Enhancing Cooperation in the Meeting Room[*]

How computer systems can support and improve cooperative meetings

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ABSTRACT

This paper analyses how face-to-face cooperation in meeting rooms can be enhanced and supported by computer systems. To do this, the evolution of systems allowing such an enhancement will be studied. Afterwards, the two main types of such systems, namely interactive interfaces and feedback mechanisms, will be analyzed. For each of the two types of systems, the main characteristics and some examples will be given. At the end of the paper, the findings will be summed up and discussed and an outlook of possible future systems will be given.

Keywords

CSCW, Meetings, Cooperation, Enhancement, Interactive interfaces, Electronic whiteboards, Feedback mechanisms, Real-time feedback, Postmeeting feedback

1. INTRODUCTION

Although distributed meetings with members from all over the globe are becoming increasingly popular (mainly thanks to the improving technologies for communication over the internet), face-to-face meetings are still held regularly.

These meetings have well established roots for what concerns their basic structure, but some aspects of them can still be enhanced. The enhancement of meetings with computer systems allows not only to make interactions easier by providing interactive interfaces (like electronic whiteboards) but also to increase them both in real-time and *a posteriori* through feedback mechanisms (like sociometric badges analyzing interactions between meeting participants [5]).

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In this paper we will analyze how computer systems can enhance meetings, by looking separately at the two distinct types of enhancement systems seen above, namely interactive interfaces and feedback mechanisms.

In order to understand these systems more clearly and explain how they can influence meetings, we will first give a short historical overview in section *Evolution*, where we will look at how interactive interfaces and feedback mechanisms evolved. Afterwards, we will look at the main characteristics and at some examples of interactive interfaces in section *Interactive interfaces* and of feedback mechanisms in section *Feedback mechanisms*. Finally we will sum up these findings in section *Conclusion*.

2. EVOLUTION

In this chapter we will see how computer systems enhancing and supporting cooperation during face-to-face meetings evolved over time.

In this short historical overview we will look in turn at two distinct categories of systems, interactive systems and feedback mechanisms, to follow the structure of the paper.

Only some major examples of systems will be given for each category, since the purpose is not to draw a complete timeline of their evolution, but only to give a short overview.

Interactive interfaces: Interactive systems have been the first type of computer systems supporting cooperation in face-to-face meetings. They have started to be used in the 1980s with the emerging of Computer Supported Cooperative Work (CSCW) [2]. The first such systems used mainly interactive whiteboards, like the Capture Lab, which uses an indirect approach, providing each meeting participant with a personal workstation integrated into the meeting table to edit the content of the electronic whiteboard [4]. Other, more recent, systems use a more direct interaction with the electronic whiteboard, like Tivoli, which allows to interact directly with the electronic whiteboard through touch [7].

Feedback mechanisms: Feedback mechanisms are more recent and become of growing importance in analyzing different aspects of face-to-face meetings in order to enhance them. The uses of feedback mechanisms are varied and go from improving time sharing, like Second Messenger [1], to analyzing social interactions during meetings, like Meeting Mediator [3]. Some of these systems allow even a deeper

analysis of meetings by proposing not only real-time feedback (like it is provided by Meeting Mediator [3] and Second Messenger 1.0 [1]), but also a postmeeting analysis of collected data (like Second Messenger 2.0 does it [1]) or even an audio and video playback of meetings with according analysis methods (like it is provided by the system of Otsuka et al. [6], which provides even an interface for 3D interaction with the recorded video and audio).

3. INTERACTIVE INTERFACES

The purpose of interactive interfaces is to enhance meetings by improving the interaction of, and between the participants. A widely used example of such systems are interactive whiteboards, but there are also other systems which allow an enhanced communication between meeting participants.

We will now look in turn at the main characteristics of interactive interfaces (which are inspired from [1], [4] and [7]) and then give some examples to make these caracteristics clearer.

3.1 Main characteristics

The main characteristics of interactive interfaces are: unselfconsciousness, fluidity and layout.

These characteristics althogether need to allow the user to interact with the interactive interface as with a traditional, equivalent system and also to build from their previous experience [7], without being obtrusive [4].

We will now look at each of these characteristics more in detail.

3.1.1 Unselfconsciousness

This is without doubt the most important characteristic of an interactive interface.

Unselfconsciousness means that the interface must support the meeting without drawing too much "attention of the participants from their interaction with each other" [7]. As DiMicco states it, the people in a meeting have always to be "the primary messengers of the ideas" [1] and therefore the system must not be the primary point of attention of a meeting.

Therefore the systems must not be too complex to use for novices (by providing the normal functionality of a traditional whiteboard, for example [7]) and blend smoothly into the background.

3.1.2 Fluidity

Fluidity is another important characteristic of interactive interfaces. It means that the interface must allow an "unhindered expression of ideas" [7].

Therefore the system must be easy to use, again, and allow the users to interact with it without limiting them in their choices by providing all needed tools (e.g. handwriting, text and images for an interactive whiteboard) and different possibilities of interaction (e.g. pen and mouse).

3.1.3 Layout

The layout of the interactive interface is also important.

The layout of the system needs to be as close as possible to existing, traditional systems, to allow users an intuitive and immediate interaction with it, without an unnecessarily high learning threshold [4].

In addition, the layout of the system must be chosen carefully. The system must be visible and accessible for everyone, but without being obtrusive and therefore hinder face-to-face interaction (this concerns both eye contact and verbal interactions) between participants [4].

3.2 Examples

A first example of interactive interface is the Capture Lab [4], which consists of an electronic whiteboard and a personal workstation for each participant (see figure 1).
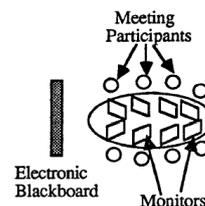

Figure 1: The Capture Lab layout [4]

The Capture Lab focuses mainly on the layout of the meeting room and its elements, but its components indirectly respect the other two characteristics, namely unselfconsciousness and fluidity.

The Capture Lab was designed in such a way that it allows for an optimal use of interactive interfaces by maintaining as much possible direct, face-to-face interaction between participants [4] and allowing for good eye contact between them, despite the additional hardware in the meeting room [4].

Another example is Tivoli [7], which is an electronic whiteboard that supports informal workgroup meetings (see figure 2).
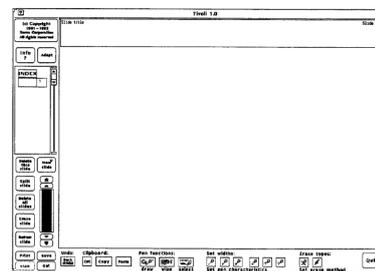

Figure 2: The Tivoli user interface [7]

Tivoli focuses mainly on unselfconsciousness and fluidity, but also its layout respects the properties seen above. Tivoli uses a Xerox Liveboard, which "'blends into the woodwork'

and appears to be just a familiar whiteboard" [7]. In addition, the board allows for an immediate use, even for novices, and allows users to build from previous experience with whiteboards [7].

Tivoli is used mainly in small informal meetings, therefore it allows all participants to access it [7] and it should not hinder face-to-face interaction of the participants.

4. FEEDBACK MECHANISMS

In contrast to interactive interfaces, feedback mechanisms focus more on the analysis and indirect enhancement of meetings than on the direct enhancement through improved interaction.

Feedback mechanisms can allow both real-time and post-meeting analysis of meetings [1]. Real-time mechanisms can influence the meeting directly by showing group dynamics to the participants, while mechanisms that focus more on a postmeeting analysis will allow the comprehension of past meetings and the improvement of future ones.

We will now look in turn at the main characteristics of feedback mechanisms (which are inspired from [1]) and give some examples to explain them in practice.

4.1 Main characteristics

The main characteristics of feedback mechanisms are: simplicity and deliberateness.

We will now look at each of these characteristics more in detail.

4.1.1 Simplicity

Simplicity is very important for feedback mechanisms to allow an easy analysis, and therefore an immediate understanding and consequent improvement, of meetings.

Although it may seem that this characteristic applies only to real-time mechanisms, where feedback needs "to be very simple to be interpreted and utilized real-time" [1], it applies to feedback mechanisms in general, because they need to provide a "simple solution to the complex problem of improving group processes" [1], therefore it would be counterproductive to provide unnecessarily complex data which would be time consuming to analyze.

Even if the collected data has to be visualized in a simple way, this does not mean that the data will be incomplete, it still has to be sufficiently open-ended in order to support successful improvement of the meeting, by allowing groups to see and express their observations about themselves [1].

4.1.2 Deliberateness

The data displayed by feedback mechanisms needs to be deliberate in order to avoid inappropriate interpretations [1].

This means that the layout of how the data is displayed has to be chosen carefully in order to reflect the desired thought and avoid eventual misinterpretations [1].

One of the purposes of feedback mechanisms is to highlight

given social messages which encourage the enhancement of the meeting [1]. In order to reach this purpose, the layout may need some additional elements (legends, labels, etc.) that reflect the actual social message. Such elements can be more or less immediate, depending on the effect one wants to obtain (e.g. the more explicit histogram labels of Second Messenger 1.0 [1] against the less heavy-handed label of Second Messenger 2.0 [1]).

4.2 Examples

An example of real-time feedback mechanism is the Meeting Mediator, where each meeting participant is provided with a Sociometric badge sending data to a mobile phone (see figure 3) [3].

The Sociometric badges can collect and analyze behavioral data of various social situations (speech features, body movement, proximity, face-to-face interaction, etc.), but Meeting Mediator uses only "the speech features and body movement features [...] to analyze collaboration dynamics" [3].

Figure 3: The Meeting Mediator [3]

To increase balanced participation and interactivity in meetings, the phone visualization displays the meeting participants as coloured squares which are connected with a line to a central circle [3]. Interactivity is shown through the color of the circle (the color shifts from white, meaning low interactivity, to green, meaning high interactivity), participation balance is shown through the position of the circle (the more a participant talks, the more the circle is attracted to his square), and finally, speaking time of each participant is shown through the thickness of the line which connects his square to the central circle [3].

Meeting Mediator therefore respects the characteristics seen above: it displays data in a simple but still clear way that reflects the desired attempt of having balanced meetings.

Another example of feedback mechanism is Second Messenger, which allows both real-time and postmeeting analysis of meetings (only version 2.0 of Second Messenger supports both real-time and postmeeting analysis, version 1.0 supported only real-time analysis) [1].

Second Messenger uses the sound level of the noise-cancelling microphone of each participant to detect relative speaking amount: every 10 msec the sound level is compared to the participant's natural speaking level, if it reaches this level for 30 msec out of 50 this is interpreted as a speech unit [1].

The data collected by Second Messenger is visualized through simple visual forms to "support rich social interpreta-

tion" [1]. There are five possible views, each of which allows a different interpretation of the behavior of the single participants or of the group as a whole [1]. The visualizations and their respective interpretations are: Histogram (which shows the speaking time of each participant), Fan (which shows the spread in participation between members of the group), Bouncing Balls (which reflect the participation level of each participant), Group Circle (which shows the speaking time of each participant, with the possibility to reflect the physical arrangement of participants and seeing speaker overlap) and Timeline (which reveals who has spoken at which moment) [1].

Second Messenger also clearly respects the characteristics seen above: it displays data in a simple way, with different visualizations that allow a clear interpretation of the different data collected. To avoid all possible misinterpretations, the visualizations are enhanced with text to specify which situation is the best on the display (e.g. the "Equal participation" label in the Histogram visualization, see figure 4, which avoids that meeting participants may think that the higher their bar is, the better it is [1]).
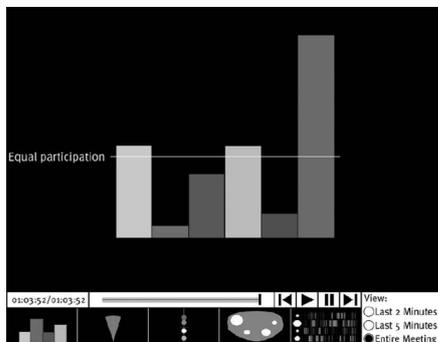

Figure 4: The Second Messenger 2.0 interface [1]

5. OUTLOOK
The systems seen in this paper accomplish their purpose of enhancing meetings in two clearly distinct ways. In the near future, one could expect that mixed systems, which propose both functionalities of interactive interfaces and feedback mechanisms, could emerge. Such systems could allow an even better enhancement of meetings, because they could exploit the strengths of both interactive interfaces and feedback mechanisms.

It is also likely that in the near future there will be even more direct, intuitive and unobtrusive ways of enhancing meetings. For example, a system which automatically detects the mood of participants (based on their cerebral activity or temperature) to explain speakers' over- or underparticipation and make other participants attentive to that, would be imaginable with the technology existing today.

6. CONCLUSION
We have seen that both interactive interfaces (the "pioneers" of computer supported meetings) and feedback mechanisms (the "newcomers") can help in enhancing meetings considerably.

On one side, interactive interfaces allow to simplify meetings by allowing an easier communication and a more intuitive display of ideas, but without drawing too much attention to the system and still allowing for traditional, face-to-face interaction between meeting participants.

On the other side, feedback mechanisms are also important, as they collect and analyze data in the background about meetings, and allow participants to adapt their behavior either in real-time, or for future meetings.

Both types of systems play an important role in enhancing face-to-face meetings, because they simplify and/or improve meetings without applying too much changes to the traditional meeting structure, to which people are used.

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