Computer Supported Cooperative Work **7:** 243–271, 1998.

Participatory Design at a Radio Station[1]

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(Received January 12, 1998)

Abstract. We address design of computer support for work and its coordination at the Danish Broadcasting Corporation. We propose design solutions based upon participatory design techniques and ethnographically inspired analysis within a full scale design project. The project exemplifies an ambitious, yet realistic, design practice, that provides a sound basis for organisational decision making and for technical and organizational development and implementation. We focus on cooperative aspects within and among the editorial units, and between editorial units and the editorial board. We discuss technical and organisational aspects of the design, seen in light of recent CSCW concepts, including coordination and computational coordination mechanisms, technologies of accountability, and workflow from within and without.

Key words: participatory design, ethnography, coordination, coordination mechanisms, organisational context

1. Introduction

Design of CSCW-systems can be related to at least two different design contexts. When a software company develops a CSCW product for a large market, "product development" (Grudin, 1991), it will be used in and among various user-groups within an organisation and/or between different organisations. When the design takes place within an organisation, "in-house development" or "contract development" (Grudin, 1991), the design and the use of the system can be thought of in terms of *specific* cooperating ensembles of users and designers (Schmidt and Bannon, 1992). Improving the latter design context is what we aim for in this article.

We use the term "design" in the same way as architects do – focusing on the analysis of needs and opportunities, and the preliminary design of functionality and form. Therefore we see results of a design project to include a conceptual design in terms of a written document, sketches, mock ups and/or prototypes. We also consider an evaluation of consequences of implementing the design, as well as a plan for the implementation, to be parts of the result. Based upon a design proposal, it should be possible for the organisation to proceed in purchasing and/or developing the proposed design.

In the article, we describe a design project from one of the radio stations in the Danish Broadcasting Corporation. The project took place in 1995 and was

conducted according to a participatory design method called MUST (a Danish acronym for theories of and methods for initial analysis and design activities). The objective was to design a coherent vision of computer support for the planning, production, broadcasting, and administrative follow-up of radio programs. The design formed the basis for the organisation's decision about the subsequent development and implementation. A majority of the design proposals were implemented. On some of the design proposals, however, a final decision was postponed pending further experiments and negotiations. We focus explicitly on coordination mechanisms within and among editorial units and between editorial units and the editorial board. These aspects of the design have not yet been implemented in the Danish Broadcasting Corporation.

We discuss coordination in a complex organisation with multiple, different, and reconfigurable groups, which have conflicting interests but at the same time have to work together in a dynamic way. We address technical and organisational aspects of the design, seen in light of recent CSCW concepts, including coordination and computational coordination mechanisms, technologies of accountability, and workflow from within and without. Thus the article adds to the small body of papers describing workplace studies and specific design guidelines (Plowman et al., 1995).

In section 2, we present the background of our approach for designing computer support. The Danish Broadcasting Corporation is briefly described in section 3. Then we present our analysis of work practices at the radio station in section 4, which is followed by a presentation of the proposed design in section 5. In section 6, we discuss technical as well as organisational aspects of the suggested computational coordination mechanisms seen in light of the entire design. The article is concluded in section 7. Throughout the article, we highlight our approach to design in an organisational context as well as the intermediate and final results which were used as a basis for the organisation's decision about the subsequent development and implementation activities. Appendix A gives a short description of the method applied in the project and appendix B gives an overview of the activities carried out.

2. Participatory design of computer support

In the project, we used the MUST method, a method we have developed over the last six years. The method suggests principles, main activities, and a number of tools and techniques as resources for designers. The method is inspired by and aims at combining participatory design approaches and ethnographic approaches. (See appendix A or see Kensing et al. (1998) for a longer description of the method.)

Ethnographic approaches to the study and analysis of work for the purpose of design strive to gain an appreciation for what users are doing and how they see things. Blomberg et al. (1993) describe "four main principles that guide much ethnographic work":

- "[Ethnographers make] a commitment to study the activities of people in their everyday settings, [. . .] as opposed to a laboratory or experimental setting".
- "[Ethnographers hold] a belief that particular behaviors can only be understood in the everyday *context* in which they occur".
- "Ethnographers describe how people *actually* behave, not how they *ought* to behave".
- "[E]thnographers are concerned with describing behavior in terms relevant and meaningful to study participants. This contrasts with the requirements of survey research where relevant categories must be known before the study begins" (Blomberg et al., 1993, pp. 125–126).

For examples of such ethnographic studies see Hughes et al. (1992) and Suchman (1995). For instance, Suchman reports on a project in a law firm that "we found ourselves in the middle of a contest over professional identities and practices within the firm: a contest between one characterisation of work, made possible by distance, and another held by those who did the work (and confirmed by our own observations of what it entailed)" (Suchman, 1995, p. 59).

Participatory design approaches aim at establishing a meaningful cooperation between designers and users (see for example Greenbaum and Kyng, 1991; Muller and Kuhn, 1993; Grønbæk et al., 1993; Kensing and Munk-Madsen, 1993; Bødker, 1994; Kyng, 1995). For instance, Greenbaum and Kyng (1991) bring together the experience of Scandinavian and American participatory designers who "see the need for users to become full partners in a cooperative system design process where the pursuit of users' interests is a legitimate element" (Greenbaum and Kyng, 1991, p. ix). They provide a range of techniques for developing an understanding of users' current practices and for the preliminary design and tailoring of technology and work practices. The CACM special issue on Participatory Design (CACM, vol. 36, no. 4, 1993) gives a historic overview of PD projects (Clement and Van den Besselaar, 1993); Grønbæk et al. (1993) report on a cooperative design project with engineers where mock-ups and prototypes allowed end users to obtain hands-on experience with envisioned computer support in design workshops; and Kensing and Munk-Madsen (1993) provide a conceptual framework for the understanding and creation of successful communication between users and designers, as well as present tools and techniques for facilitating this communication.

Ethnographic approaches and participatory design approaches have for example been combined by Hughes et al. (1993), Blomberg et al. (1996), and Mogensen and Shapiro (1998), all of which report on projects in which users, ethnographers, and designers have cooperated in the analyses of current work and in the design of technology and work practices. We have taken a different approach, in that we, as computer scientists, play the role of designers in our own endeavour to develop the MUST method. We have adopted ethnographic techniques and integrated them with participatory design techniques and techniques for project management, in order to develop a method for design in an organisational context (Kensing and

Winograd, 1991; Bødker and Kensing, 1994; Simonsen, 1994; Simonsen and Kensing, 1997). Our experiences experimenting with various techniques and tools (from the projects described in these references) contributed to the first presentation of a coherent method (Kensing et al., 1996). In this article, we describe a project, where the MUST method was applied in a full scale, commercial design project, as well as present and discuss the intermediate and final results.

When we strive to understand the problems and needs for computer support and elicit requirements in an organisation, we become engaged in a complex situation where various cooperative ensembles of users may or may not share like problems and potential solutions. In this article, we consider two types of cooperative ensembles within the Danish Broadcasting Corporation's Station 3: Editorial units and the editorial board. Editorial units are composed of journalists, technicians, and administrative staff, responsible for a daily or weekly program. The editorial board comprises managers at different levels, with different backgrounds, who meet formally once a week in order to discuss and decide upon overall planning. The editorial units and the editorial board represent multiple, different, and reconfigurable groups, having conflicting interests (in some cases) yet needing to work together in a remarkably dynamic way in order to produce 24 hours of constant radio programming. This cooperation involved in the planning and the production of programs is complex. It involves cooperation within the editorial units, across the editorial units and between editorial units and the editorial board. Artefacts therefore take on a crucial role in facilitating cooperation.

3. The Danish Broadcasting Corporation

The design project took place in one of the radio stations of the Danish Broadcasting Corporation (DBC), Station 3. We wish to use this case to illustrate the MUST method, and the results it helped us to obtain. DBC is a public, national station, that was founded in the twenties. Since the eighties, DBC has been running as a limited company. By law, every radio and TV-set owner has to pay a license fee. DBC produces and broadcasts TV and radio. The radio station consists of three national radio stations, one news group, and nine regional stations. Figure 1 depicts the structure of DBC.

The following management initiatives had recently taken place or were under implementation when the design project started at Station 3. Therefore the design had to take these initiatives into account:

- More radio for less money. This includes: Layoffs; expansion of broadcasting hours; computerised selection of music titles and computerised broadcasting from midnight to 6 A.M.; a policy of using a higher percentage of the stations' recordings from concerts.
- The editorial board of Station 3 wants to shift from "after broadcasting monitoring" to a "forward planning process", i.e. to promote and enforce

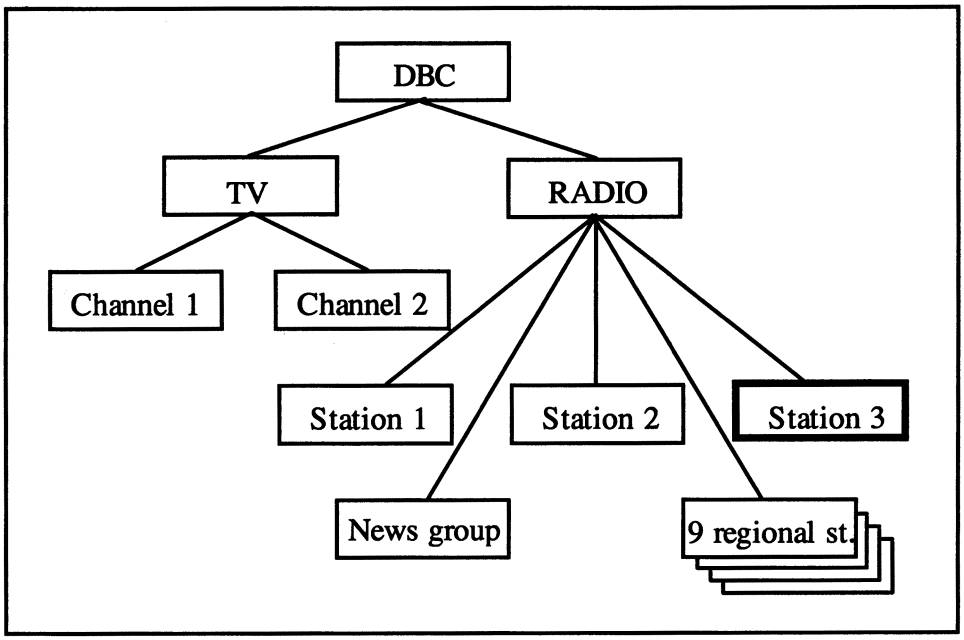

Figure 1. Organisation chart for the Danish Broadcasting Corporation.

programming ideas, and coordinate and discuss the content of each program with those responsible for it. Traditionally, the editorial board promotes ideas through its weekly meeting, but it has few means for following up on these ideas until after the programs are broadcast.

- Self steering groups. A group of journalists, technicians, and administrative staff should be responsible for organising their own work within the editorial units. This was referred to as integration and loosening of professional demarcations.
- A station should be perceived as a whole by the listeners, rather than as a collection of individual programs. This should work against a tendency of some of the hosts and producers to run their programs as personal "kingdoms".
- Workgroup computing. The station had recently decided to stop further development of its mainframe systems. It had started to implement client/server technology and Microsoft Office, which are to be supplemented with standard systems for most business systems. In the future, the corporation wishes do as little in-house development as possible.
- From analogue to digital technology. The station is preparing for digital recording, editing, and broadcasting.

Before the design project started, the unions had already been forced – by layoffs and by management hiring younger, less specialised employees – to accept these initiatives.

4. Analysis of needs for computer support in Station 3

The design project was organised around a design team and a steering committee. The design team was made up of the authors, two internal IT-consultants, and three user representatives. The steering committee was made up of the chairman of the editorial board, two staff members, and the IT manager. The design team was responsible for the investigation of IT-support for Station 3. After establishing the project, we spent three months mainly carrying out analytic activities (reported in this section), followed by three months of mainly carrying out design activities (reported in section 5). Appendix B gives a more detailed account of the activities in the project.

The analysis below of the organisation and its needs for computer support is a result of applying the tools and techniques suggested by the MUST method. The following description in sections 4.1 and 4.2 serves as an illustration of the level of understanding that we find necessary in order to design relevant and realistic visions of computer support for a specific organisation. And together with the design proposal in section 5, it also serves as an illustration of the method in use. The analytic activities were:

- observation of the planning, production, broadcasting, and administrative follow-up of radio programs, as well as of management meetings and of the work of several employees on staff
- interviews which were recorded, partly transcribed, and corrected by the interviewed persons
- document analysis of the corporation's strategic reports, and of material used for research, production, broadcasting, and administrative purposes
- thinking aloud experiments where employees were asked to describe what they were doing while working
- drawing rich pictures of current work practices
- analysis of existing software
- information modeling for the purpose of prototyping

These analytic activities conducted by the design team, involved approximately one third of the total 140 employees from Station 3. For instance, in groups of two we observed several editorial units and documented in rich pictures all work processes and artefacts involved in the production of the various types of programs. The observations were followed up by interviews to provide further details and to learn about the employees' and management's opinions of current problems and ideas for improvements. Then at the design team's weekly meeting, every-one presented their own individual understanding in order for the whole design

team to develop a common understanding of current work practices. This aided in locating potential areas for computer support and/or organisational changes, and in relating these to management strategies. We learned for instance how the division of labour among journalists, technicians, and administrative staff varied between small and big editorial units, how they did and did not coordinate in and among the editorial units, and how in different ways they made use of the material for research purposes. We wrote a report, summarising our results and presented it at a hearing at Station 3. Based upon the comments we then received, we made some changes and the report was used by the steering committee in prioritising subsequent design activities. Details about our findings are described in the following sections.

4.1. STATION 3 – A RADIO STATION

At Station 3, 140 journalists, technicians, administrative staff, and managers are involved in the production, broadcasting, and administration of 24 hours of radio programming each day all year round. The profile of the station, which broadcasts nationwide, is a mix of music and features for a young or young-minded audience. The station cooperates with the radio's news group that also serves other stations. Station 3 is organised around some 25 editorial units (each staffed by 1 to 15 people), an editorial board, a couple of staff units and an administrative staff, all under the management of a chief editor. Figure 2 depicts this structure by showing how editorial units are grouped and represented in the editorial board. An editorial unit – comprising journalists (some of whom are freelance journalists), technicians, and administrative staff – is responsible for a radio program that is broadcast on a daily or weekly basis. When the project began, each unit had only limited computer support: A few PC's and terminals to access a wide range of mainframe systems and news agencies.

Each radio program has its own concept (and in principle need not be competitive), but when, for example, a new CD is released or during larger political, sporting, and musical events, competition may take place between editorial units, despite the editorial board's attempts to coordinate among them. Cooperation, in terms of discussions of various angles on stories, as well as on advertisements and referencing each others' programs, is encouraged by management and happens on a regular basis. Thus both cooperation and competition between editorial units are parts of the work experience.

The design project focused on activities related to the production, broadcasting and administration of radio programs, rather than on managerial and general administrative work. This is why the work of one of the editorial units will be described in greater detail below. Of course we noticed many differences between editorial units, partly in relation to their varying needs for IT-support. This will be touched upon later in the conclusion.

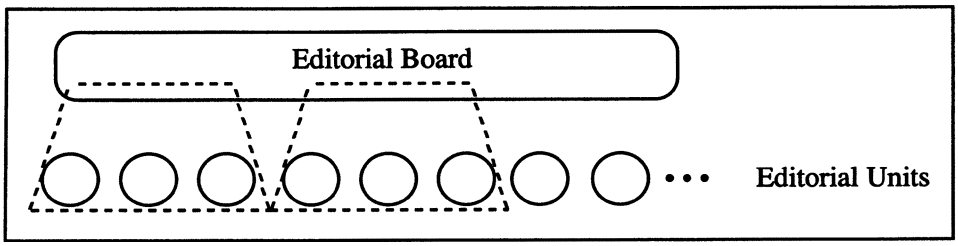

Figure 2. The structure of Station 3.

4.2. PROGRAM X

Program X runs Monday through Thursday from 4 P.M. to 6:30 P.M. It is staffed by two producers, two hosts, and four reporters (all of whom are journalists). As a consequence of the integration policy, two technicians and two assistants are also part of the editorial unit. The content of the program is a mix of popular music and features (reportage, interviews, telegrams, gimmicks, etc.).

A typical weekly schedule starts on Friday, when the producer of the coming week and a reporter meet to establish an overview of next week's four programs. They spend 2–3 hours reading newspapers and magazines. They run through the suspension files into which everybody in the editorial unit puts ideas for a specific date. A staff member produces and photocopies a list of upcoming events relevant for the station and distributes this list to all editorial units. The list of upcoming events also reflects events and ideas promoted at the last editorial board meeting. The producer and the reporter also receive a list of news stories from external news agencies. Sometimes they order books from the library and tapes from an archive of earlier broadcast material. They are informed by the current week's producer of arrangements that are set up for the upcoming week. The producer and the reporter finish their work by sketching potential features for the upcoming week. During the weekend, the producer reads Danish and international magazines and newspapers looking for additional ideas.

At 8 A.M., Monday through Thursday, a reporter starts running through the daily newspapers and writes a list of headlines for the producer. The producer shows up at 9 A.M. and turns on a computer with access to a news agency, NewsStar. Since he finds the editor in NewsStar insufficient, he uses WordPerfect instead on another computer to make up the list of potential stories for the day. He looks into a paper file to see who is going to work on the day's program. Reflecting the concept of the radio program, he runs through the reporter's list, looking for stories that are adequate for montage, for the mobile recording unit, for mixing sound or music, and for inviting guests for telephone interviews. He knows that the production cycle is short, which rules out certain types of stories. He prints out his list of about 20 potential stories for the day, photocopies the list, and gathers the editorial unit for a meeting to discuss which six or seven stories from the list the reporters will pursue as well as reactions to the previous day's

program. At 10 A.M., back at his desk, the producer sorts out the list and makes printouts for himself and the host, who is briefed when he shows up. During the day, the producer and host annotate the printouts for their individual purposes. The producer creates a new document, rewriting the stories in the order he prefers. He takes into account which programs are broadcast before and after his program and the times guests are available for interviews. The technicians show up to go over the schedule. The mobile recording unit operator calls to find out if, when, and where he is needed. The producer coordinates current status with the reporters to find out how the stories are materialising and if new ones need to be researched. He checks with the editor responsible for daytime programs to find out what stories other editorial units plan to cover. He is also in charge of the schedule for the studios where the reporters record and edit features. The producer, the assistant, and the host select the music for the program, taking the day's stories into account.

Meanwhile the reporters work on their stories. They call various people for interviews or opinions. They search the library and the archives of earlier broadcast material. They visit locations relevant to their stories. Throughout the day, reporters constantly check stories and angles with the producer and with each other, and they discuss the length of their feature so that they fit into the program schedule. For pre-recorded broadcasting, reporters use a tape recorder for interviews and for recording their stories. With the assistance of a technician, they edit the material for broadcasting. They brief the host and deliver a tape to the producer, who does a final check.

At 2 P.M. the producer, the host, and the assistant create the final plan for the program, including all features and music to be played. The assistant rewrites the plan on his computer, specifying the minutes and seconds for each story. He also includes information about each music title so that royalties can be paid and statistics kept. The producer, host, and assistant must finish their work by 4 P.M. They can become further stressed by reporters (coming and going) who are checking with the producer and briefing the host throughout this intense two hour period. The producer checks all pre-recorded stories and sometimes has to make changes in order to make them fit the time schedule. The news group calls to coordinate, since at every full hour the program is interrupted by the news. If the producer has a news story that the news group has overlooked, he may move the story to before the news break. He makes a final check on NewsStar for any big news items before he leaves for the studio. During the entire process of producing the program, the producer acts as a "center of coordination" (Suchman, in press), ensuring that he receives valuable information, but at the same time resulting in frequent, annoying interruptions.

The assistant has prepared a trolley with tapes, records, CD's and coffee. During the day he is responsible for reporting on the previous day's program. This involves collecting data from the reporters – data they were supposed to have delivered the previous day. The reporters might ask him to find various materials. In addition, the assistant fills out the necessary forms for paying reporters for their travel expenses,

artists for the right to play their music, and experts for providing opinions during the program.

During broadcasting the host is in the studio, while the producer, the technician, and the assistant are in an adjacent room. They communicate by gesturing through a big window, by using microphones and speakers (the host has an ear piece), and by meeting face-to-face (but only when the host is not on the air). They each have a paper copy of the final program plan, which they annotate for personal use. The assistant carefully notes the actual time and length of the broadcast features and the music titles played (information needed for paying royalties). Each member of the team continuously updates his or her copy of the program plan, indicating where the actual broadcast deviated from the plan (for example due to a prolonged live interview).

The description provided above of the work practices of the editorial unit responsible for program X illustrates parts of our analysis at Station 3. To sum up, we identified the following areas as candidates for computer support for the entire station:

- Coordination within and among editorial units.
  This type of coordination is a central part of the daily work mediated through meetings, phone calls, and paper. Most employees interviewed found large parts of this coordination cumbersome. Management also wanted enhanced coordination among all editorial units in order for the station's profile to be perceived as more distinct, to avoid individual "kingdoms" of programs, and to facilitate the establishment of an internal culture of belonging to one coherent radio station.
- Coordination between editorial units and the editorial board.
  This type of coordination was mediated mainly through the editorial board's weekly meetings, the editors responsible for a group of programs, and by the weekly paper list of upcoming events. Our analysis clarified that this type of coordination did not support management's request for a "forward planning process".
- Planning, production, broadcasting, and administrative follow-up of the various elements that make up a radio program.
  Very early on during our observations we were led to believe that program elements, consisting of single pieces of music or features, should be represented electronically. In this way they could easily be rearranged by the producer and accessed by several employees.
- Electronic access to audio and written material for research purposes.
  Observations and interviews highlighted a need for faster access to such material. Currently, for example, earlier broadcast programs had to be ordered hours or days in advance.
- Digital recording, editing, and broadcasting.
  The planned shift from analogue to digital production and broadcasting would

allow journalists (i.e. producers, hosts, and reporters) to work on program elements in the same digital media from early planning to final broadcasting.

In the following section, we focus especially on the first three candidates for computer support, addressing coordination within and among editorial units and between editorial units and the editorial board.

5. Design for IT-use in Station 3

A report describing the results of the analysis, in terms of problems, needs, and candidates for computer support was presented to all employees at a hearing and to the steering committee and management of the station at separate meetings. The purpose was to check the degree to which we had understood their work and to point out potential areas for IT-support. The employees gave valuable feedback, which helped the steering committee prioritise. After some minor changes to the report, we shifted our focus to design, which consisted of the following activities:

- Two visits abroad to radio stations using state of the art technology.
  To everyone on the design team, this was "a look into the future" with fully digitised radio. This experience provided the design team with a shared reference for discussing and developing design ideas and related (changed) work organisation. In other words, it provided some "flesh and blood" to the design vision for Station 3.
- Design workshops where future work practices were outlined.
  Using large sheets of paper the design team sketched future work practices, representing, for example, one whole life cycle of the planning, production, and administration of a radio program. During these workshops, specific design ideas were represented and discussed in a broader context and many new design ideas emerged as a result of this process.
- Sorting out design ideas and findings from the analysis.
  Design ideas and findings from the analysis were written down on stacks of post-it's and divided among the team members. The team collectively grouped the post-it's on a wall. This provided an overview of the entire design and gave an account of the design ideas in relation to the needs and opportunities found during the analysis.
- Data modeling.
  Through entity-relationship modeling sessions, data related to the design ideas was clarified and structured. This formed the basis for subsequent development of prototypes and for time/cost estimates of the final development of the systems. During these sessions, the specific linking between two central systems, Event Calendar and Program Manager (see below), was clarified.
- Prototyping.
  Simple, yet illustrative, prototypes were developed for all key design ideas. They were distributed, along with the final design report, for evaluation at

the station. Later, the prototypes, the design report, and a day of observations at the station constituted the starting point for implementation by external programmers.

As a result of these design activities, the design team revisited the results of the analysis to validate the design ideas. A couple of additional interviews were conducted to clarify aspects of our understanding.

The design was presented to all employees at a hearing, and to the steering committee and the management of the station at separate meetings. We demonstrated the prototypes and presented a report consisting of the analysis and a vision of the proposed suite of systems and their relations to the envisioned new work practices. The report also included a functional description of each system, a scenario of their future use, an evaluation of possible consequences for management and the employees, an implementation plan, including organisational development and required training, and finally an estimate of costs.

The overall design criteria has been to facilitate new types of coordination and to allow for qualitative improvements to work processes and programs, by providing easier access to existing and new research material and reducing the time spent on routine tasks. In addition, the design reflects major parts of the management's initiatives mentioned above. The proposed design was to be implemented for the entire station within 2 years. The employees were satisfied with the design, and management decided to fund, develop, and implement most aspects of the design. The Program Manager (see section 5.3) was postponed for two years until a standard system that met many user requirements was expected to be available.

In the presentation below, we have chosen to give only a very brief description of the proposed suite of systems, describing in some detail only two of the systems for the purpose of highlighting new ways of cooperation.

5.1. THE OVERALL DESIGN

Keeping in mind DBC's business and IT strategy, we suggested as the technical platform a client/server solution with multimedia workstations connected to a LAN with access to the Internet. Microsoft Office was proposed as the main standard software platform, since this was also part of the corporation's IT strategy. The value of these technologies is thought to be well known, although making them work in an organisation requires serious considerations (see for example Orlikowski, 1992; Okamura et al., 1994).

Now we will briefly review the proposed suite of systems in the design. Reading Figure 3 clockwise from bottom center, we first identify *Microsoft Office*, followed by access to electronic *News Agencies*. *Host* illustrates access to the corporation's business systems. *Internet WWW* provides access to Internet and WWW. *LivMus* allows journalists to search for live recordings when planning a program. *Sound Databases* consists of various sound files (jingles, trailers, spots, play lists, and

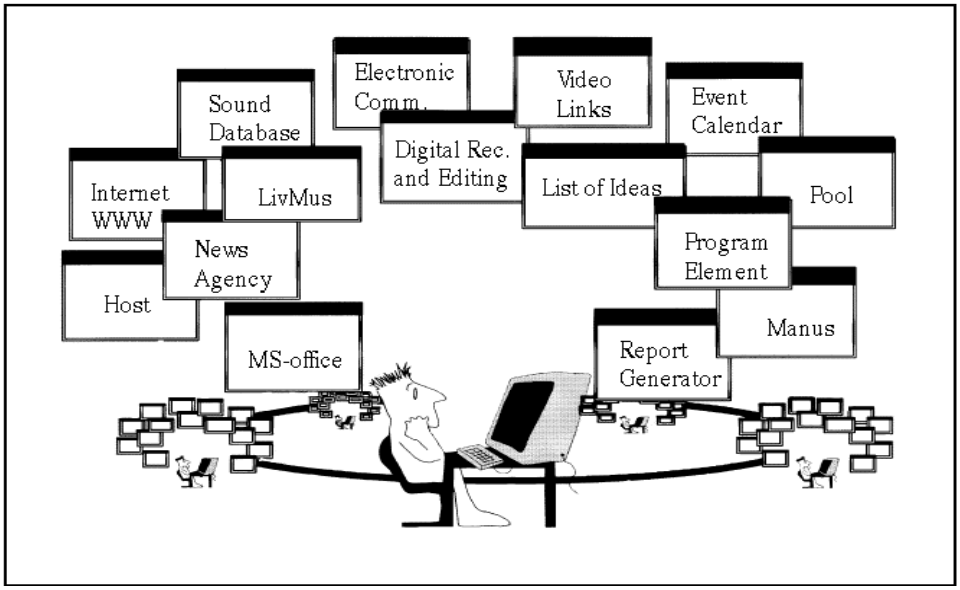

Figure 3. The suite of systems in the design.

earlier broadcast material). *Digital Recording and Editing* allows journalists to record and edit their features (for example an interview), either on portable digital equipment or on their multimedia workstation. In addition, we suggested experimenting with, for example, *Electronic Communication* during broadcasting and *Video Links* between the studios and the editorial unit's office.

Two design ideas focused especially on improving coordination within and among editorial units and improving coordination between these editorial units and the editorial board. These two design ideas are referred to and described in further detail as the *Event Calendar* and the *Program Manager*. The Program Manager consists of *List of Ideas, Pool, Program Element, Manuscript,* and *Report Generator*.

5.2. THE EVENT CALENDAR

The Event Calendar satisfies expressed needs for electronic access to research material and for coordination. The Event Calendar is an electronic version of the earlier paper-based list of upcoming events. The Event Calendar is based on information sent to the station and is maintained by the same staff member who earlier was in charge of creating the list of upcoming events. The paper version was photocopied, distributed, and used by the editorial units and by the editorial board at their weekly meeting. The Event Calendar allows the staff member to create and update an electronic version of the list of upcoming events that is accessible to everybody at the station. It contains information mailed to the station and extracted from

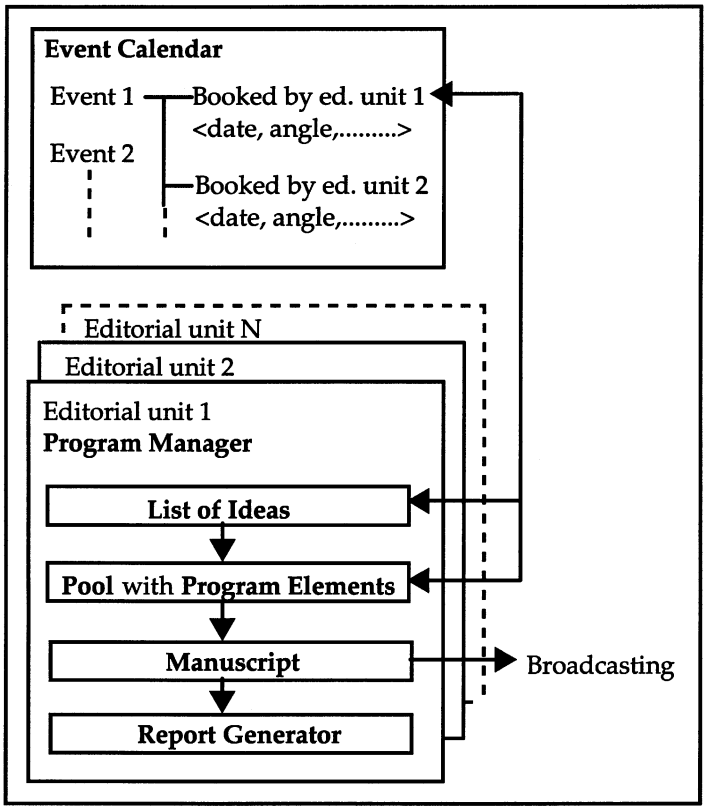

Figure 4. Illustration of the Event Calendar, the Program Manager, and the linking between them. Editorial units book events and indicate their chosen angle on the event. Data from the Event Calendar can be dragged into the List of Ideas in the Program Manager. Ideas evolve into Program Elements and are linked to the Manuscript, broadcast, and finally used by the Report Generator.

magazines and newspapers about concerts, CD releases, and political or musical events. It also records ideas suggested at the last editorial board meeting. The staff member might indicate for which radio programs a certain event is relevant, but leave it to the editorial units to book events and describe the angle (point of view) they plan to take when covering the event. The staff member has the option of being automatically notified when an event is booked.

The Event Calendar also allows for the requested coordination among editorial units. Several editorial units might book the same event, but then they have to negotiate which angle on the event they each will take. An event's data (contact persons, date and time, type and genre, etc.) can be "dragged and dropped" into the List of Ideas or a Program Element in the Pool (see Figure 4). A tendency was voiced during the analysis, that each editorial unit perceives its radio program as *the* station and avoids cooperating across programs. The Event Calendar is designed to support coordination that counteracts this tendency.

Finally, as requested during analysis, the Event Calendar allows the editorial board to maintain an overview needed for the editorial process. The system allows the editorial board to electronically notify an editorial unit that the board wants a certain event to be covered by putting the event into the unit's List of Ideas. This is one way to obtain "visible management" that some employees asked for and to provide the technical means for supporting the "forward planning process".

5.3. THE PROGRAM MANAGER

The Program Manager, which is linked to the Event Calendar, supports individual work as well as coordination between producer, host, reporters, technicians, and administrative staff. Seen from the perspective of an editorial unit such as the one responsible for Program X, this is the central part of the design. The Program Manager is made up of five elements:

- *List of Ideas.* Each editorial unit has its own list where members of the editorial unit write general ideas and ideas for specific dates. Editorial units may suggest ideas for the lists of other editorial units as well and the editorial board may mark an idea as "mandatory".
- *Pool.* This is the work space where journalists work on features for the day's program from the "idea" stage to "ready for broadcasting". Ideas are dragged into the Pool where they are embodied in Program Elements (see below). All data about an idea are copied (from the Event Calendar or the List of Ideas) into specified fields in the Program Element. The Pool contains all Program Elements to be produced for a program on a specific day.
- *Program Element.* All data and sound needed for an element to be produced and broadcast are located in a Program Element. A Program Element can be one of a variety of types such as feature, music (one title), jingle, spot, and trailer. Program Elements are used to register administrative, technical, and personal data (for example the script for the host). If the Program Element is prerecorded, it holds a link to the sound file (with the music to be played, an interview, or the like). The status of Program Elements may be inspected by the editorial board.
- *Manuscript.* The Manuscript is a template for the program, where mandatory elements (for example the news every full hour, jingles, and spots advertising other programs) are present when initiated. Program Elements from the Pool are linked to the Manuscript in the order decided by the producer. When a new Program Element is linked to the Manuscript, the start and end times of all Program Elements are automatically adjusted. The Manuscript gradually evolves from being a plan for the program to being the final collection of Program Elements, ready to be broadcast. When the program starts, the Manuscript is used directly from the studio for semiautomatic broadcasting.

- *Report Generator.* Since all data, including a digital copy of the broadcast program, are stored in the Manuscript, reports can be generated automatically.

The Program Manager eliminates the need for the journalists to rewrite information and provides an editorial unit with a common overview of a program in progress. It also supports journalists in collecting – in one media – the information relevant for themselves, the producer, the host, and the assistant. It saves the assistant a lot of time in gathering information needed for producing reports and for paying royalties. These requirements were identified by the design team during the analysis phase of the project.

In addition to such functional descriptions of the suggested systems, the design report also contained scenarios for system use (see below), data models, and an estimate of resources needed to develop and implement the design. To provoke a discussion involving the autonomy of the editorial units versus the editorial board's desire to change to "forward planning", we designed the system so that an editorial unit could decide for themselves when to make the contents of the program public (by using a "make public"-button). After the contents are made public, the editorial board and everyone else working at the station can orient themselves for coordination purposes to the editorial unit's plans. A final decision concerning this design proposal was postponed, however, pending further experiments and negotiations. Making the issue of control and confidentiality visible in the prototype design through the "make public"-button guaranteed that an important design issue was not ignored.

5.4. PROGRAM X – WORKING WITH THE NEW SYSTEMS

This section describes a scenario which was part of the project's design report. The scenario shows how we envisioned the work of the editorial unit responsible for Program X once the new systems were implemented. Table I summarises the work situation before the new systems were installed (see section 4.2) and after (this section).

The weekly schedule begins on Friday when the producer of the upcoming week's programs and a reporter meet to establish an overview of the week's four programs. They spend 2–3 hours running through the Event Calendar and the List of Ideas, looking at the News Agencies's reports, searching the Internet, and reading newspapers and magazines. They also have electronic access to an archive of earlier broadcast material. Sometimes they order books from the library on-line from their desktop. They finish by writing potential features for the coming week's program in the List of Ideas.

At 8 A.M., Monday through Thursday, a reporter looks at the Event Calendar and the News Agencies's reports. He reads the newspapers of the day, and adds to the List of Ideas. The producer shows up at 9 A.M., turns on his computer and receives an overview of the current List of Ideas. He may notice a "mandatory"

Table I. "Before and after" the new system

Activity	Before	After
Preparing next week's program (the producer)	Search ideas in: – suspension files (local paper based files), – list of upcoming events (paper based) updated weekly by a staff member, – news agencies, – newspapers, journals.	Search ideas in: – List of Ideas, – Event Calendar – continually updated by a staff member and inspected and annotated by editorial board members, – news agencies/Internet/WWW, – newspapers, journals.
	No or arbitrary coordination.	Ed. units "book" into events and coordinate with other units booking the same event.
	Order books from library and tapes of broadcast material from archives.	On-line booking of books and tapes. Recent programs may be accessed from hard disc archives.
	Sketch potential features (paper).	Update List of Ideas.
Planning the program in detail (the producer and the host)	Create a document with 20 potential stories,	Selection of potential stories from List of Ideas and Event Calendar,
	Meeting narrows down to 6–7 stories,	Meeting narrows down to 6–7 stories,
	Create a new document which he and the host make individual annotations to.	Drag selected Ideas into the Pool (Ideas become Program Elements and their basic data is copied).
	Coordinate with – reporters and other units by phone, and personal communication, – arbitrary or no coordination to other editorial units.	Coordinate with – reporters by phone, personal communication and by checking status of Program Elements and Manuscript, – other editorial units through the Event Calendar and their List of Ideas.
	Select music (CD's), text on paper.	Music selection assisted by computer, sound and text added to Program Element.
	Create the manuscript (numerous rewrites), finally rewritten by the assistant, adding the actual times of features and music.	Continuously create manuscript by linking Program Elements from Pool into Manuscript (times automatically added).
	Editorial Board does not know the content of the specific program (until after it is broadcast).	Editorial Board might give mandatory ideas and inspect Program Elements and Manuscript.
Producing the program (Reporters)	Check with producer and colleagues to coordinate.	Coordination within the editorial unit supported by Program Elements and Manuscript.
	Produce features by editing tapes with assistance from technicians. Text on paper.	Produce features by working on Program Elements in the Pool, adding and editing text and sound digitally.
Broadcasting (the host, the producer and the assistant)	Make individual annotations to manuscript	Individual parts of the Manuscript are highlighted.
	The assistant calculates and records actual time of each feature.	Automatic time calculation.
	Everyone updates their individual paper-based manuscripts when changes are made	Changes made to the Manuscript are immediately visible for everyone.
Reporting (the assistant)	Collects data from reporters about interview persons for paying salaries, etc. Reports exact usage of music titles for paying royalties.	Reports automatically generated from Manuscript.

idea for an interview previously submitted by a member of the editorial board. He marks potential stories of the day and gathers the editorial unit for a meeting.

Back at the desk, the producer drags the selected ideas to the Pool, where they become Program Elements. He then initiates the Manuscript for the day's program and starts planning the program by linking Program Elements from the Pool to the Manuscript, in the order in which he wants them to be broadcast.

The reporters use the Pool when working on their features, adding all text and sound for the feature directly into the Program Elements. Digital recordings (sound files), made from for example telephone interviews, are edited on the computer by the reporters themselves. Assistance from technicians only takes place when special equipment and advanced montage are needed. Reporters who work "in the field" use portable PC's with similar functionality and may send Program Elements directly to the Pool through a modem connection.

Suggested music to be played is represented in Program Elements as well. The music titles might be selected automatically from the sound database or the host may select the titles himself. The host adds the music titles (sound and default-information) into Program Elements, decides where and how the music should start and end (for example where and how to fade), and adds additional information into the Program Element (for example what he will say before and after the music). He links the music to the Manuscript by a drag-and-drop function.

The Manuscript evolves during the day and everybody in the editorial unit is able to follow the current status of the day's program by reviewing the Manuscript. The producer is able to monitor the current status of each Program Element, which represents the features that the reporters are working on. He can check the pre-recorded features by opening the sound files in the Program Elements and edit them for example by making cut-downs in order to make them fit. He decides when the Manuscript (or parts of it, in terms of Program Elements) should be made public for the station, for coordination purposes or for general orientation.

Even during broadcasting, the Manuscript may be changed. The Program Elements are broadcast one by one, some automatically (pre-recorded features and music) while others are started and stopped manually (reading telegrams, live interviews, etc.). When a feature ends, the timing of the following Program Elements is automatically adjusted accordingly. The producer, the host, the technician, and the assistant each have a PC during broadcasting. Depending on their own individual role, some information from the Manuscript is more relevant than other information (corresponding to the individual annotations of paper based manuscripts – see section 4.2). This information is highlighted respectively on each of their screens.

After the program has ended, the Manuscript contains all the information (text and sound) necessary for generating the necessary reports.

6. Discussion

We will now discuss the design, concentrating on the support for cooperative aspects and on the relation between technical features and organisational considerations. For this purpose, it is important to remember that the project was not about designing a single artefact, rather the design was a combination of organisational development and development of a suite of systems – some of which were purchased as standard systems, while others were developed as customised systems. In the discussion, we relate findings from the project to recent CSCW concepts: *Computational coordination mechanisms* as developed by Carstensen (1996), Schmidt and Bannon (1992), and Gerson and Star (1986); *technologies of accountability* as suggested by Suchman (1994); and *workflow from within and without* as proposed by Bowers et al. (1995).

In an organisation such as Station 3, which is made up of a large number of cooperating ensembles of users, coordination is very complex. We have shown how it was based on various physical artefacts – and on the social and professional skills of the journalists, producers, host and assistants. We suggested a distinction between coordination among editorial units, between editorial units and the editorial board, and within an editorial unit.

6.1. COORDINATION MECHANISMS

The Event Calendar and the Program Manager incorporate computational coordination mechanisms. They enable a dynamic program planning process to occur – in two dimensions, vertical and horizontal.

6.1.1. *Among editorial units*

Horizontal coordination among the editorial units was raised as a concern by journalists and management during the analysis. Therefore the Event Calendar was designed as a computational coordination mechanism which provides an overview of events and bookings. An editorial unit which tries to book an event is notified by the system if that event is already booked. Either it has to give up the event or it must negotiate story angles with the editorial unit that booked the event first. The Event Calendar is also seen by management as a way of reducing "the small kingdoms" by promoting cooperation between the editorial units.

6.1.2. *Between editorial units and the editorial board*

Vertical coordination addresses the relation between the editorial board and the editorial units. Some journalists had asked for more "visible management", and the editorial board wanted to exercise "forward planning" instead of the previous "after broadcast monitoring". Therefore the Event Calendar was designed as a computational coordination mechanism that would enable the editorial board to promote or enforce ideas by changing dynamically the content of the Event Calendar, instead

of just updating the paper based version at the weekly meeting. On the other hand, the Event Calendar and the Program Manager are tools by which the editorial units are able to dynamically inform the editorial board of the content of programs in progress. In other words, the Event Calendar and the Program manager are "technologies of accountability" (Suchman, 1994). However, during the analysis the design team became aware of a tension within the editorial units. On the one hand, they wanted to work independently ("self steering groups" was also a management policy), while on the other hand, they acknowledged the editorial board's right to intervene. Thus, for the design team the questions were: When and how should editorial units be accountable for their actions? When and how should the editorial board give directives or feedback to the editorial units? The design team raised these issues by implementing the "make public-button" in the prototypes and by describing the scenario of the future use of the envisioned design. The degree to which the editorial board should be allowed access to plans was still being discussed when we finished our design and thus was left for further experimentation during implementation and use. This reflects an understanding of design similar to Suchman's (in press): "[P]rofessional design needs to be understood not as an end point but as a starting place, or a platform, for the ongoing processes of "lay" design or design-in-use that are both inevitable and necessary for an effective working environment."

6.1.3. *Within editorial units*

The Program Manager incorporates computational coordination mechanisms to be used within an editorial unit. It facilitates coordination in relation to planning and production of a program, between the producer and the reporters and among the reporters themselves. And it eases the handing over of information from the journalists to assistants, as well as aiding assistants in producing the necessary reports. These features aim at the other sense of accountability – the sense of mutual intelligibility of actions – that Suchman (1994) identifies as aspects of technologies-in-use. The reporters use the List of Ideas to store ideas for any member of the editorial unit, as well as for other units, to take up. The reporters store their ready-made features in the Pool for the producer to link to his Manuscript. During broadcasting, the Manuscript facilitates coordination between the producer, the host, the assistant, and the technician. The coordination takes place partly through the Manuscript and partly through other coordination mechanisms (electronic communication, gestures, etc.). Thus this system addresses the predominant request for computer supported coordination that was raised by all editorial units during the analysis.

6.2. COORDINATION MECHANISMS IN AN ORGANISATIONAL PERSPECTIVE

6.2.1. *Workflow from within and without*

Bowers et al. (1995) introduce an important distinction between workflow systems which reflect methods that are internal to the work (workflow from within), and systems which seek to order the work according to, for example, a general communication theory or a process model (workflow from without). Taking previous critiques of workflow systems into account (Orlikowski, 1992; Suchman, 1994; Bowers, 1995), the Program Manager's workflow aspects were designed to mirror or reflect methods that the analysis showed were internal to the work. In addition, we added new ways to access information for research purposes and new ways of coordination, which the analysis showed were needed, but which the indigenous work practices did not support.

6.2.2. *Linking of mechanisms*

Gerson and Star (1986) demonstrate how articulation work resolves inconsistencies, and thereby closes the work system "locally and temporarily". Empirical studies by Carstensen (1996) suggest that coordination mechanisms might also have a global character, functioning as a kind of workflow system that grows out of practice and evolves over time in a bottom up manner. He suggests that coordination mechanisms may be linked and as such interoperate. Our analysis of the work practice at Station 3 clearly supports his findings. The producer's paper based list of ideas gradually evolves through many rewrites into a manuscript used by the team during broadcasting and by the assistant to produce reports and to calculate royalties. The current ways to coordinate were considered cumbersome and often led to breakdowns. The new systems were therefore designed to allow for coordination that goes beyond the ability of the paper based artefacts. The Event Calendar and the Program Manager work individually and together as computational coordination mechanisms. Since they may be made accessible to people outside the editorial unit, they enable new ways of coordination not supported by the current practice. Thus, they enable more enduring and more extended kinds of closure that reach beyond a single editorial unit.

6.2.3. *Dealing with conflicts*

In earlier projects, we have learned how the design of computational coordination mechanisms in an organisational context may entail conflicts (Bødker and Kensing, 1994; Simonsen and Kensing, 1997). In this project the editorial board, on the one hand, wants to promote and enforce a "forward planning process" instead of an "after broadcast monitoring." On the other hand, the editorial units want to retain their autonomy, deciding for themselves which events to cover and how, even though they acknowledge the editorial board's right to give suggestions and intervene.

To design computational coordination mechanisms is not just a matter of taking a set of technical criteria into consideration. It also is a question that resides in the realm of political discussions, characterised by power, norms, and traditions for how such issues are dealt with in the organisation. What kind of computer support do we want – systems for control or for support, and support for whom? And who is the "we" who decides?

These issues have been dealt with in previous studies of CSCW systems in use, where the introduction and adoption of CSCW products in organisations have been studied (see for example Bullen and Bennett, 1990; Orlikowski, 1992; Okamura et al., 1994; Ackerman, 1994; Rogers, 1994). In most cases, the product development oriented CSCW contributions have not taken organisational and political issues into account. However, design in a specific organisational context of coherent systems has to be organisationally feasible. This is why organisational issues have to be an integrated part of the design and implementation. We have demonstrated how technical and organisational issues can be dealt with during a project in an organisational context. The role of a design team is neither to cover up nor to solve political conflicts. Rather it should expose such conflicts and help the parties to formulate technical and/or organisational ways of dealing with them, and leave it to them to solve the conflicts in the appropriate fora. During the project, organisational aspects were an integral part of our interactions with the management and employees of Station 3. The design team's final report addressed such issues and evaluated the consequences for the various parties. Some controversies were solved as part of the evaluation of the report at the hearing and at the final steering committee meeting. Some were left to further experimentation and negotiation during implementation.

7. Conclusion

We have presented findings from a design project in an organisational context, which involved ethnographically inspired studies of cooperating ensembles of users and participatory design of computer support for collaboration and individual work. The project exemplifies an ambitious, yet realistic design practice within a full scale commercial design project. We have discussed technical and organisational aspects of the design and have related our findings to recent CSCW concepts including coordination and computational coordination mechanisms, technologies of accountability, and workflow from within and without.

We have designed computational coordination mechanisms as integral parts of the suite of systems, to coordinate work among various cooperating ensembles of users. We acknowledge the differences among the 25 editorial units and between these and the management. Some units are quite small and may be comprised of only one person. They are allowed to work alone, producing a weekly or biweekly program. Some units have very particular domains of interest while others have broad domains. As a result of these variables, there are differences in terms of

work domain and workplace culture, and thus differences in the perceived need for computer support, both in general and in terms of coordination in particular.

In the article, we have focused on Program X, one of the larger editorial units. We expect the future use of computer support for individual work to be similar among the editorial units. However, we expect the future work practice, in relation to the coordination aspects of the systems, to be quite diverse. This does not present a problem in relation to the design as long as it is conceived as a suite of systems. Individual users can choose which parts of the systems they want to use as long as a minimal set of reporting procedures, supported by the design, is followed.

The design facilitates improved managerial control of the content of programs. Though some conflicts were postponed until later experimentation and negotiation during development, implementation, and use, the employees generally accepted the design because it offered support for their individual and cooperative work. Hence, the project demonstrates that designing computational coordination mechanisms in a complex organisation must be guided not only by technical design criteria, but by careful consideration of the organisational context, including organisational politics.

Acknowledgements

We are very grateful for valuable comments by the anonymous reviewers of a shorter version of the article accepted for ECSCW '97, as well as for comments by Liam Bannon, Jeanette Blomberg, Jonathan Grudin, Susan Newman, Lucy Suchman, and Randy Trigg to prior drafts of this article. Also we want to thank all the employees at Station 3, the two IT-consultants, and their manager for a most valuable collaboration.

Appendix A. The MUST method

The MUST method supports participatory design in an organisational context, whether this be in-house or contract development. The method has been developed by the authors of this article throughout 10 projects in Danish and American organisations, and it has recently been evaluated and adopted by IT professionals within a large Danish organisation. The method is inspired by ethnographic approaches and by Scandinavian participatory design approaches.

Design in an organisational context is an open-ended process. The objective of the design project is to investigate the situation and provide information for a decision about how to proceed. If appropriate computer support can be identified, the overall functionality and form of such systems are outlined. The project may proceed to development and implementation, but we consider these parts of systems development to be outside the application area of our method.

We see organisations as frameworks for cooperation as well as for conflicts. Groups and individuals participating in design should be expected to have common, as well as

conflicting goals. The role of IT professionals is neither to cover up nor to solve political conflicts that arise during design. Rather they should help the parties to formulate their visions, and leave it to them to solve conflicts in relevant fora. A good design most often is a mix of tradition and transcendence. One reason for bringing in IT professionals is to transcend the tradition. However, IT professionals need to understand traditions in the organisation, in order to maintain – or establish – credibility, but also in order to understand the rationale behind phenomena that otherwise can be perceived as odd by an outsider.

The method is grounded in six principles and suggests that a project be organised around five main activities. It offers a set of techniques and ways of representing current work and the envisioned computer based systems. We consider the principles to be indispensable, while the techniques and representation tools may be chosen by the IT professionals based on their preferences and understanding of the situation in question.

THE SIX PRINCIPLES

Principle 1: Participation

A large proportion of the software installed in organisations is never used. The primary reason for this is that IT professionals have not understood the specifics of the organisation in question. Participation is a way of increasing the chances that a design corresponds to real needs and will be used as intended.

Principle 2: Close links to project management

Project management deals with the division of labour in the project, how the project is designed as a process, quality control, and how conflicts are dealt with. We deliberately include establishing close interaction between project management and activities related to the design proper as a principle, because it has not been dealt with explicitly in the participatory design literature.

Principle 3: Design as a communication process

It is the responsibility of IT professionals to choose the techniques and the representation tools that will allow them to establish a communicative process with users. Through this process, they are able to jointly develop knowledge within three domains: “Users’ present work”, “Technological options”, and “New system”. In each domain, we need to deal explicitly with two levels of knowledge. We need abstract knowledge to get an overview of a domain of discourse, and we need concrete experience in order to understand the abstract knowledge and in order to evaluate its relevance to the design process.

Principle 4: Combining ethnography and intervention

We apply a combination of ethnographic techniques and intervention in an iterative approach to design. We strive to select carefully the area and the mode of intervention, based upon what we have learned by applying ethnographic techniques. While ethnography and intervention contrast in terms of their basic approaches and intended results, we have experienced that at a practical level, combining the two approaches and iterating between them has been an effective way in learning about the organisation and has been an important resource in generating realistic visions of future use of technology.

Principle 5: Co-development of IT, work organisation, and users' qualifications
IT is introduced because someone – usually management – wants change. However, projects far too often focus solely on IT systems, leaving it to the users to struggle with the organisational implementation afterwards, and educational aspects are often reduced to training in the functionality of the systems. A design project needs to address and take into account the technical, organisational, and educational issues. A sustainable basis for the organisation's decision making, and for the development and the technical and organisational implementation should also include an evaluation of the consequences and an estimate of the costs of implementing the design.

Principle 6: Sustainability
The early design activities are a first step in introducing sustainable IT. We deliberately use this ecological concept as a metaphor in an attempt to capture an overall perspective of the use of the method. What is needed is a change of attitude for most managers and IT professionals. They need to question the traditional expert strategy that has often resulted in the reverse of what was planned for. The introduction of new systems often results in major breakdowns where rationality lapses into irrationality. In working with managers and IT professionals during most of the 10 projects contributing to the development of our method, we have experienced an increasing awareness of the pitfalls in the predominant practice as well as a willingness to experiment with alternatives.

FIVE MAIN ACTIVITIES CONSTITUTING THE DESIGN PROCESS

In the MUST method the overall design process is constituted by five main activities: 1) project establishment, 2) strategic analysis, 3) in-depth analysis of selected work domains, 4) developing visions of the overall change, and 5) anchoring the visions. They support a stepwise decision making process. Iterations are recommended, especially between activity 1 and 2 and between activity 3 and 4. The fifth activity should be seen as an ongoing concern throughout the project.

Project establishment
We recommend always to start with Project Establishment - a systematic technique supporting the clarification and negotiation of the aim, level of ambition, scope, and conditions of the project. The technique also suggests activities for the design team to decide which tools and techniques it will use to conduct the project, as well as for establishing the team as a social unit. While many projects start out from a rather loose description, project establishment provides the steering committee and the design team with a sound basis for the succeeding project activities.

Strategic analysis
The purpose of strategic analysis is to clarify and delimit which work domains should be in focus in the design project. Strategic analysis is a management related activity which clarifies the alignment between business strategy, IT-strategy, and the overall purpose of the design project. In case such issues have been dealt with before a project starts, the design team simply has to understand the implications for the current project and include this in the Project Establishment. However, more often than not we have found that such issues are still unclear when a design project starts.

In-depth analysis of selected work domains
The work domains pointed out by the strategic analysis are in focus when in-depth analyses of current work practices are performed. The purpose is to reveal and develop an understanding of the rationale behind current work practices. The intention is not to map old practices into the new computer-based system. However, we have experienced that users have good reasons for what they do and that the rationale underlying current work practices is relevant for the design, even if the management aims at rather drastic changes.

Developing visions of the overall change
Developing one or more visions of the overall change is the central activity. We emphasise that the visions should not only deal with the functionality and the user interface of the suggested systems, but also include organisational change and changes in qualifications needed by the users. Ideas and visions are developed throughout the project, and they are often voiced in the very beginning of the project. They emerge in nearly all activities conducted in the project, but the purpose of this activity is especially to develop ideas and visions, and form these into one or more coherent visions for change.

Anchoring the visions
We use "anchoring" as a metaphor that moves beyond the design/implementation dichotomy. In order for a vision to materialise, it needs to be deeply rooted in the organisation. Its rationale needs to be understood by:

- management and the steering committee, who decide if it should be implemented;
- those who will carry out the technical and organisational implementation – the latter including educational/training activities;
- the users who will have to live with its consequences.

Appendix B. Overview of the project at Station 3

The design project was carried out from January 1995 through June 1995. Referring to the main activities described above, project establishment and strategic analysis were done in January, in-depth analysis of selected work domains was (mainly) carried out in February and March, developing visions of the overall change was (mainly) done in April, May and June, while anchoring the visions was part of the activities throughout the whole project.

The table below should be read as follows:

- *Activities* outlines the approximate order of the activities carried out during the project.
- *Who* indicates which participants from the design team carried out the activities: This could be either everyone from the team (All), the designers, or the user representatives (User rep).
- *Whom* indicates with whom the activities were carried out. This could be with management from the steering committee and/or the editorial board (Managers), representatives from the IT-department (IT), or employees and managers from Station 3 (Users). (*Whom* is only indicated where applicable.)
- *No.* indicates how often a certain activity was carried out. (*No.* is only indicated where applicable.)

	Activities	Who	Whom	No.
Jan	• Meetings with IT-department, Editorial Board and steering committee	All	Managers	6
	• Document analysis of strategic reports	Designers		
	• Interviews	Designers	Managers	3
	• Analysis of existing software	Designers	IT	
	• Writing Project Charter	Designers		
	• Approval of Project Charter	All	Managers	
Feb	• A hearing concerning the Project Charter	All	All	1
	• Observations of radio programs	Designers	Users	4
	• Interviews (interviews and observations involved app. one third of all 140 employees)	All	Users Managers	27
	• Thinking aloud experiments	Designers	Users	3
	• Document analysis of material used in radio Designers production	Designers		
Mar	• Workshops drawing rich pictures of current work practice within radio production	All		2
	• Categorizing the results of the interviews, observations, and thinking aloud experiments	Designers		
	• Mapping problems, needs, and candidates for computer support	All		
	• Writing report from analysis	All		
	• Approval of report (incl. prioritising problems, needs, and candidates for computer support)	All	Managers	
Apr	• A hearing concerning the report from the analysis	All	All	1
	• Visits to abroad radio stations using state of the art technology (visits included observations, videorecording, interviews, and thinking aloud experiments)	All	Users Managers IT	2
	• Analysis of new IT-products	All	IT	
	• Design workshops sketching future work practices	All		2
	• Interviews	All	Users	4
May	• Design workshops sorting out design ideas	All		1
	• Data modeling (ER-diagramming)	All	IT	3
	• Prototyping (3 different prototypes)	Designers	Users	
	• Writing scenarios	All		
	• Estimating costs	Designers		
	• Planning implementation	Designers		
June	• Writing final design report	All		
	• Demonstration of prototypes	All	All	
	• Approval of report	All	Managers	
	• A hearing concerning the final report	All	All	1

Note

1. A condensed version of the paper – entitled "Designing for Cooperation at a Radio Station" – was presented at ECSCW '97 and appears in Hughes et al. (eds.): ECSCW '97 Proceedings of the Fifth European Conference on Computer Supported Cooperative Work, Kluwer Academic Publishers, 1997, pp. 329–344.

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