

# Handheld CSCW in the Meeting Environment

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**Abstract.** This paper discusses the role of PDA in the meeting environment. Three fundamental design issues are raised: PDA as mobile devices, CSCW devices and coordination devices. The research work described in this paper is focused on the coordination facet. The paper proposes three levels of detail to characterize meetings as coordination mechanisms and ascertain the role of PDA in that process. The first level identifies meeting agents and roles, as well as the tangible things necessary to support those roles. The second level describes how the tangible things are organized in meetings, highlighting repetitive patterns in meeting processes. Finally, the third level draws the functional requirements of the PDA support to the tangible things. The paper applies the proposed approach to a specific meeting environment, staff briefings, and uses a small consulting company as test bed. The PDA functionality was specified from analyzing how the test bed organization conducted staff briefings. A prototype was then developed. The test bed organization also produced feedback information on the prototype use. The obtained results indicate a general satisfaction with the functionality and increased enthusiasm with PDA usage in the meeting environment.

## 1 Introduction

PDA play an important role as mobile devices that support personal information [1]. In that context, PDA allow one person to create and manipulate personal information away from the desktop and plug in to remote information sources to upload, download or synchronize specialized information.

Several researchers analysed in detail the concept of mobility. Dix et al. [2] consider three levels of mobility: fixed, mobile and autonomous systems. Kistoffersen and Ljungberg [3] [4] define three different modalities for mobile work: travelling, wondering and visiting. Travelling is the process of working while going from one place to another. Wondering is extensive local mobility in a building or local area. Visiting is spending time in one place for a period of time before moving on to another place. The concept of visiting clearly encompasses formal meetings, where people get to-

gether in a conference or office room, while the wondering concept applies to informal meetings held in places such as hallways and cafeterias.

Mobility should also be considered in terms of context [5]. Context deals with the situated nature of groups of users and existing work practices and poses significant problems to the design of information devices that allow mobility between different contexts [2].

PDA can also be regarded as CSCW devices, able to manipulate collective artefacts. Luff and Heat [6] illustrate the importance of these artifacts with the example of the medical record, which in many circumstances serves to organize work and mediate the interactions between doctors and patients, as well as other health care personnel. In this perspective PDA must support two fundamental requirements of collective artefacts. One is fluidity between public and private contexts [1]. The other requirement is flexibility. People manage collective artefacts in many subtle ways according to the affordances of the medium, situated nature of work, type of interaction and degree of cooperation (Luff and Heat highlight the importance of what they designate micro-mobility [6]). Meeting environments represent another instance where fluidity and flexibility are vital. During meetings, people alternate between private and public information in very fast and disorganized ways. Meeting subgroups are dynamically created and reconfigured as well. Moreover, meeting processes are governed by many complex and subtle rules and procedures. Thus, meeting environments challenge the design of adequate PDA support to shared meeting artifacts.

PDA can finally be regarded as coordination tools. A critical issue to organizational and team performance is coordination. According to some authors, coordination can be classified in two major categories: impersonal coordination and coordination by feedback [7]. Impersonal coordination is exemplified by the use of plans, schedules and procedures. Coordination by feedback is illustrated by two significant examples: one-to-one communication and group meetings. In everyday activities, people move around personal information, such as calendars and address books – possibly the most widely used PDA tools – creating opportunities to reduce the effort associated to impersonal coordination [8]. However, PDA are as well becoming important tools in the support to coordination by feedback.

In this paper we analyze the role of PDA in the meeting environment. Our main scenario is a meeting room where people meet face-to-face, have a desktop computer in the room, possibly linked to a shared whiteboard, and bring their own PDA as well. This scenario emphasizes the importance of the link between personal information and meeting information. The issue then is to understand how can the PDA be used in this environment, considering the design issues of mobility, support to shared artifacts and coordination.

In this paper we also describe an implementation of a handheld meeting system in the scenario broadly described above. The system was experimented by an organization, thus drawing some preliminary results also presented in this paper.

## 2 Related Work

Several research projects studied the role of PDA in the meeting context. We will overview these projects according to the three major design issues that were previously considered: mobility, support to shared artifacts and coordination.

One of these research projects is Pebbles, developed at the Carnegie Mellon University [9] [10] [11] [12]. Pebbles connects PDA devices and desktop computers in real-time. The major concern of Pebbles is to explore different modalities, such as having the PDA controlling a slide show on the desktop. Another area of concern is developing mechanisms to exchange information between PDA and large display devices, which are awkward to write directly.

Another project, developed at the University of Calgary, is the SharedNotes prototype [1]. Shared Notes is a meeting system that uses PDA to integrate public and private artifacts. The project addresses the issues of information exchange and presentation, while resolving important design issues such as feedback and awareness.

NotePals is a note sharing system designed to take individual notes during meetings and later synchronization and sharing via the web [13]. As such, NotePals is fundamentally concerned with mobility issues, information uploading and post-meeting sharing of information. One example of NotePals usage is the post-production of meeting reports.

The RoamWare project intended to support informal face-to-face meetings, such as the ones that people have in hallways and corridors [14]. One research issue addressed by this project is the support to ad-hoc meeting arrangements, where PDA must scan for co-located devices to establish connections. In what concerns shared artifacts, RoamWare pursues the seamless distribution of notes taken during meetings while preserving their context. RoamWare associates meeting notes with the particular group of individuals interacting in a ad-hoc meeting, creating, for instance, e-mail distribution lists and thus facilitating information distribution to the right people.

**Table 1.** Systems and major design goals

<b>Systems</b>	<b>Mobility</b>	<b>Shared artifacts</b>	<b>Coordination</b>
Pebbles		Multiple modalities; Information exchange and presentation	
Shared Notes		Information exchange and presentation	
Note Pals	Note taking in meetings; Uploading and sharing		
RoamWare	Ad-hoc meetings	Seamless integration; Meeting context	
FieldWise			Knowledge management
MeetingLog, MeetingManager	Individual recording meeting topics		

FieldWise addresses the problem of autonomous mobile workers that must coordinate with co-workers to make decisions and accomplish tasks [15]. FieldWise is a mobile knowledge management system. It supports evolving tasks and notifies users of interdependencies. One should note however that FieldWise was basically designed for remote work rather than face-to-face meeting environments.

Besides the several systems described above, developed in the research field, we should also mention that several commercial/freeware PDA tools (e.g. MeetingLog and MeetingManager) can be used in meetings for individual recording and tracking of topics, notes, decisions, etc.

As summarized in Table 1, the role of PDA in meetings has mainly studied and developed the mobility and shared artifacts facets. The work described in this paper will essentially focus on coordination though.

### 3 Focusing the Problem

Meetings bring together people sharing a common purpose. Meetings combine a series of dimensions in human behavior, such as communication, interaction, decision-making, negotiation, conflict resolution or creativity. The major argument in favor of meetings is that they increase creativity, coordination and informed decision-making [16]. In this context, coordination may be defined as managing dependencies between activities [17]. Often, meetings are connected in meeting systems revolving around the same problems over a long period of time and thus serve as a control mechanism by determining whether and when work is performed.

Malone et al. [18] [19] conceptualized the types of dependencies between activities and corresponding coordination mechanisms. In this conceptualisation, resources emerge as a fundamental mediator between activities.

We will not go into the details of the relations between resources, activities and dependencies. Instead, we will consider two different types of information in these resources:

- The intangible things – The contribution of the resources to organizational objectives, such as reconcile conflicts, make decisions, solve problems, plan actions, approve activities, etc.
- The tangible things – Physical testimonials that report and preserve the intangible things that will be consumed or produced during meetings. Examples are meeting minutes, action plans or meeting transcripts (e.g., [20]). Many organizations are even legally required to document this way some particular meetings, such as stakeholder meetings.

For us, this distinction is necessary to delimit the type of interventions in the meeting environment that we are considering for PDA.

Having PDA supporting the management of intangible things leads necessarily towards the field of workflow and, particularly, flexible workflow and mobile workflow, (e.g. [21]). Ancona, et al. [22] describe such approach in a healthcare system. On the other hand, the PDA support to tangible things deals basically with organizational

memory. For instance, Davis et al. [23] developed a note-taking repository that uses PDA.

Our work focuses only on the PDA support to the tangible things that turn up in meeting environments. Having in mind these considerations, we will now delineate a conceptual approach to the problem.

## 4 Conceptual Approach

In this section of the paper we characterize in more detail the tangible things that mediate meetings and the other activities in organizations.

Our conceptual approach proposes a characterization at three increasing levels of detail [24]. The first level describes the context of the problem, including the main agents and activities. The second level describes the institutionalised communication patterns, categorizing the tangible things consumed and produced by meetings. Finally, the third level is the implementation level, describing what and how tangible things integrate in the organization, and the role of PDA in the process.

In the first level we can identify five types of agents (or roles):

- **Sponsor** is the owner of the meeting, who defines the meeting objectives and rules.
- **Facilitator** is the person that plans and manages a meeting.
- **Participants** are those who attend a meeting and contribute by making comments, giving opinions, voting, etc.
- **Secretary** is the agent that produces the meeting report and distributes it to the other agents.
- **Organisational agents** are those agents that affect meetings or find their activities directly affected by meetings.

This first level allows us to identify a set of generic tangible things necessary for accomplishing the above roles: (1) the **agenda**, produced and managed by the facilitator and approved by the sponsor; (2) **issues**, produced by organizational agents and related to the topics proposed in the agenda; (3) **decisions**, taken by the meeting participants and affecting organizational agents; and (4) the meeting **report**, produced by the secretary to document the other tangible things.

The second level of the framework is intended to describe how the different tangible things are organized in a meeting. This organization is not ad-hoc, it is rather ritualized, reflects organizational culture and most times follows a ceremonial order [20]. In fact, the organizational values and rules impose repetitive **patterns** in meeting processes.

One issue to ponder is how to identify these patterns. We adopted an organizational analysis/diagnosis method designated genre analysis [25] [26]. The genre concept was imported from the literature, where its main purpose was to classify literary works, and generalised to the organisational context [27] [28]. A genre of “organisational

communication” is an institutionalised **template** for social action, such as a memo, report, resume, inquiry, letter, meeting, announcement, expense form or training seminar.

Genres are primarily characterised by their purpose and form. The purpose is not an individual’s private motive for communicating, but a purpose socially constructed and recognised by the community, and invoked in typical situations. The form refers to observable aspects of the communication, such as medium, structural features and linguistic features, which entail recognition and action by the community.

The genre approach gains particular interest considering that organizations utilize many different computational systems to communicate and work, such as e-mail, video conferencing, web chats, workflow, calendaring tools or group editing. Genre analysis captures and categorizes the different “digital genres” used by the organization in terms of communicative purpose and form.

Furthermore, the genre analysis also captures how organizations combine different genres in complex communicative patterns designated “genre systems”. These genre systems highlight how organizations structure work and manage interdependencies.

Considering the meeting environment, the genre analysis highlights typical patterns in meetings. Orlikowski and Yates [28] consider that meetings can be regarded as a system consisting of four generic genres: **logistics**, agenda, the meeting itself, and the meeting report. Note that the agenda and meeting report are two tangible things that we already identified at the first level. The genre approach adds logistics to that list, i.e., details on who participates in the meeting, when and where is the meeting taking place, what technology is being used.

Most importantly however, the genre approach defines a scheme to classify and characterize different types of recurrent meeting systems in organizations, such as planning meetings, quality circles, staff briefings, formal evaluation meetings, design meetings, task forces, brainstorming meetings, conferences and workshops, ceremonial meetings, etc. These different types of meeting systems include particular types of logistics, agenda, meeting genres and reports, as well as particular types of agents and roles, issues and decisions.

This second level of detail thus amalgamates in coherent patterned structures the tangible things that make up meetings.

Finally, we will consider the third level of detail. The third level concerns implementation details: how genres and genre systems are materialized and integrated in the organization, how people enact and use genres to accomplish work. How PDA will participate in that process.

Considering our previous discussion, we can at this level identify the following functional requirements to the PDA use in the meeting environment:

- Allow users to produce, distribute and carry to meetings a meeting **agenda**;
- Support the production of **issues** related to the agenda items;
- Document **decisions** taken during meetings;
- Integrate the agenda, issues and decisions into a meeting **report** that can be distributed to organizational agents;
- Document the meeting **logistics** (who, when, where, what);
- Support concrete meeting **patterns**;

- Offer different **templates** of the agendas, issues, decisions, reports and logistics according to the meeting patterns that are recurrent in the meeting environment.

In the next sections we will describe the implementation of our conceptual approach to the particular case of staff briefings.

## 5 Applying the Approach to Staff Briefings

Organizations regard staff briefings as particularly important coordination mechanisms. Usually, staff briefings call for project members to report on the progress of individual or group tasks, allowing management to track and assess the overall project status, identify project risks and apply any corrective actions that may be needed.

In order to study in detail the particularities of staff briefings, we observed and analyzed how a small financial consulting and accountancy company conducted weekly staff briefings. Both the type of structure (small, flat) and core business (independent consultancy) of this company stresses the role of briefings as a primary coordination mechanism.

The target organization uses, on a daily basis, several coordination technologies, such as web chat, net-meeting and e-mail. Fundamentally, these technologies support one-to-one coordination. The organization relies on meetings to achieve more broad coordination, encompassing the whole senior staff, which includes accountants and consultants.

We participated in several meetings and were able to find out that the organization coordinates itself around three recurrent meeting patterns: (1) process definition meetings, dedicated to analyze work processes in an informal way, clarifying and improving the organizational maneuver; (2) planning meetings, which allocate staff to consulting projects and schedule individual tasks; and (3) briefings, where the state of each committed task is analyzed.

Briefings, in this organization, have a weekly frequency, occurring in general every Friday. The typical composition includes two senior consultants and one senior accountant.

We will now describe how we applied the conceptual approach described in the previous section to derive design goals for PDA support to this company's staff briefings.

### ***Level 1 – Agents, Activities, and Tangible Things***

In the target organization, the same person carries out the sponsor and facilitator roles. This person is the top responsible for the organization, although we should note that the power distance is small, considering that the organizational structure is small and flat. The sponsor/facilitator is also a meeting participant.

The secretary role is distributed through all participants. The participants write down their own actions committed during the briefing, while the sponsor/facilitator is also informally responsible for tracking the others' actions.

The organizational agents affected by these briefings are the senior consultants and accountants. Thus, the meeting participants are also organizational agents but not all organizational agents participate in a weekly briefing.

The sponsor/facilitator manages an agenda consisting of a list of tasks currently in progress. The issues contributed by participants consist of progress reports. The decisions taken during briefings involve approvals of on-scheduled tasks and re-schedules of delayed tasks. Each participant is responsible for taking notes about the decisions made during the briefings.

Finally, this organization does not produce a formal report, although the sponsor/facilitator preserves the whole list of tasks that the organizational agents are responsible for.

### ***Level 2 – The Briefing Pattern***

The sponsor/facilitator brings to the briefing the list of tasks that were previously scheduled in planning meetings and are currently in progress. This list shapes the briefing agenda. During the briefing the sponsor/facilitator goes through this agenda, item by item. The participants may bring their issues already prepared to the briefing, reporting the progress of the tasks that are their responsibility, or produce them during the briefing. Apparently, the consultants and accountants prefer a certain level of informality in their meetings and thus a formal progress report is not required.

While going through the agenda, the participants analyze and discuss the issues, considering in detail what was done and what was not done and why. The decisions taken during briefings consist fundamentally in informally approving on-schedule tasks and re-scheduling delayed tasks. Sometimes re-scheduling also requires re-assigning tasks to participants and organizational agents.

Each participant is responsible for taking notes about the individual tasks that are re-scheduled. The sponsor/facilitator also takes notes about the status of all tasks.

This organization uses simple and fixed logistics. The briefings happen in a weekly frequency, occurring every Friday, in the same room, at the same hour, with the available senior consultants and accountants.

### ***Level 3 – Functionality***

The proposed system functionality is based on the assumption that the sponsor/facilitator has a PDA. The other participants may have PDA as well or use paper and pen to write down the meeting decisions. Furthermore, there must be a desktop computer available in the meeting room, ideally connected to a shared whiteboard.

The sponsor/facilitator brings the agenda to the briefing in her PDA. The agenda consists of a “topic list”. The sponsor/facilitator can synchronize the PDA with the desktop computer, thus sharing the agenda with the other participants through the whiteboard.

Then, the sponsor/facilitator goes through the topic list to get issues from the participants. The participants may have prepared these issues in their PDA and, in that case, are able to synchronize their PDA with the desktop computer to present an issue to the audience. The desktop computer collects these issues and associates them with



the topic list in the agenda. The participants may also insert issues directly on the desktop computer.

At any time the sponsor/facilitator may synchronize her PDA with the desktop computer and get a coherent collection of topics and issues. To that collection, the sponsor/facilitator may append the decisions taken in the briefing. The participants can take individual notes on their PDA, documenting the decisions and schedules concerning their individual tasks. These individual notes are collected in “to-do lists”. Such lists can be associated with the collection of topics and issues synchronized with the desktop computer.

In the next section we will describe in more detail the implementation of this functionality.

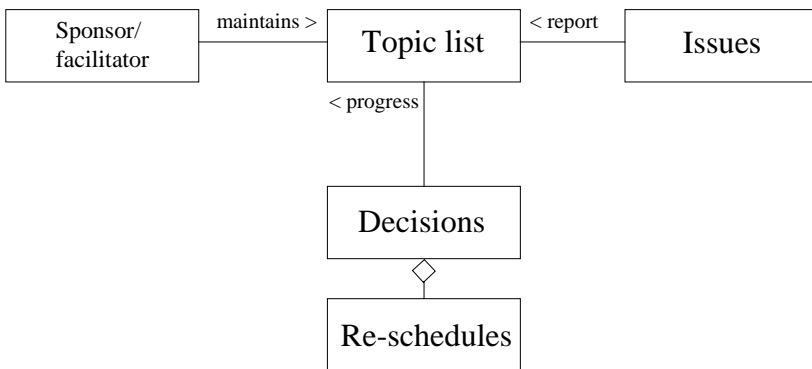
## 6 Prototype

The prototype consists basically of three different components: (1) the sponsor/facilitator’s database; (2) the participants’ database; and (3) the shared whiteboard application.

The PDA software implementation used the Jfile database system ([www.land-j.com](http://www.land-j.com)) for the Palm Pilot.

The sponsor/facilitator’s database has the following elements: topic list, issues, and decisions. The participants’ databases add to-do lists to the above elements. In Figures 1 and 2 we illustrate the structure of these databases, while in Figure 3 we illustrate the Palm user-interface for the to-do list.

The shared whiteboard application was implemented using Internet technology (HTML files, CGI and Perl scripts) and a relational database from Microsoft. Users can interact with this application using a web browser, since it runs on the Xitami ([imatix.com](http://imatix.com)) web server.



**Fig. 1.** The sponsor/facilitator’s database

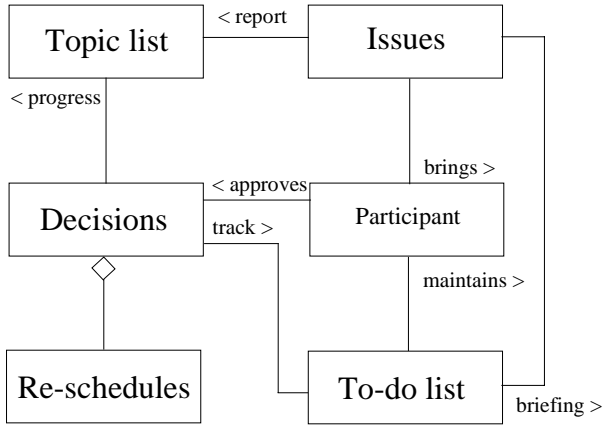


Fig. 2. The participants' database

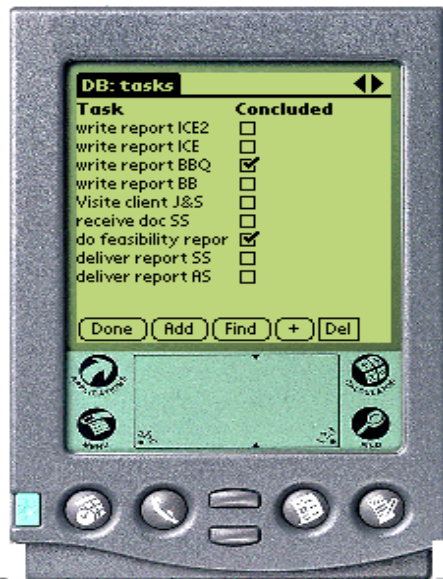


Fig. 3. To-do list on a participant's database

We should mention that this prototype was developed from a previous prototype that we built to integrate PDA with an Internet-based Electronic Meeting System (also built by us). In fact, the prototype described in this paper is the result of removing functionality to the previous one. While experimenting the PDA/EMS integration mechanism, we found out that the added value was resulting from the coordination support provided by PDA rather than integration with EMS. More details on the previous prototype can be found in [29] [30].

## 7 Feedback and Discussion

The solution that was developed to integrate PDA in the meeting environment was experimented by several employees of the organization where the study was conducted. Although no formal evaluation was performed, we could obtain some preliminary feedback information about the overall acceptance of the system.

The major aspect of the solution that made the users generally satisfied is that it preserves the flexibility of the team. The conceptual approach does not mandate formalized work procedures but, instead, supports the recurrent work practices and types of information exchanged between the meeting participants.

All of the users that participated in this project had a PDA (one had a Psion while the others had Palm Pilots). However, at the beginning of the project, they were not very enthusiastic about using PDA in meeting environments, basically because they considered its use very disruptive. By the end of the project, however, there was a rebirth of interest in PDA usage during meetings. Apparently the benefits provided by the system (synchronizing meeting information) surpassed the associated costs (disruptive use).

We should also mention that many aspects pertaining to the characterization of the tangible things managed in briefings were oversimplified. For instance, re-scheduling and re-assigning tasks may be a complex procedure, requiring the group to manage project, process and task information. However, the users were satisfied with the level of detail that was implemented. Some users even criticized any attempt to increase functionality. This attitude should be further analyzed in the future, but it hints that this kind of system should be kept simple.

We note however that briefings are a particularly simple meeting pattern. Briefings are very ritualized and do not seem to offer much latitude for creativity, discussion and decision-making. Furthermore, the tangible things managed in briefings are also very simple. For instance, people mention projects, processes and tasks but do not seem to analyze or discuss their inner details, rather focusing on status information. Other meeting patterns should thus be more difficult to implement, such as planning meetings or strategic meetings. Future work is necessary to understand if our conceptual approach can be applied to more demanding situations.

## 8 Conclusion

This paper describes how we brought handheld CSCW into the meeting environment. Our major concern was to understand how PDA could improve the role of meetings as fundamental coordination mechanisms. PDA have already an important role in the support to individual information, but its support to team meeting information is still low.

The conceptual approach proposed in this paper defines three levels of detail for handling the problem. The first layer highlights the major roles and activities that people assume during meetings, as well as the tangible things necessary to accomplish those roles. Then, the second layer is concerned about how organizations bring to-

gether the tangible things into identifiable repetitive patterns in meeting processes. Finally, the third layer is dedicated to identify the functional requirements of the computational system and, particularly, the role of PDA in that system.

The paper describes the application of the conceptual approach to a particular type of meetings: the staff briefings. A target organization in the accountancy field was selected to help us identify the major roles and activities, tangible things and patterns associated to briefings.

The implementation work was accomplished with the cooperation of several employees of the organization. The employees had also the opportunity to experiment the developed prototype and provided us with some feedback about their satisfaction with the whole system functionality. The prototype was considered adequate to support briefings and also seemed to increased users' enthusiasm towards PDA usage.

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