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EXTENDING A MEETING MODEL AND IDENTIFYING SOCIAL ACTIVITIES FOR APPLICATION SUPPORT

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ABSTRACT

One research area that has failed to produce any effective results is support for *face to face* meetings. In reality, there are almost no well known applications that support the inherently social nature of this type of group work. People in small teams do not always follow predefined processes, such as agendas, and they may ignore prescriptive direction. Given that people's actions are unpredictable, it becomes very hard to provide technological support. Further, there is a lack of understanding of what teams really do during interaction and that meetings, in the holistic sense, are not being examined in enough detail. This paper has two main contributions. First, an extended model of meetings is presented that includes the cognitive system formed by team members as well as artefacts and resources. Next, we examine meeting activities at a fine grained level this includes some of the social aspects that accompany the more formal processes. We provide a mini case study to exemplify our model and provide evidence of social processes that need to be considered for support.

KEYWORDS

Meeting model, social processes, actions, activities, face to face, meetings.

1. INTRODUCTION

We have seen little progress in recent decades for developing collaborative information technologies (CITs) that are not web based. Focal research domains include Group Support Systems (GSS), Computer Supported Cooperative Work (CSCW) and Groupware. One such area that has failed to produce any effective results is support for synchronous, colocated team work; in other words, *face to face, meetings*. In reality, there are almost no well known applications that support the inherently social nature of this type of group work. Researchers have been unable to leverage the computational benefits of software applications to support the ill structured nature of group interaction that emerges when teams engage in their work. Given that this area of research seems to have had almost no impact (Shumarova and Swatman, 2008), we claim that there is more that needs to be considered in a meeting than processes and agendas. Further, there is a lack of understanding of what teams really do during interaction and that meetings are not being examined at a suitable level of fidelity.

Formal CITs that might be used to support teams in meetings impose a process (agendas may be useful as a guide), they can only operate within a defined structure and have a limited universe of discourse (Wegner and Godin, 1999). This does not match well with the way that meetings operate. In reality, people can ignore prescriptive direction, they have an unlimited universe of discourse and are not predisposed to adopt structure. Their actions are unpredictable, highly flexible, nuanced, and contextualised (Ackerman, 2000). The paths that people follow through meetings are emergent (Suchman, 1987) and contingent on factors such as other people, the task and the environment (Lave, 1988). How can we design support applications for team activities when even the team members are unable to predict what they might say or do during the task?

When we turn to Requirements Engineering for clues about this problem (a common starting point in the design of an application), we discover that data capture methodologies are not always effective. Data capture techniques are often based on what users or researchers "think people do" as opposed to "what they really do." Analyses of human activities are often informed by post hoc rationalisation and reconstruction of people's actions as well as theories of cognition and Rational Choice (Scott, 2000). These approaches may not necessarily produce sound or accurate results (Ford et al., 1991).

Application support for face to face teams is one of the focal points for the CreWS project. We are using a real time observational approach through a multi modal infrastructure to record our lab meetings and we have noticed that there are many other actions and activities that occur in meetings that are potentially worth analysing and considering in application design

We report two main contributions in this paper. We revisit the issue of what components need to be considered in a meeting support architecture and then we look in a finer grained manner at the human actions and activities that might be important within such a framework. We extend Powell's (2004) Input-Process-Output (IPO) model to include: the distributed cognitive system formed by teams, as well as components such as resources and artefacts. With our meeting architecture established, we observe a group of four people during a day long meeting. We found evidence that supported our meeting model and, in addition to processes such as decision making and team building, we discovered a number of other activities. For example, all team members had undeclared agendas and would lie to keep them hidden. These agendas were subject to capricious change contingent on environmental factors, other group members and time pressures.

This paper is structured as follows. In Section 2, we provide a brief overview of some of the research relating to meetings and then, in Section 3, we examine the sorts of components we think are important for the purposes of building support applications. In Section 4, we share our observations of a meeting that took place *in a car* during a tourist expedition. In Section 5, we argue for validating our meeting model and, finally, we conclude and discuss where we are going with this work

2. BACKGROUND

Meetings have been studied in many domains and for many different reasons. The corpus is large and we can only identify some of the main threads in this paper. Often the motivation for meeting research has been to increase productivity, which has been measured across various dependant variables. For example, information quality, contribution equity and members' satisfaction (Flanagin et al., 2004) was the focus of one research effort while meeting success was also measured over discussion quality, member dominance & status effects (Rains, 2005). The most common meeting dimensions are size, duration and location (Panko and Kinney, 1995) as well as time and location (Dean et al., 2000). Sub sets of these dimensions include partially distributed groups (Johnson et al., 1996) and virtual meetings (Geyer et al., 2001).

Interactive and social aspects of meeting research includes: analysing formal meeting protocols (Zhang et al., 2003), using popular literature to illustrate meeting dynamics (McLeod, 1999) as well as a field that focuses on multi modal research (Nijholt et al., 2005). The theme with this work is to observe small groups through video cameras and microphones, while experimenting with different inferencing approaches. Examples include identifying group action sequences (Al-Hames et al., 2006) and abductive models of behaviour (Aiken and Paolillo, 2000).

There are many other research initiatives with different themes but one salient point that emerges is that each project examines just one or two specific aspects of meetings. This is not a criticism; merely an observation. The problem is that we still have no clear "big picture" of what happens in meetings from the perspective of being able to clearly articulate everything that is happening at any arbitrary point in time. This is necessary if we are to build infrastructures that can dynamically observe and understand the actions and activities in a meeting in the same manner as humans yet without human involvement. In addition to brainstorming, decision making and the like, people are simultaneously maintaining communication channels, managing group interactions as well as dealing with peoples' egos, unforeseen problems, changing circumstances and other issues. This goes beyond agendas and process execution, and a useful first step is to try and classify all of the relevant entities or components in a meeting.

3. MEETING COMPONENTS

In this paper we define a set of classes to represent the meeting activities, entities and artefacts that might be important. Previous work in this area included Powell (2004), who modeled team work using the Input-Process-Output (IPO) paradigm (see Figure 1). The *inputs* in this model: technical, training (experience), culture and design, are brought to the team by its members. The *processing* can be characterised as task work

and different types of human interaction and the *outputs* are also anthropocentric. Our model extends this framework and includes: the system that represents the team; artefacts as outputs (they link pre and post individual work to team work) and resources other than those that directly relate to people

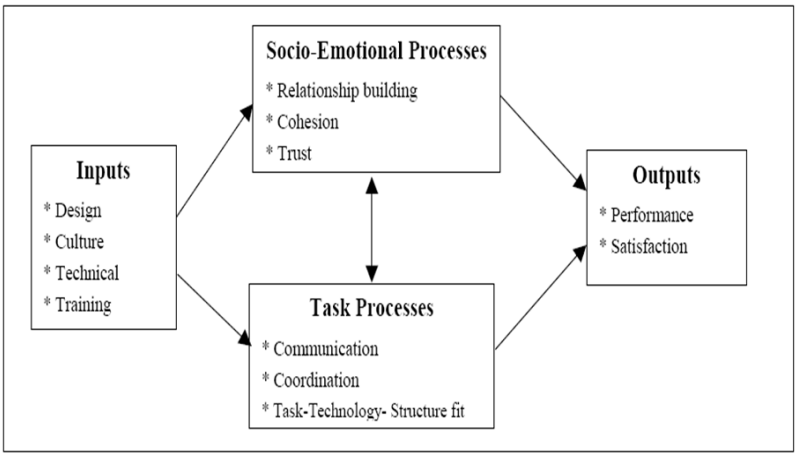


Figure 1. Powell's (2004) IPO model of teamwork

Our perspective also examines relationships between the components and the base classes in this model, as depicted in Figure 2, are:

- a distributed cognitive system;
- a group of people;
- social factors;
- processes and
- resources and artefacts.

The distributed cognitive system, comprising all transient and persistent representations, is an architecture that includes people, technologies and artefacts. It focuses on information flow, coordination and cognitive offloading. The properties in the system include: duration, (temporal properties of a meeting), synchronicity (events that occur over contiguous periods of time) and context. Context is important if meetings are interrupted or postponed and resumed at a future point in time. It contains state (up to the point of interruption) and records: the condition of artefacts, elapsed time, the number of people, their identities and other variables.

An important aspect of meetings is the interaction and communication between people. Interaction protocols and turn taking for speech (Parker, 1988) must be negotiated between the individuals (Graham, 2003) and this can happen in an explicit manner or it can be done in a more sub conscious way. Social aspects of interaction, then, are important. Verbal communication must be delivered and received in a shared context for correct semantic interpretation. This context includes volume, pitch, annunciation and similar properties. Other important non verbal aspects of communication which exist in meetings include: gaze (Novick, 2005), body language, body position and emotional states (Liao et al., 2006).

Terms such as *processes*, *activities*, and *actions* are widely used and can have different domain meanings. We consider *processes* to be high level *repeatable courses of action* and, accordingly, highly structured. Below them in a taxonomy are semi structured *activities*. These are still abstractions and include decision making, idea generation and goal formulation. At the lowest level are the *actions* that are combined to form activities. They include: speaking, pointing, writing notes, listening and others. These are ill structured and cannot be prescribed in terms of when and how they must be executed. They will be different for each activity. For example, the conversations required to execute any arbitrary brainstorming session will differ between sessions and cognitive input is required to achieve different outcomes. Tasks and sub tasks are concretisations of activities that produce outcomes and artefacts

Artefacts have been defined as "man-made objects". We extend this to include documents, drawings, digital and conceptual objects, processes, plans and agendas; most of which originate in conversation before being transformed into their consequent state. We consider that almost everything produced by group members is an artefact and, once created, becomes a potential resource for the team

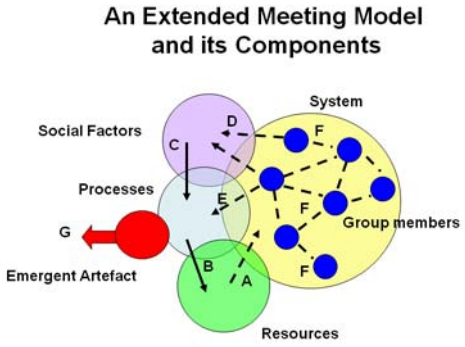


Figure 2. A model of the major classes and relationships in team interactions

The environment is the main sources of resources for a task. Resources can be: physical, such as desks, computers and white boards; conceptual, such as previous discussions, goal hierarchies (Wright et al., 2000) and memories (Antunes and Carriço, 2003); or digital, such as bandwidth and archived data.

Equally as important as the classes in a small group meeting are the relationships between them as shown in Figure 2. The set of rules **{R}** that govern these relationships is described below

- **R1** Resources cannot be accessed directly by group members but can be available in a meeting workspace (eg information can be pushed onto a public screen by the system) through *actions*
- **R2** Processes (including activities and actions) can directly access resources. This means that a person has to be engaged in an action to use a resource
- **R3** Roles, which are a social construct, can manage processes and, indirectly, access resources
- **R4** Group members can assume any of a variety of roles
- **R5** Members can access processes directly without assuming an explicit or meaningful role
- **R6** Members of the group communicate with other members in either a synchronous manner or an asynchronous manner depending on their context
- **R7** Members of the group create artefacts but only some will be used as resources. For example when many versions of a document are created it is usually the final version that is important.

People, then, assume roles throughout the meeting and these may be transient or permanent. Through these roles, people can undertake activities and access resources. During the process of trying to achieve their goals, the group's activities produce artefacts, which in turn may become resources for the group. We present evidence for our model in our case study.

4. CASE STUDY

This study details the activities of four tourists as they drove on a day trip from Bled across the local Alps, south to Trieste and back to Bled (see Figure 3). The data was historically reconstructed the next morning by way of a recorded interview with three of the travelers.

They left Bled (point A in Figure 3) at 10.00 in a hire car for a scenic drive with no clear route in mind but a desire to see Trieste if time would allow. (Dinner was thought to be starting at 18:00.) They obtained a map from their hotel and asked the car hire people to suggest a picturesque route and to circle some of the interesting destinations. Carlo took the role of driver and the rest of the team discussed who would navigate. This wasn't popular role but eventually Mary reluctantly agreed to it. The road from Bled led North and then

West through mountains. Just out of Bled, they arrived at a turnoff to a scenic gorge; a popular tourist spot. Mary made a passing remark that it was apparently a beautiful place. She suggested a visit but, after some discussion, the idea was rejected. The travelers then continued heading towards the Alps.

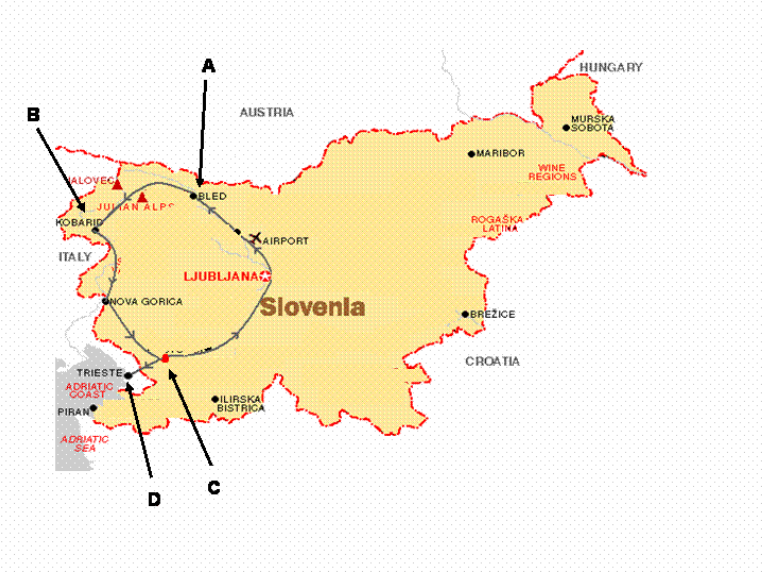


Figure 3. The route followed by the travelers (adapted from http://www.ired.com/pix/map/slovenia.gif).

The journey through the pass in the Alps was very scenic and they stopped often to take photos. With the support from the others, Mary was now comfortable as the navigator although everyone helped at times. The roads were stressful as they were narrow and wound slowly up and down through the mountains. This caused the trip to take longer than planned and by 14:00 they were only in Kobarid; one third of the way to Trieste.

At this point they discussed changing their plans and most suggestions included missing Trieste to arrive back in Bled on time. Hilary, a new member in the group, sided with Mary for returning early whereas Wolfgang remained quiet. Hoping to get to Trieste, Carlo proposed staying with the original route suggesting that dinner would not start before 19:00. The tension in the group was permanent now with each person having their own (partially declared) agenda. Eventually, a compromise was reached such that a decision on which route to take would be deferred until an important intersection at point C in Figure 3. Mary estimated the times between towns as they drove in order to keep people informed and aware of progress.

As the travelers reached Nova Gorica, an argument occurred about where they were. Mary thought they had already arrived at Nova Gorica but Carlo disputed it. He was proven correct a few minutes later when they arrived at a large sign with the name of the town. Everyone was now hotly debating about whether to go to Trieste. Mary, motivated by guilt and wanting to be seen to be "doing the right thing," expressed subtly that she did not want to go in order for the team to get back to Bled in time. Hilary still supported this idea and Wolfgang was still sitting on the fence. Carlo argued that there was enough time left and that they should stick to the original plan. The group resolved, instead, that they would drive a little further than the intersection (at point C in Figure 3) and go to the top of the hill that overlooked Trieste.

They sped along and reached the hilltop earlier than expected. After studying the map and considering their current speed, Mary suggested that they might make it to Trieste and back to Bled on time. This served to reduce the conflict that was very evident in the group. Due to the early arrival at the hilltop, Hilary suggested that they should actually go down to have a look around Trieste (at point D in Figure 7.3). Everyone agreed and they had fun taking pictures around the water's edge before returning to Bled. Upon arriving at their destination at 18:45, the group found out that dinner was scheduled for 20:00.

5. VALIDATING THE MEETING MODEL

During the interview next morning a richer picture emerged. To avoid conflict, all of the group members had tacitly exercised a communications protocol that included *vaguely* stating their personal goals. Carlo wanted to go to Trieste but didn't always admit this. Mary definitely did not want to go but did not make this clear. Hilary wanted to do the right thing for the group and return to Bled but did not state this forcefully. Wolfgang was keen to go to Trieste but, not wanting to favour only one side, remained silent. Wolfgang and Hilary shaped their *articulated* position from their perceived views of the group, which did not reflect the individuals' true views. They adopted their positions to avoid adding to the stress and, accordingly, they avoided a confrontation and eventually achieved an outcome that seemed to be satisfactory. We argue that the activities in the car are analogous to those in a face to face meeting; the type that might be held by software developers, emergency service planners or other professionals. By describing the driving activities in the context of our meeting framework, many similarities begin to appear

Disregarding the location of the meeting, the emergent actions and activities were similar to those in a semi-formal, face-to-face meeting. There were agendas, brainstorming activities, idea evaluations, negotiations, goals and roles. Some roles were interchanged during the course of the trip, e.g. the map reader role rotated occasionally. Some emergent agenda items, such as the decision to visit a town were negotiated on the run. Most of the members had dissimilar views of the global agenda. A example involved deciding whether or not to visit Trieste. This was very important for one member, but two of the others were indifferent and could have easily driven past the city. Due to the existence of private, unexpressed agendas, visible behaviours and expressed opinions were sometimes inconsistent with each person's goals. This adds a level of complexity when trying to observe and interpret what people are doing during interactions.

Their itinerary (agenda) was unplanned except for visiting some specific towns on the suggested route and the goal was to return to Bled for dinner. Problems such as an unsuitable map, the unknown nature of the roads and the unknown time for dinner had a substantial influence on the actions, activities and interactions in the group. As the trip progressed, the people realised that, due to time constraints, they might not be able to accomplish all their goals (i.e. visiting all desired places). As a result, tension and stress became evident during the second half of the trip as conflicts between different agendas crystalised.

When people are communicating in synchronous activities they assume roles. These may be transient, such as a pacifier or explicit and permanent, such as a driver. Some sort of role assumption is inevitable if people engage in interaction. As communications progress, social factors such as dominance and attitudes produce leaders, facilitators, coordinators or any of a range of other roles. In our case study, the driver and navigator shared the roles of leader and facilitator. (Did that mean they were also making a tacit grab for power? This was not revealed or sought for in the interview.) Hilary emerged as a pacifier and this was effective for managing the stress produced by the challenging roads and arguments. Others became cheerleaders, where they provided encouragement for Mary's navigation work. The cheerleaders also became assistant navigators at times such as when relevant road signs were spotted. When the value of the pacifier role became obvious, the navigator joined in and provided humourous progress reports.

The goal structures were also similar to those in some meetings. There were two initial goals and these swapped importance as the trip progressed. The dominant goal (for Carlo, at least) was to get to Trieste and the lesser goal was to return to Bled in time for dinner. This agenda was discussed at the start of the trip and revised during the day. Eventually, each member of the group developed their own version. These were only partially articulated and this caused some of the stress. Each member's goals were based on their own values and self interests. The group had to reconsider their goals due to the time lost crossing the Alps and the time for dinner was unknown. Changing the agenda is also common during meetings. If a presenter or speaker goes beyond their allotted time to speak, agendas have to be revised.

The concept of individual views existing along with a global view was important in this case. If the personal views had been successfully reconciled into a consistent global view, there would probably have been less stress during the day and the travelers would have had more pleasant outcomes. Towards the second half of the trip, one member suggested bypassing Trieste and going directly back to Bled. This view enjoyed some support in the group but the idea was never discussed with total honestly. All group members held back their real thoughts and only expressed views that were (partially) acceptable to the group. In effect, and for different reasons, they all told lies. This is not unusual. People tell lies for many reasons such as protecting others, avoiding confrontation, escaping censure or getting what they want (DePaulo et al., 2004).

The driver at all times wanted to go to Trieste even though he appeared to compromise by agreeing to go as far as the city lookout. The navigator did not want to go to Trieste and was not happy about the compromise but didn't say as much in deference to the driver. The other two members based their expressed views on the apparent positions held by other members. One member expressly wanted to go to Trieste and one did not. They changed their expressed views to conform to the apparent desires of the group and to maintain a balance. This behaviour emerged within the group due to time pressure and the need to juggle goals.

There is enough evidence to allow us to compare the activities during the car trip with those in our model of face to face meetings. There were negotiations, decisions made, idea generating sessions and different examples of group development theories. As people, the travelers handled all of these activities. They did not need better decision or group support systems, although some negotiation support might have been useful, but they did not communicate honestly. This, we have claimed, is a social factor and we are unaware of any social support systems that are available to assist group members while they traverse the rocky grounds of social interaction while under pressure.

We recognise that juxtaposing the activities in a car, as we have described them, with traditional face to face meetings has limitations. The seating arrangement, while useful in a car, is unnatural in the context of meetings. This constrained the two people in the front seat with regards to communication channels. The verbal channel was almost exclusively used during the negotiations and decision making processes. This precluded using any nonverbal channels, which also carry important information. For example, when Mary proposed early in the trip that the group should visit the gorge (just outside of Bled), Carlo and Hilary misinterpreted her desire as just a suggestion. The request was not reinforced by other channels such as the facial movements of smiling and widening eyes

6. CONCLUSIONS AND FUTURE WORK

In order to design applications to support face to face meetings, we have, as a first step, presented a fine grained meeting model with a comprehensive set of components. We have claimed that social factors also need to be considered and we have provided evidence of actions and activities that are part of the social aspects of meetings. We observed these actions and activities during a one day road trip and these are analogous to those in some types of face to face meetings. While these meetings may not have the same set of social influences or diversity of personal goals, we have observed many of the component classes of our meeting model in the scenario:

- a distributed cognitive system: four people communicating, interacting and mediating cognition
- a group of people: the four travelers;
- social factors: roles; power grabs and attempts to dominate; personal and global goals; lies; as well as compliance and conformity;
- processes: idea generation, team building and managing emotions and
- resources and artefacts: maps, signposts, clocks.

The relationships between the classes are also evident and some examples follow. People access resources, sometimes while playing a role, when they are engaged in a process (R1, R2 and R3). For example, the navigator tries to direct the team by consulting a map and observing signposts. Any other person using the map and looking at signposts can also assume the role (R4) of navigator although their purpose may only be to update their personal information about the environment (R5). The navigator must communicate (R6) with the driver or to the whole group, and the planned route becomes one of the resultant artefacts (R7). This artefact may undergo changes and the old versions will become less relevant.

These are the actions and activities that we seek to observe and support in a real time manner. The travelers spent a lot of time observing the other members in the party through their own multimodal (eyes and ears) sensor framework. They collected a record of all observable communication actions, modeled and abstracted the actions, linked them to their personal, experience based models of behaviour and interpreted the actions as behaviour within their own comprehensive frameworks. This is the same process we are following with our multimodal framework. We are currently collecting and storing data from observations of our own meetings as we build an infrastructure to support face to face activities without human intervention.

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