

Participatory IT Design - an exemplary case

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Abstract

We address IT design and provides examples of how to design solutions based upon participatory design techniques and ethnographically inspired analysis within a full-scale design project. The case 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 of the work at The Danish Broadcasting Corporation. We discuss technical and organisational aspects of the design.

Keywords

Participatory design, ethnography, coordination, coordination mechanisms, organisational context.

1. Introduction

We focus in improving IT design that takes place in an organizational context, "in-house development" or "contract development" (Grudin, 1991). 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 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 discuss IT design 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. Throughout the article we address technical and organisational aspects of the design. 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. The article is concluded in section 6. Throughout the article, we highlight our approach to design in an organisational context as well as the intermediate and final results that were used as a basis for the organisation's decision about the subsequent development and implementation activities.

2. Participatory design of computer support

In the project, we used the MUST method (Kensing et al., 1998; Bødker, Kensing, and Simonsen, 2004). The method

suggests principles, concepts and frameworks, a structure for IT design processes, 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.

Ethnographic approaches to the study and analysis of work for the purpose of design strive gain an appreciation for what users are doing and how they see things. Blomberg et al. (1993, pp. 125-126) describe "four main principles that guide much ethnographic work":

"study the activities of people in their everyday settings, [...] as opposed to a laboratory or experimental setting".

"particular behaviours can only be understood in the everyday *context* in which they occur".

"describe how people *actually* behave, not how they *ought* to behave".

"describe behaviour in terms relevant and meaningful to study participants".

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) and three special issues on Participatory design: CACM (1993), HCI (1998), and CSCW (1998). Greenbaum and Kyng (1991) "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" (ibid., p. ix). The book and the special issues 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. Further they hold historic overviews of PD projects, reports on specific design projects, and they provide conceptual frameworks for the understanding and creation of successful cooperation between users and designers.

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; Bodker and Kensing, 1994; Simonsen, 1994; Simonsen and Kensing, 1997; Kensing, 1998). 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) that was subsequently refined into a textbook (Bodker, Kensing, and Simonsen, 2004). 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 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; a policy of using a higher percentage of the stations' recordings from concerts.

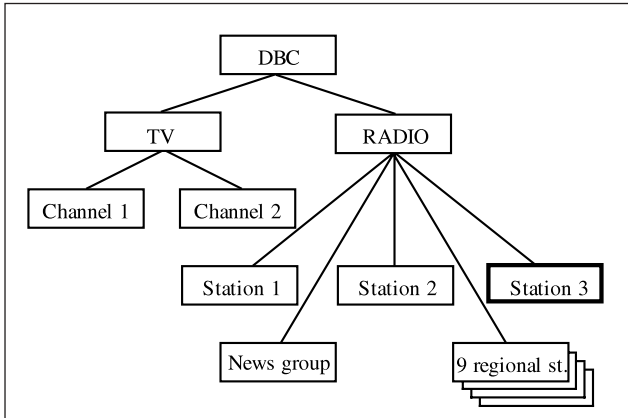


Figure 1. Organisation chart for the Danish Broadcasting Corporation.

The editorial board of Station 3 wants to shift from "after broadcasting monitoring" to a "forward planning process", i.e. to promote and enforce 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).

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 drawings and collages 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, everyone 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.

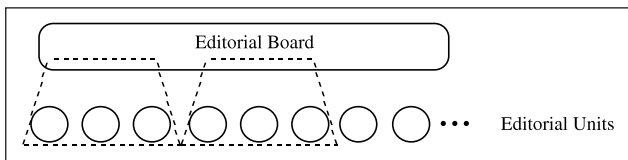


Figure 2. The structure of Station 3.

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.

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 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 coordinator, 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 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.

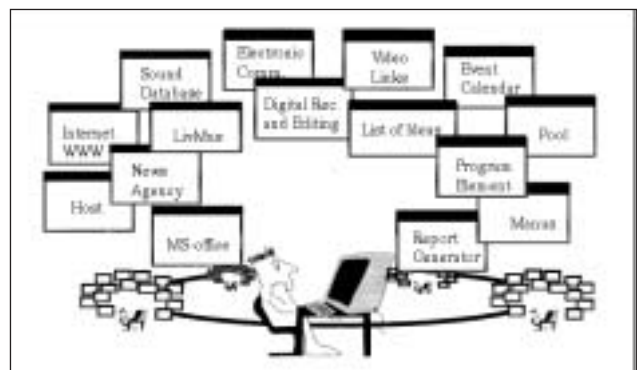


Figure 3. The suite of systems in the design.

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 improved and 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 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

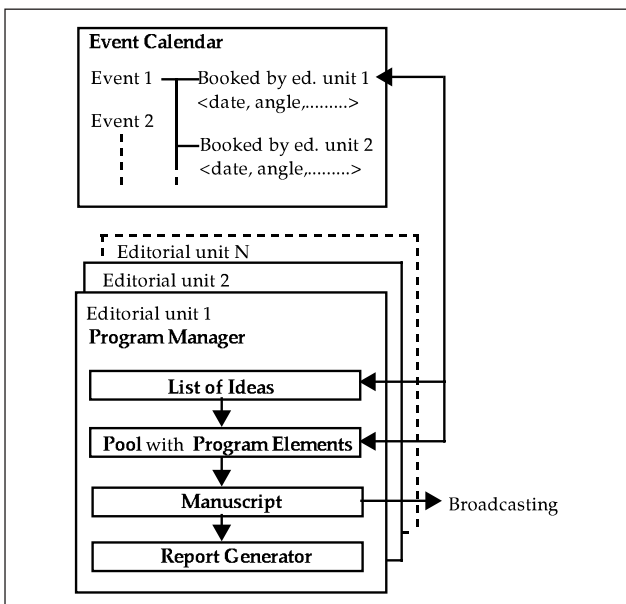


Figure 4. Illustration of the *Event Calendar*, the *Program Manager*, and the linking between them. Editorial units book events and indicate their chosen angle on the event. Data from the *Event Calendar* can be dragged into the *List of Ideas* in the *Program Manager*. Ideas evolve into *Program Elements*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

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 was implemented. Table 1 summarises the work situation before the new system was 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" 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 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

ACTIVITY	BEFORE	AFTER
Preparing next week's program (the producer)	<p>Search ideas in:</p> <ul style="list-style-type: none"> - suspension files (local paper based files), - List of upcoming events (paper based) updated weekly by a staff member, - news agencies, - newspapers, journals. <p>No or arbitrary coordination.</p> <p>Order books from library and tapes of broadcast material from archives.</p> <p>Sketch potential features (paper).</p>	<p>Search ideas in:</p> <ul style="list-style-type: none"> - 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. <p>Ed. units "book" into events and coordinate with other units booking the same event.</p> <p>On-line booking of books and tapes. Recent programs may be accessed from hard disc archives.</p> <p>Update List of Ideas.</p>
Planning the program in detail (the producer and the host)	<p>Create a document with 20 potential stories,</p> <p>Meeting narrows down to 6-7 stories,</p> <p>Create a new document which he and the host make individual annotations to.</p> <p>Coordinate with</p> <ul style="list-style-type: none"> - reporters and other units by phone, and personal communication, - arbitrary or no coordination to other editorial units. <p>Select music (CD's), text on paper.</p> <p>Create the manuscript (numerous rewrites), finally rewritten by the assistant, adding the actual times of features and music.</p> <p>Editorial Board does not know the content of the specific program (until after it is broadcasted).</p>	<p>Selection of potential stories from List of Ideas and Event Calendar,</p> <p>Meeting narrows down to 6-7 stories,</p> <p>Drag selected Ideas into the Pool (Ideas become Program Elements and their basic data is copied)</p> <p>Coordinate with</p> <ul style="list-style-type: none"> - 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. <p>Music selection assisted by computer, sound and text added to Program Element</p> <p>Continuously create manuscript by linking Program Elements from Pool into Manuscript (times automatically added).</p> <p>Editorial Board might give mandatory ideas and inspect Program Elements and Manuscript.</p>
Reporters	<p>Check with producer and colleagues to coordinate.</p> <p>Produce features by editing tapes with assistance from technicians. Text on paper.</p>	<p>Coordination within the editorial unit supported by Program Elements and Manuscript.</p> <p>Produce features by working on Program Elements in the Pool, adding and editing text and sound digitally.</p>
Broadcasting (the host, the producer and the assistant)	<p>Make individual annotations to manuscript</p> <p>The assistant calculates and records actual time of each feature.</p> <p>Everyone updates their individual paper-based manuscripts when changes are made</p>	<p>Individual parts of the Manuscript are highlighted.</p> <p>Automatic time calculation.</p> <p>Changes made to the Manuscript are immediately visible for everyone.</p>
Reporting (the assistant)	<p>Collects data from reporters about interview persons for paying salaries, etc.</p> <p>Reports exact usage of music titles for paying royalties.</p>	<p>Reports automatically generated from Manuscript.</p>

Table 1. "Before and after" the new system.

interviews, etc.). When a feature ends, the timing of the following Program Elements are 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. 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.

We have designed a 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 IT support for in a complex organisation must be guided not only by technical design criteria, but by careful

consideration of the organisational context, including organisational politics.

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