Participatory Analysis of Flexibility: Some Experiences

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ABSTRACT

Analysis conducted according to conventional systems development approaches focuses on standard data formats and general data flow. The growing concern for tailorability issues reflects an increased attention towards the need to consider the variations in the work activities. The general argument for the need to use participatory approaches holds even stronger when it comes to understanding the variation and flexibility aspects of a workplace, since flexibility concerns not the general procedure and standard way of doing things but the unexpected, the unprecedented, the exceptional cases, situations and events that are only experienced by the people who do the day to day work. In this paper we report our experiences of applying participatory techniques in addressing the flexibility aspect of a specific workplace: the radiology department of a hospital. Though Blueprint Mapping, one of the techniques, was intended to represent the general way things are done at the department, the map also triggered statements about variations and unexpected situations. And though the Organizational Game, the other technique, originally was not invented with flexibility issues in mind, the idea of starting out from cards describing specific situations proved to be very successful for this purpose.

KEYWORDS: Participatory analysis, flexibility, tailorability, organizational game and computerized radiology.

INTRODUCTION

Greenbaum and Madsen (1993a, p. 47) have framed the general discussion about the need for Participatory Design (PD) approaches by pointing out that the issue can be viewed from a pragmatic, a theoretical and a political perspective. *Pragmatically* we may observe that since people who do the day-to-day work are the ones who know how it is done we need to involve those people in design projects. Among the *theoretical* foundations of PD we find the philosophy of Heidegger whose notion of "involved action as opposed to detached reflection" constitutes one of the axioms of participatory or cooperative prototyping (Winograd & Flores,

1986; Ehn, 1988, p. 63ff.; Grønbæk, 1991, p. 39ff.).

The *political* motivation for PD has been particularly strong in Scandinavia reflected by notions such as work place democracy, where the message is that in a democracy people ought to have a say in the kind of technology they use at work (Bjerknes, Ehn & Kyng, 1987; Ehn, 1988).

Mogensen and Trigg (1992) coined the term *participatory analysis* as a label for the kind of participatory systems development activities that focus on current work practices. Though analysis is the part of conventional systems development approaches that involves end-users the most, they very often only play a passive role - being subject to the professional designers inquiry into current work practices through interview, observations, etc. A participatory approach to analysis changes the relationship between designers and users.

Analysis, conducted according to conventional systems development approaches like structured analysis and object oriented-oriented analysis, focuses on standard data formats and general data flow. The data dictionaries and data flow diagrams of Yourdon's structured project life cycle (1982 p. 11ff.) model the general standard data format and flow, respectively. Within the object-oriented paradigm Booch (1991, p. 17) emphasizes, quoting W. Wulf, that »We (humans) have developed an exceptionally powerful technique for dealing with complexity. We abstract from it. Unable to master the entirety of an object, we choose to ignore its essential details, dealing with *the generalized, idealized model of the object*« (our emphasis). The hermeneutic approach discussed by Winograd and Flores (1986) talks about design based on *recurrent* patterns (ibid., p. 64), while at same time taking into account the need to handle unstructured and emergent situations (ibid., p. 153).

In contrast with conventional approaches emphasis on general aspects of work activities, the growing concern for tailorability issues reflects an increased attention towards the need to consider the variation of work activities and need for flexibility. Tailorability concerns the modification and adaptation of systems after they have been put into use. The various kinds of modifications include a) choosing between alternative anticipated options, for instance by setting switches, b) constructing new behaviours from existing ones, for instance by writing macros, or c) more fundamentally changing the system by modifying code or writing new code (Henderson & Kyng, 1991). Numerous case-stud-

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ies of tailoring in practice have been published. Among the most prominent are Nardi and Millers' (1991) study of spreadsheet users and Mackay's (1990) of UNIX users and Information Lens users. Trigg (1992) has identified *diversity* and *fluidity*[1] as two fundamental triggers of tailoring. Diversity can either be understood in terms of the same tool or system being used for different purposes or used in different organizational contexts perhaps by different professions. The notion of fluidity captures the changing nature of work over time due to changes in organizational structure or task at hand.

The common arguments about the need to use participatory analysis hold even stronger when it comes to understanding the flexibility aspects of a workplace, since flexibility concerns not the regular procedures and standard way of doing things but the unexpected, unprecedented, the exceptional cases, situations and events which are only experienced by the people who do the day to day work.

In this paper we report our experiences of applying PD techniques in addressing the flexibility aspect of a specific workplace, the radiology department of a hospital. In a previous paper (Greenbaum, Kjær & Madsen, 1993) we have presented a conceptual framework for flexibility, focusing not only on flexibility aspects of the technology but also the flexibility of work organization and physical space.

The paper is outlined as follows. First we introduce the context of the investigation followed by a brief introduction of our conceptual framework. Then follows the main part of the paper where we report our experiences applying participatory techniques in addressing the flexibility aspect. The paper is concluded by a summary of our findings.

CONTEXT OF THE INVESTIGATION

The context of the investigation is formed by the organization in question, the specific systems development project, and our research agenda.

The Organization

The analysis was conducted at the radiology department of the local county hospital. The radiology department offers a number of sophisticated examinations using a variety of technologies beyond conventional X-ray radiography. During ultrasound examination sound waves are projected into an area of the patient's body and the returning echoes are converted into electronic signals which are interpreted by a computer as an image displayed on a monitor. Other examinations combine the injection of iodine dye or other chemical substances into the blood vessel followed by a rapid series of X-ray pictures taken to track the movements of organs, for instance the heart. Still other imaging devices, for instance digital subtraction angiography (DSA) combine conventional radiography and computer image processing to produce images of anatomical structures. Computer aided

tomography (CAT) produces images of cross sections of the body by taking X-ray pictures from a number of angles.

Radiologists (i.e. physicians who have specialized in radiological examinations), secretaries, radiographers (i.e. nurses who have specialized in radiological examinations), and nurses are the main staff categories of the radiology department. Radiographers carry out examinations either on their own or together with radiologists. The most complicated examinations, including those involving incisions and catherization, are carried out by radiologists. The radiologists are also responsible for approving the examinations requested and for reporting on the X-ray images. The secretaries handle the administrative work including receiving referrals for examination, filing and retrieving referrals as well as hard copies of pictures, and type the X-ray reports dictated by the radiologists.

No patients come directly to the radiology department; they are initially admitted through one of the other wards. Requests for examinations are phoned from the ward to the secretary responsible for scheduling examinations (requests for emergency examinations are directed to the radiologist on duty). A referral is also sent via internal mail. The day before the examination one of the secretaries retrieves the referral and, if available, previously taken images. In the morning the chief radiologist on duty reviews the examinations requested, and if required notes which further examinations are needed. After the examination has been conducted one of the radiologists reports on the X-rays. The X-ray report is typed by one of the secretaries immediately afterwards. During X-ray conferences results are discussed by the radiologists and the physicians from the ward. Conferences are conducted for the specific ward in question, for instance I-conferences for patients from intensive care and C-conferences for patients from the cardiology ward.
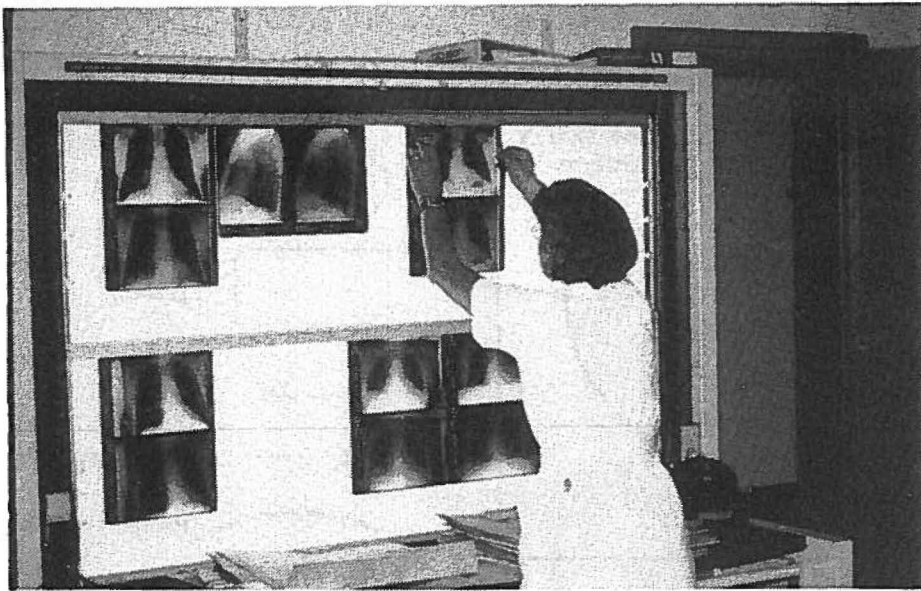
This is the general pattern of responsibilities and examination procedures, but as we will see later, variations and exceptions exist.
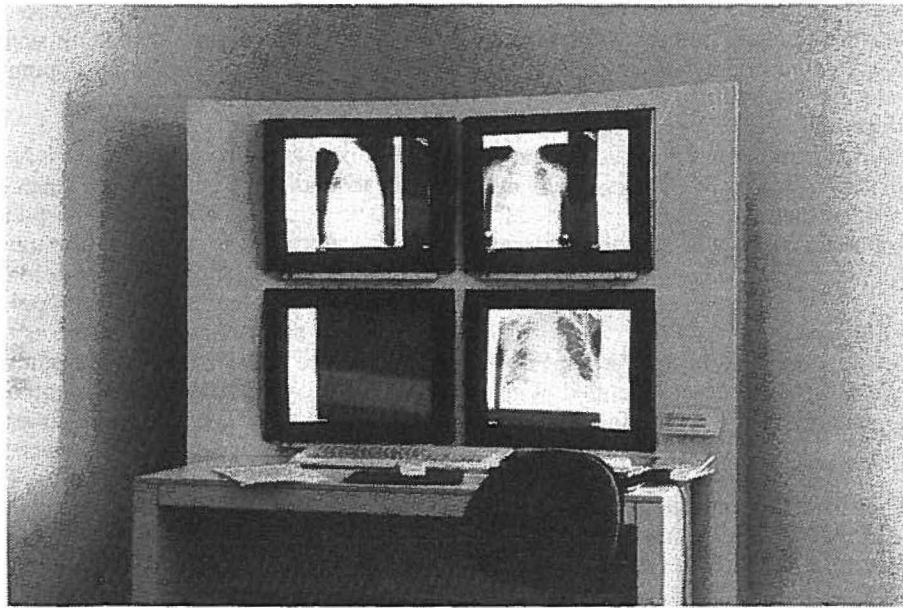
The Systems Development Project[2]

In the early fall of 1991 we were contacted by the Chief of Radiology. The department is test site for the introduction of new PACS hardware and software. Picture Archive and Communication Systems (PACS) are quite new, representing a change in media; rather than using film-based images (Picture 1), they process digitized pictures which can be stored and transferred directly to computer screens (Picture 2). The new imaging systems are expected to process a wide range of radiographic images including X-rays, ultrasound, and CAT scanning.

A meeting was set up between us and the radiology department's PACS Group (made up by the chief radiologist, the head nurse, the chief secretary and a radiographer who is the local PACS super user). The group is responsible for coordinating the introduction of the new system, including providing feed-back to the vendor.

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[1] Trigg mentions a third trigger of tailoring, ambiguity, which seems to be some kind of mix of fluidity and diversity since »Uncertainties like E's point to the possibility of future changes in work practicies, as well as the importance of maintaining multiple perspectives« (Trigg, 1992).

[2] This section is based on (Greenbaum, Kjær & Madsen, 1993)

Picture 1. Displaying analogue pictures

Picture 2. Monitors displaying digitized pictures

At the initial meeting we were told about the expected benefits of the new system. One of the intended advantages is that digitized X-rays and other medical images can be easily stored, retrieved and transmitted to other departments within the hospital. A major concern of radiology departments is the time lost trying to locate pictures that are sent on loan to other departments or to other hospitals.

At the same time, there clearly was an awareness of the fact that the introduction of the new system can have far-reaching effects throughout the department and the hospital. The situation was further complicated by the radiology department's planned move to a larger building and the efforts of the hospital's computer department towards developing an interface between the existing Hospital Information System (HIS) and PACS.

The motivation for involving us was to document the (hopefully positive) effects of the new technology. During a series of meetings over approximately half a year the contents and the nature of the project were discussed and negotiated between us and the PACS Group. Initially there was some discrepancy among the parties involved concerning the nature of the project. The chief radiologist expected a purely analytical project in no way affecting the use of PACS at the department. We, on our side, argued in favour of a participatory project involving staff members with a day to day work experience; an approach which was likely

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to affect their perception of the situation at the department including PACS.
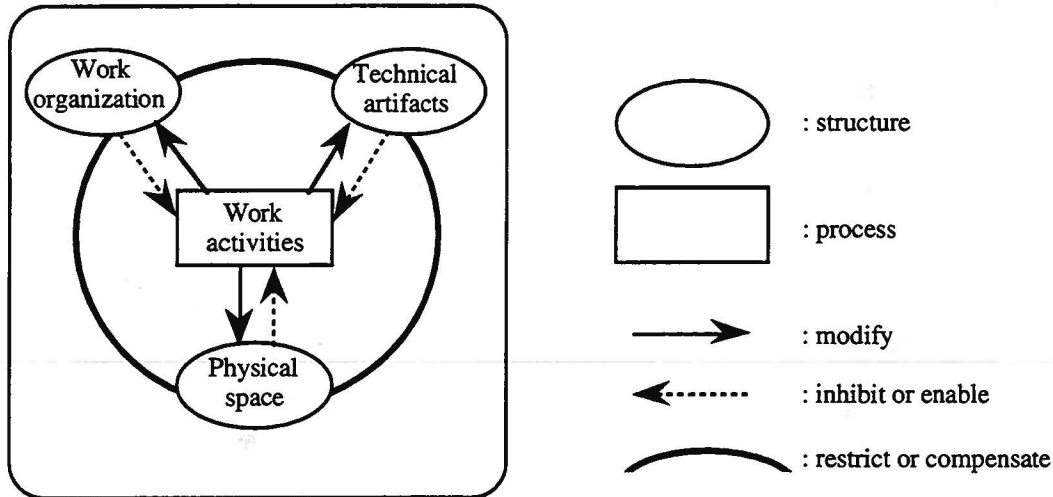

Figure 1. Conceptual framework

The controversy was resolved when we clarified our research approach. Our interaction with people from the department participating in the project would affect their perception of the situation, but it was the departments own decision whether to change work procedures, change PACS requirement, or formulate other systems requirements. Since action planning and action taking were not an integrated part of the project it was not an action research project, cf. Susman and Evered's Action Research Model as discussed in (Baskerville & Wood-Harper, 1992).

The Research Agenda

Like many other projects reported within the Participatory Design field, the project was closely associated with academia and research rather than being a pure industrial or commercial project.

In the previous part of our research project at the hospital we have developed a general conceptual framework addressing the dependencies between work activities, technical artifacts, space, and work organization (Figure 1) (Greenbaum, Kjær & Madsen, 1993).

The structural elements (i.e. technical artifacts, space, and work organization) provide the conditions for the work activities by inhibiting or enabling the process. On the other hand the work activities themselves may modify the technical artifacts, space, and work organization. Between the various structures (i.e. technical artifacts, space, and work organizations) there is another kind of interdependency. An aspect of one structure may restrict what is feasible in the two other elements, and an aspect of one structure may

compensate for deficiencies in another element[3]. *Flexibility* concerns the potential for making such mutual adaptation together with the potential for coping with dependencies among the structural elements.

The project at the hospital ended up as a merge or symbiosis of the radiology department's needs and our research interests in flexibility issues. The hospital's move of its radiology department to new building gave reason to look at the use of physical space. In addition, the PACS system was just one of a number of new types of equipment being introduced, and this fact motivated us to consider technical artifacts as a broader element for study rather than relying on a traditional definition of technology. And as it often happens when new technical artifacts are introduced, organizational changes were initiated, which made it particularly relevant to look at work organization. Hence, in part driven by our research interests, the goal of the project was to focus on the flexibility aspects of the elements of the framework.

WHAT WE DID

The analysis at the radiology department was conducted over two periods of time; in the spring of 1992 before the move to the new building and in the early 1993 after the move. During the initial investigation we applied fairly conventional techniques like interviews and observations. We conducted 14 interviews with people representing the four professions and staff from both the radiology department and the wards[4]. The focus of the interviews - which were audio taped to facilitate exact reference - was the general work

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[3] Specific examples can be found in (Greenbaum, Kjær & Madsen, 1993).

[4] We interviewed the local management at the department (4 people) and 5 people doing the ordinary tasks at the department. Beside this, we interviewed the manager from the local edp-department, and a physicians, a nurse, and a secretary from three different wards.

procedures and the roles of the professions involved. The interviews were supplemented with observations at numerous locations including the secretaries' office, the conference room during various types of conferences, as well as the different examination rooms. In addition a series of black and white pictures were taken as documentation of the physical setting before the move. Moreover seven of the staff members from the radiology department participated in two workshops. The focus of the Storytelling Workshop (Greenbaum & Madsen, 1993b) was exceptions and deviance from the standard work procedures. In the Future Workshop (Jungk & Müllert, 1987; Kensing & Madsen, 1991) the focus was visions about the future PACS technology.

During early 1993 interviews and observations were conducted to expose changes due to the introduction of PACS and the move to the new building. In addition, Blueprint Mapping and an Organizational Game were conducted as described below.

Blueprint Mapping

The purpose of what we have chosen to name *Blueprint Mapping* was to start out from a regular blueprint of the building and establish an overview of the daily work as seen through the lens of the elements of the framework. The idea was to create an overview of the current situation and at the same time try to frame the ideal future. In relation to the discussion about flexibility, our main objective was to map the typical or normal situation, but as we shall see what actually constitute the typical or normal was challenged in this very same process.

Blueprint Mapping is inspired by two other techniques — The Layout Kit and Wall Graphs.

The *Layout Kit* technique (Ehn, Möllerud & Sjögren, 1990; Ehn & Sjögren, 1991) has been developed as part of the UTOPIA project (Dilschmann et al., 1985) and the Carpentry Shop project (Ehn & Sjögren, 1986). The generic design tool uses Post-Its in different sizes and colors, representing the various aspects of the production process in focus. When using the Layout Kit within a specific domain, Post-Its with pictures and text are created to represent the specific work processes, work material, equipment etc. From these building blocks a map of the material flow and transformation is created on a poster size piece of paper. The poster is created by people from the work place who carry out the daily work tasks. The main purpose of creating the map is to support a shared understanding of the production process and the current organization and its problems, as well as to develop ideas for alternative organizational designs. The shared understanding is developed by discussing the meaning of Post-Its while placing them on the poster. New types of building blocks may be created and defined during the process.

The *Wall Graph*[5] technique (Norwegian Employers' Association, 1977) is a predecessor to the Layout Kit. It focuses on the work tasks in an office environment which is mapped by a one level data flow diagram (DeMarco, 1978), representing control flow and copies of forms used in the tasks. After mapping the current situation, the group makes a functional analysis, including the purpose of the tasks and the different interest groups state their demands to the tasks. The objective of the analysis is to produce suggestions to changes in the procedures. The wall graph description may be used in later analyses, in connection with the introduction of new staff members, and as task documentation.

The *Blueprint Mapping* we did at the radiology department is a modification of the Layout Kit while at the same time including the original concern for data from the Wall Graph technique. Whereas the Layout Kit starts out from a blank poster sheet, Blueprint Mapping is initiated from a blueprint of the building. In the specific case, the blueprint was easily available since the radiology department had just moved into the new building. We had the diagram scaled up to 7 times 4 feet size in order to make space for Post-Its etc. Like in the Layout Kit we used Post-Its to represent information about the tasks performed. The task labels were marked with additional information telling which professions perform the specific tasks. Rather than using Post-Its with drawings or pictures to represent equipment as in the Layout Kit, we went to the department and took black and white photographs of the various type of equipment from which we created a collection of 24 * 36 mm miniatures. To facilitate repositioning of the miniatures we sprayed them with re-adhesive glue. The various (unconnected) networks - part of the technology - were represented by tape in different colors. Data entered into the computer systems was represented as notes on Post-Its (Picture 3).

Besides getting an overview of the current situation the Blueprint Mapping also supports creating a shared understanding of "the production process" within the radiology department as the Layout Kit does.

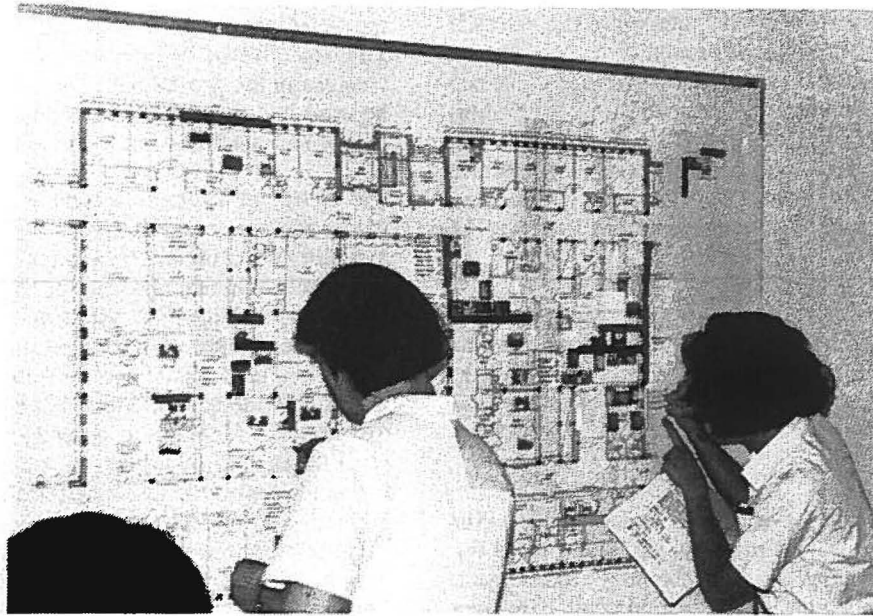The process of creating the Blueprint Map was divided into three steps

- our preparation,
- mapping the current situation,
- review of the current situation.

Our preparation was to create the basic building blocks as described above. In addition, we made a first draft of the Blueprint Map. Miniatures were placed on the blue print according to the actual location of equipment and connected with the colored tape to show connections in networks. Likewise, Post-Its were placed on the locations to indicate where tasks were performed or data entered into the computer systems. The reason for making a draft before involving people from the department was that we did not want to waste their time asking for what have already been explained during the initial interviews, workshops, etc.

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[5] The Wall Graph technique is, as far as we know, developed by the Norwegian insurance company Norske Folk Livs- og Pen-

sjonsforsikring A/S (Norwegian People Life and Pension Assurance Inc.) in the mid seventies. It is used to some extent in both Norway and Sweden.

The PACS group, i.e. the management of the department as well as the super user of the PACS system, participated in *mapping the current* situation. We involved these people because we expected them to be familiar with the general utilization of the PACS system. We started out by presenting the concept of the Blueprint Map. After the presentation they went through the Blueprint Map, adding, changing, and deleting whatever needed correction.

Picture 3. The Blueprint Map.

As expected, the Blueprint Map proved to be easily created and modified because we used Post-Its and miniatures with re-adhesive glue. The process may be characterized as creative and interactive with us acting as catalysts.

What we experienced in this workshop was that the participants actively participated in developing the Blueprint Map. For the PACS group the process served as a review of status for the PACS project and the Blueprint Map became a new way of representing this information.

In *reviewing the current situation* a group of non-managers, representing the different professions within the department participated. The process served two purposes

- it enabled the members of the group to discuss their view of the current situation using the Blueprint Mapping,
- it served as a starting point for the next part of the workshops; the Organizational Game.

The first of these will be discussed in the following, while the second will be dealt with in the next section.

In the workshop we went through the Blueprint Map as it looked after the workshop with the local management. There was a good discussion and several corrections and adjustments were made which confirmed that the two groups of people had different views of the work.

When the meeting had lasted half an hour a chief radiologist arrived and it was remarkable what happened. She looked very quickly at the Blueprint Map and identified several tasks dedicated to secretaries, nurses or radiographers that are carried out by radiologists once in a while. Among other things, she pointed out that radiologists sometimes change the storage box in the server room, retrieve pictures taken previously and send pictures to a requesting ward.

Though the Blueprint Map was intended to represent the general way things are done at the department, it can be concluded that the map also triggers statements about variations and unexpected situations. This represents a unintended use of the Blueprint Mapping which could be further developed and reflected upon.

Organizational Game
The purpose of playing an organizational game was twofold

- to analyse the needs for flexibility in carrying out the daily work,
- to evaluate the usefulness or the benefits of using an organizational game in addressing the needs for flexibility.

The way we conducted an organizational game is based on the STAR Method.

The *STAR Method* (Ehn, Möllerud & Sjögren, 1990; Ehn & Sjögren, 1991; Sjögren, 1991) offers a structured way of working with and developing work organization and professional roles. At the same time it is a learning process for the people involved. The play metaphor is used explicitly and it is supported by the following six ideas or concepts:

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»The *playground* is a subjective and a negotiated interpretation of the work organization in question. The *professional roles* are represented by both individual professional ambitions and organizational requirements. The *situation cards* introduce prototypical examples of breakdown situations. *Commitments* are made by individual role players as actions related to a situation card. *Conditions* for these commitments are negotiated, and an action *plan* for negotiations with the surrounding organization is formulated.« (Ehn & Sjögren, 1991, pp. 254 - 255)

The situation cards make the play move. As described above, the cards represent a breakdown situation, and the play is used to discuss how to handle the situation: who is going to take responsibility and who is going to carry out which tasks. The conditions for these agreements are negotiated, and may include demands for educational activities as well as other job development initiatives. The playground represents the common understanding of the work in question and the role scripts are a representation of the work organization.

At the Radiology department we conducted a variation of the organizational game. The Blueprint Map served as the playground and our first activity was to introduce it to the participants and to have them review it according to their understanding. This has been described and discussed previously.

The participants in the game played their own roles and hence didn't need any role scripts. Since the purpose was not to implement changes at the department the participants did not make any commitments and no action plan was made.

What we essentially used was the idea of the situation cards. We met with the participants from the department a week before playing the organizational game and asked them to pay special attention towards situations where they didn't follow the normal procedure and then write down a situation card describing the situation. To illustrate the idea we had created some examples of situation cards in advance.

On the day of the Organizational Game, the situation cards triggered discussions about how particular situations are actually handled and how they could be dealt with alternatively. During these discussions we referred to the Blueprint Map to see how structural elements (cf. figure 1) limited the possibilities to handle the situation. In this way we got examples of unique situations representing diversities and variations from the normal procedure, exceptions or real breakdowns. Many of such situations occur during a day, so making a situation card of an episode means that the situation had some importance for the work carried out.

In the following we present the discussions associated with two specific situation cards. In the conclusion we summarize our use of the techniques by discussing the use of the Organizational Game to address the needs for flexibility and

the relation between the situation card and the Blueprint Map, i.e. the playground.

Situation Card no. 4.
    »After the conference with the intensive care ward (I-conference), the radiologist in charge reports on the pictures of each patient. Today, this dictation hasn't been finished before 12 o'clock. This creates two problems:
    1) the next conference (C-conference) is taking place in the same room at 12.15,
    2) the secretary can't start the preparation of the next days conference, because this includes preparing the computer conference in PACS.«[6]

The situation and the interpretation of the problem may be understood from different perspectives.

At the workshop, one of the radiologists suggests that the PACS conference[7] should be moved to the other console[8]. One possibility is to move it to the other conference room. But several of the participants immediately points out:

»The other room is too slow.«[9]

By this they mean that the server running the PACS software hasn't got enough capacity and there might be some kind of priority between different units. One of the nurses suggests a solution:

»They need twice as much software.«

Another possibility is to move the PACS conference to one of the description consoles[10], but one of the radiologists calls attention to a restriction:

»Only 80 pictures can be stored at a time.«

The secretary who prepares the C-conference rephrases the problem as seen from her perspective:

»If I remove the whole PACS conference I have to put it up again.«

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[6] The participant formulated the situation cards and the translation is ours.

[7] The PACS conference is the computer support for the physicians' conferences. It consists of a number of patients organized in sequence and a number of pictures associated with each patient. The system then offers some function to handle these pictures, among others leaf through the patient's pictures and go to the next or previous patient.

[8] A conference console is a special purpose workstation with four screens enabling the user to see more than one picture in a reasonable size at a time (see picture 2). Consoles are only available in the conference rooms. At the time of our investigations there were two conference rooms, but only one of these was in operation.

[9] Quotations are from tape recordings of the workshop.

[10] A description console is a special purpose workstation with two screens, which is mostly used to report on the pictures.

This problem exists because it isn't possible to have more than one computer conference at a time at the same conference console. This means you can't name a collection of pictures as a separate PACS conference.

For the secretaries, there is yet another problem, as they use the afternoon to prepare the I-conference for the next day, and

>As a secretary you want to get started preparing the next day conference.«

Finally, one of the radiologists raises the question of moving the hour of the conferences, but it turns out that the conferences also have to fit in with other activities at the wards, and

>They want the conference before the ward round.«

What the secretary and the radiologist actually decided to do, was to put together patients (pictures) belonging to both the C-conference and the I-conference into one PACS conference. After the conference the secretary had to delete the patients (and their pictures) belonging to the C-conference from the PACS conference and the radiologist was able to finish the report on the pictures from the I-conference. This shows how they in the situation adapted the work activities to the actual situation. But the situation should not occur, because the policy at the department is to make descriptions of the pictures as soon as they have taken the pictures, cf. the description of the general procedure in the organizational context section.

Viewing the situation as a matter of flexibility, the problem may be described as a matter of too many work activities tied up to the same equipment, the conference console (one of the structural elements in our framework, cf. figure 1), at the same physical location, the conference room (another of the structural elements) at the same time. This makes the system and the room too inflexible. The discussion at the workshop indicated different changes in the structural elements which alter the possibility to be more flexible when carrying out work activities in unexpected situations. Various changes were proposed.

1) Within the PACS system it might be feasible to have more than one PACS conference at a time, say a PACS I-conference and a PACS C-conference at the conference console at the same time.

2) There could be an opportunity to move a PACS conference from the conference console in the conference room to another console, e.g. the description console. This implies that the radiologist in charge of the I-conference wouldn't be tied up to the conference room but could do the reporting on the pictures elsewhere.

3) The department could use both of the conference rooms for conferences but this also requires additional capacity at the picture archive server.

4) It might be possible to prepare the PACS conferences at other places than the conferences room, e.g. at the description console, or the required equipment could be placed in the secretaries' office. After the preparation, the PACS conference as a whole could be transferred to the conference console in the conference room.

Suggestions like these would make it easier to handle situations where different people need to use the conference console or the conference room.

Situation Card no. 3.
>The patients booked for DSA examination are registered in two files. This creates problems when the booking is changed as secretary sometimes misses the referral when she follows the procedures.«

The following procedure is used when DSA examination are booked. The ward requesting the examinations gets a list of time slots to fill in. The ward returns the list together with a referral for each patient to the nurse who together with the radiologist reviews the referral and registers the examination in the nurse's registration book. Subsequently, the referrals with the times for the examination are handed over to the secretary, who additionally register the patients in the computerized booking system. In the afternoon, the secretary prepares the examination list for the next day and prints the schedule. This means that the patients booked for DSA examinations is registered in the nurse's registration book and in the computerized booking system.

The ward continuously assess the patients' situation with the intention to give priority to the patients who need examination and/or surgery most urgently. Therefore, physicians from the ward often want to change the schedule.

To the secretary (who makes the registration in the computerized booking system) the problem looks like this:

>If the ward wants to postpone the examination of a patient and put another one on the list, they often phone the nurse (because she participates in reviewing the referral, our comment). But I don't always get a message.«

>It also happens that the referral doesn't reach my desk, because it hasn't been forwarded by the nurse.«

>The problem is the existence of two registration files.«

If the referral doesn't reach the secretary's desk it means that the examination isn't registered in the computerized booking system and the examination will not appear on the printed schedule.

Carrying out the work activities the nurse and secretary try to overcome the problems, as one of the secretaries says:

»The nurse and I spend a lot of time talking together.«

One way of solving the problem could be to drop the registration file held by the nurse. To the radiologist in charge of the examinations the situation looks like this:

»I use the nurses' registration book to indicate when I'm not at the department, for instance if I have a day off or a meeting outside the hospital. There is no room for this kind of information in the computerized booking system. And then we use the book when the nurse and I make the review of the referrals.«

»During the day I may need an overview of the examinations. If I'm going to attend a meeting there will be a problem if I have to examine a patient, and I can't use the computerized system.«

Actually, there are not two but three registration files, as there is one at the ward as well. The participants discuss, whether the registration at the ward should be the only one. The radiologist in charge doesn't want to change the present situation, as the radiology department would otherwise loose control over the booking, and

»The secretary at the ward doesn't know who makes the examinations and who is on duty the actual day.«

With a solution like this, the radiologist still needs to use the booking system to get an overview.

Seen from a flexibility perspective the problems can be summarized in the following way. The ward needs a maximum of flexibility to change the scheduling of examinations, and give priority to the patients who need the examinations most urgently. At the same time, the radiology department has the professional knowledge to evaluate the examinations and ensure that the best use is made of the staff. Furthermore, the radiologist in charge uses the schedule to make priorities about her own time schedule. Finally, the existence of more than one registration file sometimes creates problems for both the secretary and the staff doing the examination.

On the basis of the analysis we proposed two different changes in the structural elements (cf. figure 1) in order to support the need for flexibility in carrying out the work activities.

The most radical solution would be to move the booking of examinations to the ward (a change in the structural element of both Space and Work Organization). This would make it possible for the ward to change the schedule. If this new way of organizing things is combined with an electronic mail system (a technical artifact, cf. figure 1), a message could be sent to the nurse at the radiology department, making it possible for her and the radiologist to review the referral. Doing this, re-scheduling of examinations would become more flexible as seen from the ward. But as one of the radiologists pointed out, having the schedule available to the wards would make it more inflexible - as seen from the radiology department - to change the workplan and to go to meetings with short notice, since this could affect the scheduling of examinations.

Another argument against moving the booking to the ward was related to the actual design of the current booking system. As one of the radiologists pointed out, it wasn't possible to indicate in the official computerized booking system, as opposed to the nurses' booking plan, that a certain type of examinations was not conducted on a certain day.

This last reflection is also the reason for having two different booking system at the department and the reason why the nurse doesn't make the registration in the official booking system, which was the other possibility we discussed. Having only one registration file causes changes in the structural element Technical Artifacts.

The analysis makes it clear that we can investigate the need for flexibility, but when the needs are uncovered, the required changes to support flexibility may be unacceptable for other reasons. And what may support the flexibility in carrying out the work activities in one place (the radiology department) may inhibit or limit the flexibility in another place (the ward).

CONCLUSION

The main idea in the part of the project reported in this paper was to examine whether flexibility issues could be addressed by using addapted participatory techniques.

Both workshops demonstrated the need to address flexibility issues. Paradoxically, what was described as general procedures in the first interviews turned out to be exceptions during the workshops. To allow for exceptions seems to be one of the general rules.

Though Blueprint Mapping was intended to represent the general way things are done at the department, the map also triggered statements about variations and unexpected situations. And, though the Organizational Game technique was not originally intended to deal with flexibility issues, the idea of starting out from cards describing specific situations proved to be very successful for this purpose.

Mogensen and Trigg (1992) have reported their experiences using artifacts as triggers for participatory analysis. In their analysis, the artifacts considered were a prototype of a computer based system and situation cards in an organizational game. Our experiences with the Organizational Game confirmed Mogensen's and Trigg's observations and in addition we observed that an artifact like the Blueprint Map support participatory analysis.

Our attempt to integrate or combine the two techniques by using the Blueprint Map as the playground was less successful. It turned out to be difficult to relate the discussion of a situation card to the map. Obviously this part needs to be more carefully thought out.

Through the analysis it became evident that focusing on the flexibility aspects of the work activities also puts focus on the fact that different groups of staff members may have different interests in how the work activities are carried out. It is a question of organizational politics. It depends on your attitude whether you believe that putting such questions forward brings the organization further or whether you think that such conflicting interests ought to be hidden.

The analysis demonstartes how the various structural elements set different conditions for the works activities, and we have attempted to show that changes in one or more of the structural elements may change the conditions for the work activities in a way that potentially affects the flexibility in carrying out the work tasks. Further, the analysis shows that using technique like Blueprint Mapping and Organizational Game may contribute to the understanding of the need for flexibility in the daily work. The analysis also points out that the unique is at least as interesting as the general.

The analysis we have reported is part of our initial research on flexibility. We have documented that the need for flexibility not only concerns the technology, but also other structural elements of the work activities. Further research in this area is needed; among other thing we suggest to look at theories and methods addressing the unique situations. Suchman's (1987) theoretical work in »Plans and Situated Actions« is an obvious candidate as well as is Blomberg's et.al.'s (1993) »Ethnographic Field Methods and Their Relation to Design«. Finally, we suggest to investigate and evaluate the potential of other participatory design techniques in relation to analysing flexibility.

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REFERENCES

Baskerville, R. & Wood-Harper, T. (1992): *A Critical Perspective on Action Research as a Method for Information Systems Reserach*. Salford, UK: Technical Report MCS-92-13, Deptartment of Mathematics and Computer Science, University of Salford.

Bjerknes, G., Ehn, P. & Kyng, M. (1987): *Computers and Democracy*. Aldershot, England: Gower Publishing.

Blomberg, J., Giacomi, J., Mosher, A. & Swenton-Wall, P. (1993): Ethnographic Field Methods and Their Relation to Design. In (Schuler & Namioka, 1993).

Booch, G. (1991): *Object Oriented Design with Applications*. Redwood City, CA: The Benjamin/Cummings Publishing Company.

De Marco, T. (1978): *Structured Analysis and System Specification*. New York, NY: Yourdon Inc.

Dilschmann, A., Ehn, P. & Sjögreen, D. (1985): Gränslandet (The Border District, in Swedish). Stockholm, Sweden: Swedish Center for Working Life.

Ehn, P. & Sjögren, D. (1986): Typographers and Carpenters as Designers. In: *Proceeding of Skill-based Automation*, Karlsruhe.

Ehn, P. (1988): *Work-oriented Design of Computer Artifacts*. Stockholm, Sweden: Swedish Center for Working Life.

Ehn, P. & Sjögren, D. (1991): From System Description to Scripts for Action. In (Greenbaum & Kyng, 1991).

Ehn, P., Mölleryd, B. & Sjögren, D. (1990): Playing in Reality. *Scandinavian Journal of Information Systems*, vol. 2, pp. 101-120.

Greenbaum, G. & Kyng, M. (eds) (1991): *Design at Work*. Hillsdale, New Jersey: Lawrence Erlbaum Ass.

Greenbaum, G & Madsen, K. (1993a): PD: A Personal Statement. *The Communications of the ACM*, vol. 36, no. 6, p. 47.

Greenbaum, G. & Madsen, K. (1993b): Small Changes: Starting a Participatory Design Process by giving Participants a Voice. In (Schuler & Namioka, 1993).

Greenbaum, J., Kjær, A. & Madsen, K.H. (1993): *Flexibility in Organizations: The dependencies between work activities, technical artifacts, space, and work organization*. Unpublished manuscript. Aarhus, Denmark: Information & Media Science Department, Aarhus University. A previous version appeared as: Toward Flexibility: The Coupling of Work Activities, Technical Artifacts, Space, and Work Organization. In Bjerknes, G., Bratteteig, T. & Kautz, K. (eds) (1992): *Proceedings of the 15th IRIS (Information systems Research seminar In Scandinavia)*, Larkollen, Norway, pp. 536-544.

Grønbæk, K. (1991): *Prototyping and Active User Involvement in Systems Development: Towards a Cooperative Prototyping Approach*. Ph.D. thesis. Aarhus, Denmark: Computer Science Department, Aarhus University.

Henderson, A & Kyng, M. (1991): There's no place like home: Continuing design in use. In (Greenbaum & Kyng, 1991).

Jungk, R. & Müllert, N. (1987): *Future workshops: How to create a desirable future*. London, UK: Institute of Social Invention.

Kensing, F. & Madsen, K.H. (1991): Generating Visions: Future Workshops and Metaphorical Design. In (Greenbaum & Kyng, 1991).

Kuhn, S., Muller, M. & Meskill, J. (eds) (1992): *Proceedings of the Participatory Design Conference*. Palo Alto CA: Computer Professionals for Social Responsibility.

Mackay, W. (1990): *Users and Customizable Software: A Co-Adaptive Phenomenon*. Ph.D. thesis. MIT Sloan School of Management.

Mogensen, P. & Trigg, R. (1992): Artifacts as triggers for participatory analysis. In (Kuhn, Muller & Meskill, 1992, pp. 55-71).

Nardi, B. & Millers, J. (1991): Twinkeling Lights and Nested Loops: Distributed Problem Solving and Spreads-

heet Development. *International Journal of Man-Machine Studies*, 34, pp. 161-184.

Norwegian Employers Association (1977): *Det gjelder våre RUTINER* (It is about our Routines, in Norwegian). Oslo, Norway: Norwegian Employers Association.

Schön, D.(1983): *The Reflective Practitioner*. New York, NY: Basic Books Inc.

Schuler, D. & Namioka, A. (eds) (1993): *Participatory Design: Principles and Practices*. Hillsdale, NJ: Lawrence Earlbaum Associates Publishers.

Sjögren, D. (1991): Arbete och förändring (Work and Change, in Swedish). Stockholm, Sweden: Statskontoret.

Suchman, L. (1987): *Plans and Situated Actions: The problem of human-machine communication*. Cambridge England: Cambridge University Press

Trigg, R. (1992): Participatory Design meets the MOP: Informing the design of tailorable computer systems. Unpublished manuscript. Previously appeared as: Participatory Design meets the MOP: Accountability in the design of tailorable computer systems. In Bjerknes, G., Bratteteig, T. & Kautz, K. (eds) (1992): *Proceedings of the 15th IRIS (Information systems Research seminar In Scandinavia)*, Larkollen, Norway, pp. 643-656.

Winograd, T. & Flores, F. (1986): *Understanding Computers and Cognition*. Norwood, NJ: Ablex Publishing Corporation.

Yourdon, E. (1982): *Managing the Systems Life Cycle*. New York, NY: yourdon press.