L., "Groupware: some issues and experiences", Communications of the ACM, Vol. 34, No. 1, 1991, pp 38-58.

Moran, T.P., Palen, L., Harrison, S., Chiu, P., Kimber, D., Minneman, S.L., Van Melle, W. and Zellweger, P. " 'I'll get that off the audio': A case study of salvaging multimedia meeting records", Proceedings of CHI'97, Atlanta GA, USA, 1997, pp 302-309.

Morgan, N., Baron, N., Edwards, J., Ellis, D., Gelbart, D., Janin, A., Pfau, T., Shriberg, E., and Stolcke, A., " The Meeting Project at ICSI", Proceedings of HLT 2001, San Diego CA, USA, 2001.

Olson, G.M., Olson, J.S., Storrøsten, M., Carter, M., Herbsleb, J. and Reuter, H. "The structure of activity during design meetings" from Moran, T.P., and Carroll, J.M., "Design rationale: concepts, techniques and use", Lawrence Erlbaum New Jersey USA, 1996.

Robillard, P.N., D'Astous, P., Detienne, F., and Visser, W., "An empirical method based on protocol analysis to analyse technical review meetings." Proceedings CASCON'98. Toronto, Canada, 1998, pp 20-31.

Selvin, A., Buckingham Shum, S. et al "Compendium: Making Meetings into Knowledge Events", Proceedings of the Knowledge Technologies Conference 2001, Austin TX, USA, 2001, [www.KnowledgeTechnologies.net].

Gregory Huet
University of Bath, IMRC, Mechanical Engineering Department
Claverton Down, Bath, UK
Telephone: +44 1225 386131, Telefax: +44 1225 386928
E-mail: gregory.huet@bath.ac.uk