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Abstract

This paper identifies and analyses complex coordination processes at radiology departments in Austria[1], Denmark, and Sweden. The understanding of coordination work is emphasised by focusing on different interdependencies between work activities. It illustrates that various interdependencies have different properties, which in turn have derived different coordination dimensions. We refer to these dimensions as predefined and situated coordination. This paper points to the needs for designing coordination tools inscribed with properties that fit the properties of various kinds of coordination work. Finally, ways of integrating these tools are discussed.

Keywords: Coordination work, ethnographic studies, health care, artefacts, systems design.

1. Introduction

Coordination problems within health care are increasing (Strauss et al. 1985). It is a fact that the need to coordinate and exchange information faster, better, more accurately, and comprehensively within health care is becoming most evident. The improvement of radiological coordination is being conceived and implemented with the use of information technology in several hospitals. A recent inquiry illustrates that 60% of all radiology departments in Sweden are in the process of implementing picture archiving and communication systems (PACS) by year 2001 (Laurin 1998). This transition to PACS is one of the most drastic and significant changes in health care today. There is a general opinion of large promises relating to this new technology supporting communication and coordination work. Other researchers have stated that by its nature computer technology transcends cultural, territorial, practical, and political boundaries (Dahlbom and Janlert 1997).

Hospitals are large distributed organisations containing decentralised departments. The medical staff needs to coordinate activities, for example, allocating and scheduling actors, resources, and other activities (Strauss 1985). The coordination must be accomplished through people who are not generally in face-to-face contact with each other. These factors add tremendously to the difficulty in achieving smooth coordination. When one examination drops behind, all the pressures from the remaining patients descend upon this incident. Therefore, timing and coordination are key problems of the health care organisation.

Another factor that adds to the complexity in coordination work in health care is that large parts of medical work are often unpredictable, because there are so many unexpected contingencies and process complexities. For instance, a patient may develop side effects from the injected contrast medium prior to a computer tomography examination or the

1. This project was carried out by the Austrian Academy of Sciences' Institute of Technology Assessment in the scope of a project "Das digitale Krankenhaus" which was funded by the Austrian Ministry of Research and Transport and the Wiener Krankenanstaltenverbund (Peissl et al.. 1997, Wild et al. 1998).

patient may be seriously ill, but the cause of the desease may be hard to find out, thus making the work unpredictable. Furthermore, working with people adds a dimension of hazard to the coordination work, patients may become scared, frustrated and even angry at the way a treatment or examination is being carried out or depressed by the implications of the findings.

In hospitals, radiology departments are unique in two senses; firstly, by being a service department within the hospital and secondly by being extensive users of electronic medical technology. For instance, the radiological staff pulls switches on machines and programs computers, processes data, just as they prepare and position patients in, under or in front of examination technologies. The medical specialisation and technological innovation are simultaneous, parallel and interactive, creating an impetus to further technological innovation and specialisation (Strauss et al. 1985). We have chosen radiology departments for our ethnographic study because it is the place in hospitals where information technology is used mostly and intensively.

We found that the coordination work was in constant change between a more or less predefined or situated coordination, due to contingencies aligning with whatever the situation calls for. It is a complex relationship, where there was no absolute coordination. We also found that different coordination dimensions were derived from the various properties and features in interdependencies. We have seen that the different properties in computer technologies supporting coordination work must fit the properties of the various kinds of coordination work. We have found that computer systems supporting predefined coordination work call for more conventional process-oriented technology. These trajectories are predefined in the system, based on known contexts and circumstances, while computer support for situated coordination calls for new inter-personal mobile technologies, in which designers are encouraged to build coordination tools supporting situations where medical staff may need to improvise coordination work and communicate in real time. The challenge is not only to design the two technologies, but to find a way by which the two are smoothly integrated and aligned in work.

The aim of this paper is to analyse and illustrate *complex coordination processes* in radiological work. This is done by emphasising various interdependencies and their properties in work. We try to reveal the integral dimensions of coordination work from the point of view of those who use these technologies, fitting to the needs of users. And, as Suchman (1995) pointed out, the goal of making work visible for systems design is to develop more appropriate technologies from the point of view of those who will be using them. To make work visible is to represent work's contingent and embodied structure. Strauss et al. (1985) also pointed out that since the type of work may vary for different kinds of activities, the investigator needs to analyse the integral dimensions of work. Otherwise the analysis will fail to encompass much of the actual complexity of work that occurs in the realm of the activity under investigation.

We have contributed with the understanding of complex coordination work in large and heterogeneous organisations as health care. In this work we explored the concepts of the ad hoc *situated coordination* (SC) and the structured *predefined coordination* (PC) in order to understand and explain interdependencies between radiological work activities. We believe that we, as designers, need more differentiated set of concepts to grasp the different ways the different actors handle the different situations. With this paper, we have tried to start with one of them, namely with the differentiation between predefinition and situatedness, and we hope to contribute with more detailed concepts in the future.

We have found how the different properties in computer technologies supporting coordination work must fit the properties of the various kinds of coordination work. This means that there is a need for different kinds of coordination tools because the interdependencies in work have different features and properties. For instance, the sequential interdependence is process-oriented, re-iterative and predefined, calls for a technology that aligns and supports the triggering of and control over activities guided by organisational formal structures. While the reciprocal and sometimes simultaneous interdependence is unexpected, unique and unfolding, it calls for a technology supporting improvised coordination according to unfolding events and contingencies. It involves both actors' initiative and judgement which are guided by the actors' knowledge and skills. These issues are important to consider for practitioners in the design of coordination technologies.

After describing the related research, we will introduce our research approach. In the Section 4 we will present our theoretical framework surrounding coordination work by exploring the notion of predefined and situated coordination. The Section 5 contains detailed description of work activities in radiology departments among which we try to analyse interdependencies before we illustrate some examples of real time coordination work in the Section 6. Challenges for design of coordination technologies are discussed in the Section 7. Finally, we discuss the different notions of coordination introduced and the issues for designing information systems to support coordination work.

2. Related research

Coordination research within health care has been a central issue for CSCW researchers (Strauss et al. 1985, Symon et al. 1996, Bardram 1997, Lundberg and Tellioglu 1997). In their studies of health care (1985), Strauss et al. focused on the interdependence between activities in work practices, with particular focus on humans' social interaction from a patient perspective. The study highlights various kinds of work that are otherwise invisible, for instance, comfort work, safety work, sentimental work, articulated work, etc. It contributes with essential and rich illustrations of social aspects of how things happen in the workplace.

The conceptualisation of "illness trajectory" in medical work (Strauss et al. 1985) refers to the organisation of work around the patient mainly passing from admission to discharge from the hospital. Symon et al. transferred this concept to the term "procedural trajectory" (1996, p.6). They analysed work practices in a hospital context in order to ascertain how coordination occurs in the relative absence of technology. They defined two different work activities, which are described as formal procedures and informal practices. The informal practices are those activities and interactions which, while not explicitly stated or prescribed by managers, are traditionally accepted as enabling the work and as being culturally appropriate. "Around the formal procedures, coordination is achieved through experience, personal relationships and shared contextual knowledge" (p.28). In their case study, Symon et al. showed that the relationship between formal and informal is more complex than it first appeared. Formal procedures are defined as the correct way to conduct work. However, they are associated with a number of well-known problems, including their inability to cope with the dynamics of an ever-changing situation and to account for social and political aspects of that situation.

Our approach differs from Symon et al.'s on a number of aspects. Firstly, we analyse radiology departments in the presence of small and large-scale PACS implementations. Secondly, Symon et al. focus on what Carstensen (1996) defined as work activities around the patient as they undergo a particular medical procedure. We instead focus on the work conducted to coordinate the formal procedures and informal practices.

In the scope of ethnographic studies, Kjaer and Madsen tried to understand the role of computer applications in organisational settings (1995a, 1995b). They proposed a conceptual framework that focused on four different aspects of organisations - work activities, technical artefacts, space, and work organisation. They investigated the dependencies between these elements and tried to understand how the flexibility of one element can either trigger or constitute a barrier for change in another element (1995a, p.24). Our framework is also based on work activities. But we focus more on the concept of interdependencies between work activities and we see the place where work is organised in and through the coordination work.

Based on experiences in systems design in hospitals, Bardram explored the term situated planning (1997). In his paper he discussed how plans themselves are made out of situated action and in return are realised in situ. He mainly focused on workflow systems with an activity theory approach. Workflow systems contain mechanisms giving order to work such as pre-hoc representations of medical work like plans, checklists, schedules, protocols, work programmes, etc. Exception handling and questions on how to deal with unforeseen situations have always been an issue in workflow management technologies. Bardram argues that "breakdown situations are not exceptions from work activities but are a natural and very important part of any activity which forms the basis for learning and thus for developing and enhancing plans for future action" (p.27). In his empirical study he illustrates "the important role, which planning plays within hospital work and how a computer system was designed to support planning without emphasising rigid matches between plans as representations of work itself" (p.19).

Various kinds of coordination work have also been well described within organisational theory. For instance, Thompson described three kinds of coordination work as standardised, involving the establishment of routine and rules (1967). In our research we call this *predefined coordination* because the term standardised gathers a connotation of a fixed and absolute standardisation that cannot, regardless of anything, shift to another coordinated way within a given organisational structure. The second kind of coordination work is coordination by plan, involving the establishment of schedules that allows a greater extent of dynamic work. Finally, coordination by mutual adjustment involves the transmission of new information during the process of action.

In our research these two last kinds of coordination are conceptualised as *situated coordination*. The term 'plan' gathers the connotation of established plans, which is too restricting for our purpose, just as mutual adjustment gathers a connotation which unduly requires face-to-face communication. Situated coordination may involve communication across individuals, but it cannot be assumed that it necessarily does. Thompson's work is also different from ours by means of having an organisational perspective when defining coordination work. While we have a design perspective, aiming to understand work practice in order to inform systems designers.

To analyse work practices and design appropriate systems, the understanding of Malone and Crowstone's (1990) interdependencies as well as of situated and predefined coordination are essential. There are distinct parallels between the different kinds of interdependencies (prerequisite, sharing of resources, simultaneously and reciprocal[1] interdependencies) and situated and predefined coordination. With prerequisite interdependence and sharing of resources the predefined coordination is called for. Simultaneously and reciprocal interdependence is managed by the situated coordination work. These parallels will be further illustrated in the Section 6.

3. Research approach

To analyse coordination patterns in work activities, e.g. in hospitals' radiology departments, we first have to study work practices. In this paper we try to emphasise interdependencies between different work activities. Our *ethnographic studies* give rich descriptions of work activities in hospitals with different computer use. We carried out our studies in Austria, Denmark, and Sweden. The studies offer material for further analysis of coordination issues depending on existing cultural, social, and technological circumstances. The interviews can primarily be characterised as open-ended qualitative interviews. Thirty interviews (lasting 1-2 hours) were conducted at the respective sites. We observed approximately 80 hours of

1.Within organisational theory has Thompson (1967) identified reciprocal interdependencies. It refers to the mutuality, where the outputs of each become inputs for the others.

radiological work. Additionally 43 hours of video documentation was recorded in Sweden. We conducted interviews while showing video documentation, which made it easier for the radiologists to describe and talk about their work practices. This also facilitated our own understanding of their work practices. We have, furthermore, spent about 120 person-hours observing the design process of PACS as well as documentation of PACS and RIS (radiology information system). The interviews, observations, video-based work practice analysis, the integration of discussions and interviews, observations of diagnostic practice and social interactions were conducted over a period of approximately 4 months, and were followed up by several meetings, mainly with the IT-project managers.

A *paperless* department is defined in this paper as one where all examination requests and radiological reports are digital using a RIS, while the definition of a *filmless* department is one where all images are digital using PACS. The definition of off-line images are 6 months or older images that are stored on portable optical discs, which are not permanently assembled on jukeboxes that allow access to images. Images stored on these optical discs must be requested via the personnel in the (central) archive, which then put the correct optical disc into the jukebox to enable access.

The field studies reported in this paper were conducted at three radiology departments in three different countries:

- *Lorenz Böhler Emergency Hospital, Austria.* This is an emergency hospital with 62,000 radiology examinations per year. On average, 290 patients are examined and treated per day. The electronic data processing department of the hospital developed a system, called ASTRA. It is the only computer system used in the whole hospital. The Lorenz Böhler Emergency Hospital is completely paperless and filmless.
- *Skejby University Hospital, Denmark*. The Skejby University Hospital is a growing hospital with 509 beds. Approximately 34,000 radiographic examinations are carried out annually. In Skejby University Hospital, a PACS was introduced in 1992 for the handling of images. The department is a paper-based department, using paper documents for all examination requests and radiological reports, and almost filmless.
- *Sahlgrenska University Hospital, Sweden.* In the Thoracic section, Radiology Department at Sahlgrenska University Hospital, Sweden, a total of about 45,000 examinations are carried out annually in the thoracic section. The radiology department is a filmless and paper-based department, using paper documents for coordination work, and communicating examination requests and radiological reports with clinical units.

4. Coordination work

We define coordination as the act of managing interdependencies within and between activities, according to achieve a goal (Malone and Crowstone 1990, Schmidt 1993). There are three different types of *interdependencies* in work processes (Malone and Crowstone 1990, p.362). The first is *prerequisite*. Information is moved from one activity to the next, new information is not necessarily added, the static information functions as a trigger for carrying out different work activities. This interdependence exists in radiological work if for instance the booking of an examination has been done by the administrative staff in the clinical units. The administrative staff at the radiology department will thereafter place the examination in a shelf reserved for a particular examination and day, without adding any new information. The glance at the shelf will trigger the radiographer to fetch the request and read the document.

Another kind of interdependence is described as the sequential *sharing of resources* (ibid.). Here the resources are dynamic. One actor adds information to the shared resource that is needed by the next actor to take action. This interdependence occurs in all radiological examinations. For instance, a radiologist adds information to the medical request that is both supervising and required by the next actor, or a nurse adds essential information about patient's health condition to the examination request that is needed by other medical staff. The *simultaneous* interdependence is the last kind of interdependence described. It is addressed to the situations where activities need to be performed in a synchronised manner. This occurs in radiology departments in cases of some kinds of examinations, which in fact are the major part of the patient treatment such as angiography, urology, or ultra sound. The image production and handling are usually coupled with other activities like diagnosing and reporting, or discussing the treatment options with the associated clinicians. In these examinations, all activities mentioned have to be carried out simultaneously.

The interdependence between activities is derived where the outcome of one activity is necessary to the next activity, and where information is simultaneously needed by multiple actors working at distributed environments. Hence, interdependence arises when work is divided (Galbraith 1977). For instance, the radiologist can not diagnose X-ray images if the radiographers have not produced them. Before the radiologist has conveyed a diagnosis several other departments are linked to the patient. His illness may simultaneously need the X-ray images for further treatment.

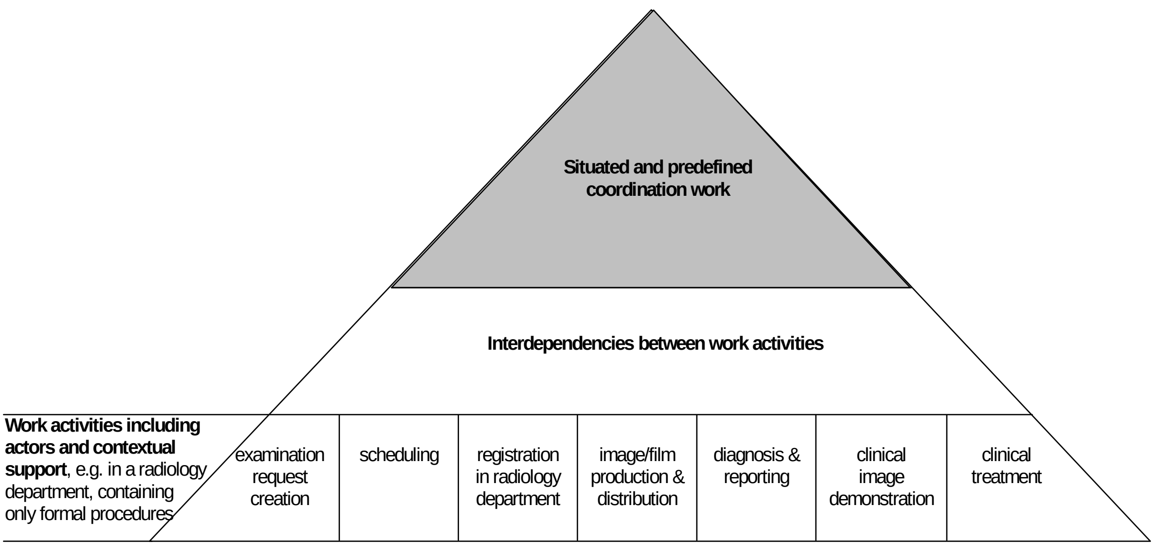
There is a difference between coordinated work that is a description of the work, and coordination work that is the process of practising coordination, or in Carstensen's terms (1996), the work conducted to coordinate work activities carried out by workers. We think that work activities are a series of tasks that, one way or the other, belong together within an activity. Coordination work is sometimes very hard to distinguish from work activities, especially in health care, where several activities have been translated and merged after the introduction of computer support. Activities were prior to this translation performed by many different communities. The obvious coordination work had to carry out the medical practice. After the merge, activities are carried out by mainly one individual within one particular community. Hence, the distinction between coordination work and work activities is not as obvious as before, even if it is just as essential for the work practice. In this paper, regardless whether one or several communities perform activities, we will refer to *coordination work as the work carried out to manage the interdependencies between activities*.

Strauss et al. introduced the concept of unexpected contingencies in health care as an important phenomenon (1985). Health care happens in a work environment with activities of high complexity. The sequence of activities and how coordination is carried out can vary from time to time and from person to person. When contingencies occur in the way work activities are carried out, the various artefacts need to be re-coordinated. There is often a need for coordination towards a goal, depending upon its contingencies. Several computer systems and common artefacts used may be coordinated in an ad-hoc and improvised manner. In these situations, we call the response to the set of unexpected contingencies arising in work practices *situated coordination* (SC). SC contains the unfolding usage of artefacts exposed to unanticipated changes articulating the situated activities. It accommodates a wide variety of activities and behaviours that are not predefined, but must instead be viewed as a unique and unfolding in each case.

On the other hand, there is always an order of work activities over time, especially in health care. Common resources have to be aligned, actors' routine work has to be coordinated according to a predefined "procedural trajectory". To achieve this *predefined coordination* (PC) is necessary. PC is a process-oriented trajectory, which creates a model of work containing a sequence of work steps. Different settings within the PC may be routed in different predefined trajectories depending upon the circumstances, which have been described in advance. PC supports the non-disruptive way of giving a chronological overview of actors' activities if it is computer-supported. PC does not allow actors to "design work practices for themselves or others or whatever" (Bowers et al. 1995, p.51). For instance, in hospitals doctors have predefined the coordination of routine patient treatment, and the medical staff coordinates according to those definitions. In this coordination work the staff uses coordinating artefacts, for instance written documents as an accumulated representation of their actions that support the coordination of medical staff's activities.

The main goal in a service-oriented work setting, like health care, is to establish both stability and flexibility in on-going work simultaneously. "Flexibility concerns not the regular procedures and standard ways of doing things, but the unexpected, unprecedented, exceptional cases, situations and events that are only experienced by the people who do the day-to-day work" (Kjaer and Madsen 1995b, p.54). It is important that the on-going work processes are carried out continuously, and unexpected situations can be handled easily if they occur. To achieve this, predefined and situated coordination work must be interrelated to each other and coexisting within the same work setting.

Figure 1: Situated and predefined coordination is defined on top of interdependencies of different kinds (prerequisite, sharing of resources, simultaneous) and activities carried out in a work environment.



For instance in radiology departments, the computer systems supporting coordination work are very complex information systems, we want to illustrate in the remainder of this paper. There is a socially shared border between coordination work requiring contextual decisions and coordination work that may be managed by predefined standardised guidelines. This border may be identified through the analysis of unexpected contingencies. Designers, nonetheless, have to draw lines[1]. We could just imagine what coordination work would be like if the designer lacks an understanding of unexpected contingencies that influence coordination work strongly. There is a need to explore how information systems may be designed to support complex coordination processes managing interdependencies in continuously changing organisations.

5. Work activities in radiology departments

This section contains a detailed description of work activities among which we try to analyse interdependencies in radiographic health care before we illustrate some examples of real time coordination work in the Section 6. First, we briefly describe the computer technology used to which we will refer in the presentation of work practices.

1.The conflict between standardisation and flexibility is further discussed by Hanseth (1996) and Bowker and Star (1994).

PACS supports the electronic storage, retrieval, distribution, communication, display, and processing of image data. In combination with HIS (hospital information system) and RIS (radiology information system) it allows the management of work associated with radiological examinations in a networked hospital. RIS, which is mainly used for administrative purposes, includes functions for communicating and managing patient data and examination requests sent from HIS, managing patient registration, scheduling radiological examinations, creating reports used for accounting, and producing radiological reports. The different functions of PACS can be placed into four categories (Greinacher 1994, p.22f):

- *Administration functions.* These include the users' login procedures and managing access rights, creating work folders, queuing functions for database access, creating hard copies of images, communicating with other nodes in the network, and creating work lists to manage various activities.
- *Display functions*. After having retrieved images from the archive (mostly on optical discs in jukeboxes) and the patient folders, users can change the configuration of the image display on their local screens without changing the original image saved on the (central) archive. They can manipulate images' grey scale, size, and orientation (rotate or invert the images), etc.
- *Image measurement functions*. These enable users to measure the length between image points, and to measure angles and areas on the image. Through these functions, pixel statistics and definition of specific areas that must be highlighted for observation are possible. Subtraction, addition, and density measurement can also be performed.
- *Three-dimensional reconstruction*. These are very useful for displaying images in stacks by scrolling between them. These three-dimensional effects are mostly used in displaying computer tomography images.

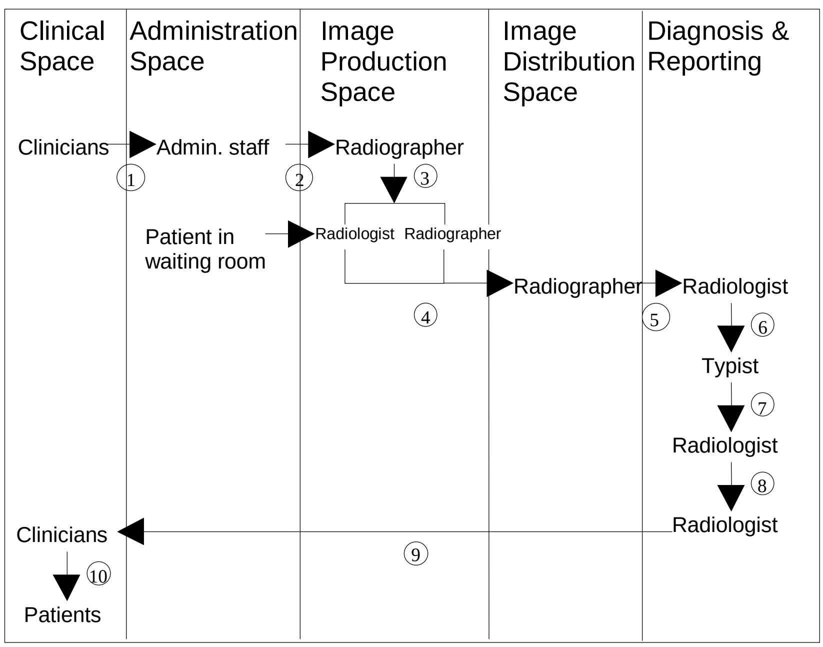
A hospital can introduce PACS in different scales. The first scale PACS consists of a conventional image production module with a digital archive unit without any network. PACS of a second scale, includes a local network connecting image production modules, the archive, the hard copy machine, diagnosis and reporting workstations. Large scale PACS is built around a network connecting many departments in the hospital. The integrated interface to RIS and HIS are available and used on a daily base. The Thoracic Section at Sahlgrenska University Children's Hospital has a second scale PACS. There is no integrated interface between RIS and HIS. However, RIS and PACS are integrated with the network technology supporting other departments. The interface has primarily been implemented by gateways, e.g. plug-ins to the Intranet. Gateways allow the information flow between systems of different technical solutions (Hanseth and Monteiro 1996). Lorenz Böhler Emergency Hospital has a large scale PACS which is the only computer system used for all activities carried out within the whole hospital. In Skejby University Hospital, PACS installed is a large scale one whereas there is no integration between the PACS and HIS.

PACS is not only an archiving, but communication and coordination system as well. Its main function is to create a shared electronic space where radiology images (connected to patients' demographic data) can be stored. Embedded in a network environment, PACS facilitates the sharing of the image data across organisational and professional boundaries. Images can be archived and organised in central units, and accessed and used cooperatively by locally distributed actors.

The *actors* involved in radiology are from varying disciplines and occupations: clinicians, who initiate the radiological examination and treat the patients; administrative staff, who serve as the link between the radiology department and the outside world; radiographers, who are specialists in image production and support the radiologists; radiologists, who are the 'real' specialists in radiology departments; typists, who transcribe the radiologists' reports; and computer technicians, who support all the other actors with regard to computer systems.

Radiological work consists of a high degree of interrelated routine and non-routine work. In case of non-routine work the ad-hoc conversations are an important component. At several occasions, clinicians call and visit radiologists, with request form at hand to get answers to questions they have about their patients. Such ad-hoc meetings are needed whenever there are emergency cases or severe complications in the progress of patient's illness. In the majority of cases, radiologists retrieve images on PACS. In addition, radiologists may need additional film images from the archive. In acute non-routine cases, radiological staff usually receives a preparatory phone call from the emergency department or another hospital ward prior to the patient's arrival at the department. Sometimes for these instances medical staff needs to split up into small heterogeneous collaborative units, or sometimes to form more or less extensive ones. These contemporary units may need to develop rapid complex strategies. They have to make a number of innovations, which in turn provoke unexpected rearrangements of the context and content of work activities. The heterogeneous collaborative units are usually dissolved when patients have been diagnosed and their treatment has been initiated.

Figure 2: Different activities in radiological work. The enumeration refers to the activities carried out.



In the radiological setting various activities need to be coordinated (Figure 2):

(1) *Examination request creation.* For a radiological examination, patients are usually sent from clinical wards, outpatient departments or primary care units to the radiology department. An examination request must be created either electronically on HIS or manually by a paper-based system. It includes data such as the patient name, date, the name of the clinician requesting the examination, the type of examination required (e.g. computed tomography, magnetic resonance, angiography, chest examination, ultrasound, mammography, etc.), and the clinicians preliminary diagnosis.

(2) *Scheduling.* After the examination request is received in the radiology department, it is categorised as acute or elective and then prioritised in time accordingly. A room and in complex cases also a radiologist are assigned to each examination. The receptionists use RIS to check whether the patients have been examined at the department previously. The demographic patient data, e.g. name, address, date of birth and telephone number, etc.,

are retrieved. If there are any prior examinations that seem relevant for the current exam, images from these examinations are required from the archive.

Registration in the radiology department and waiting. When the patient has arrived in the radiology department, he/she must be registered for the requested examination by using RIS. After the registration the patient waits in the waiting room until he/she is called for the examination.

(3) (4) (5) *Image/film production and distribution.* By using image production machines, radiographers - in the case of magnetic resonance, angiography, ultrasound, etc. in collaboration with radiologists - prepare the patient, the equipment (by means of RIS) and the room for the examination (3). They create the images/films, by using image production equipment (4), and carry out the preprocessing of the images, e.g. optimising their size, formatting, and checking their quality, before the patient leaves. Images are archived on the central server. If films are needed they are printed on a laser printer. Afterwards, radiographers must combine images/films with corresponding patient data before they distribute them to radiologists and/or clinicians via PACS (5).

(6) (7) (8) (9) *Diagnosis and reporting.* In case of partly filmless and paper-based radiology departments previous film (i.e. non-digital) images, in case there are any, must be placed onto a common place, e.g. in a trolley, in the diagnostic area, before the examination starts. The barcode on the paper-based examination request must be scanned to get an overview of the patient's previous radiological examinations. In case of filmless departments, relevant previous images must be retrieved from the (central) archive and uploaded onto the PACS-workstation for the diagnosis. Retrieving images (prefetching) can be done either automatically by appropriate algorithms implemented in the computer applications or manually by radiologists or administrative staff. If off-line images are needed, a request must be sent to the personnel in the (central) archive to put the correct optical disc into the jukebox. The latest report of the patient if there is one (in RIS) must also be retrieved. Radiologists read and compare the images to complete the diagnosis.

After image analysis and diagnosis (6), radiologists dictate the report onto a tape recorder, which is later typed and transcribed by administrative staff into RIS (7). Radiologists' reports, when short, are entered into RIS directly by radiologists. The written report must be checked by its creator or another radiologist and signed in RIS (8). It can then be sent to the referring clinician to HIS (9).

(10) *Clinical image demonstration.* The majority of images and radiological reports are discussed in the daily interdisciplinary meetings between clinicians and radiologists by using PACS. Images are presented, cases are briefly described, radiologists explain their diagnosis, and clinicians discuss further diagnosis and the treatment of the patient.

(11) *Clinical treatment.* In normal cases, each radiological report is distributed to clinical wards and outpatient departments by 'transporters' or via RIS respectively. Clinicians read radiological reports and write a summary of the radiological report into the medical record. The radiographic examinations and reports make a significant contribution to the correct diagnosis and treatment of patients. After regular meetings with radiologists, images are instituted by clinicians.

Besides demonstrating the interdependencies between work activities, Figure 2 shows actors' involvement for different activities in radiological work. It is a formalised representation of the prerequisite interdependence and the sharing of resources at radiology departments. The locations at which the different activities are carried out often indicate the relationship between the activities (Tellioglu and Wagner, submitted). Clinicians work mainly on the wards and in outpatient departments. For regular meetings or in case of emergencies or particular problems they may visit the radiology department. The workspace of the administrative staff is mainly the registration or back office. Typists, who usually belong to the administrative staff, interact with radiologists in their "territory" - in the diagnosis and reporting room. Image production and distribution are the main areas of the radiographers' work. Radiologists mostly work in the diagnosis room and enter the image production area when they collaborate with radiographers. They consider the whole radiology department as their terrain as they have overall responsibility for all radiological services. Computer technicians work throughout the radiology department depending on where problems occur.

According to Malone and Crowstone (1990) the interdependence between activities can be analysed in terms of common objects that are involved in some way in several actions. In our cases one or several common objects have been translated to allow more ready access to some patient information. For instance, X-ray films have been translated into X-ray images, and written documents have been translated to electronic documents. In work practices we found common objects as a shareable representation of work which can take many forms and serve multiple purposes (Robinson 1993). Therefore a common object such as an examination request, an examination schedule, a "to-do" or patient list categorised by the examination type needs to be accessed by many different actors in multiple contexts and under different circumstances. A radiological report may also show the work done in radiology departments by offering an overview of the sequence of work activities. These representations support the implicit communication of suggestions for the diagnosis, which can take the form of a textual remark, a sign on the image, or an annotation to communicated documents.

6. Real time coordination work in radiology departments

The following examples illustrate how coordination is managed in particular activities and in the overall work flow.

6.1 Coordination work surrounding radiological work at the Sahlgrenska University Hospital (SU)

At SU an examination request is created on HIS and printed on paper. It includes patients' demographic data, the name of the clinician requesting the examination, the type of the examination required, the patients' symptoms and the clinicians' preliminary diagnosis. When the examination request is received in the radiology department, it is scanned into the RIS system. This enables the radiological staff to access all medical data of the patient via the RIS and PACS. The request form is thereafter put into a shelf. If there are any prior examinations that seem relevant, images are requested from the film archive. The films are transported in trolleys from the file room to the radiology department. In practice, unfortunately, some clinicians or radiologists may keep some films after patient diagnosis, instead of bringing them back to the archive, which causes interruption in the routine work.

The day before the examination is taking place the examination request is placed in a trolley (see Figure 3). The trolley is organised according to examination types and time schedules. A glance into the trolley gives an overview of the day's schedule and workload.

Figure 3: Trolley organising the examinations during a day and shelves with documents showing the workload and enabling the distribution of work between actors.

When the patient arrives in the radiology department, she is registered for the examination. The patient then waits in the waiting room. The radiographer fetches the examination request from the trolley, prepares the patient for the examination and creates the images. She views and selects the PACS images, adjusts the density level to produce the optimum image, performs any reorientation and annotation which is necessary, and then verifies the examination. When images have been verified, PACS automatically transfers them to a folder, containing the 1,500 most recent radiological examinations. Thereafter, she places the paper examination request on a table visible to the administrative staff. When an administrative employee sees the document, he/she distributes it manually to the shelves in the diagnostic area, visible to radiologists (Figure 3).

Radiologists can see how big the piles of requests in the shelves are while reading PACS images from a workstation in the image interpretation area. When it has reached a certain size - which depends of the degree of urgency of other tasks - radiologists fetch piles from the shelf and sit in front of one of the PACS workstations to carry out the diagnosis. All workstations are provided with infrared barcode readers. Radiologists fetch patient data onto workstations by "swiping through" a barcode-encoded ID sticker attached to the paper request. When all barcodes have been swiped through, a 'work-list' has been generated. After selecting a patient in the work-list with paper at hand, radiologists read and compare images on screens and light boards to complete the diagnosis. Radiologists' reports, when short, are entered directly into the RIS by radiologists themselves. They print the reports on a laser printer and put them into a plastic folder together with the paper request and place them on shelves accordingly.

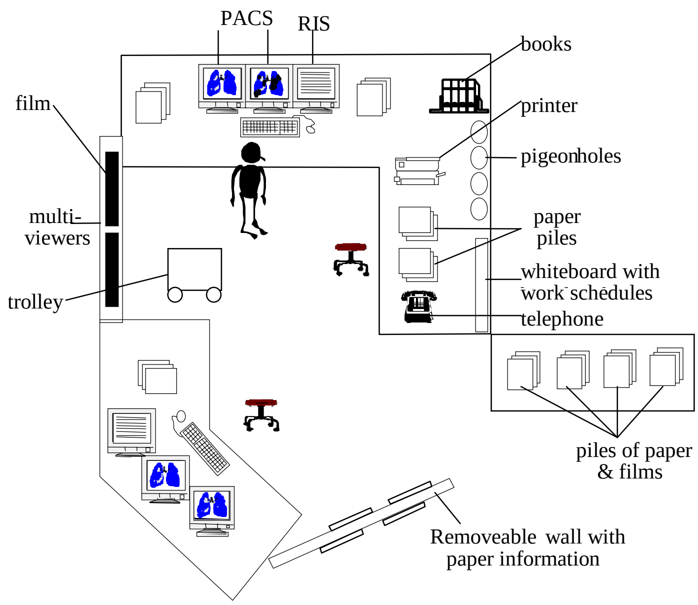
In case of a long report, radiologists dictate their reports on tape and place it together with the paper request on a table. When a typist sees them, he/she transcribes the reports on RIS, prints them on paper and places them on the radiologists' shelves to be signed off. Radiologists complete the report-checking activity by placing the written report on a shelf labelled with "out" to the medical department. Radiographic reports are picked up by transporters in the out-shelves and brought to the referring departments.

This case illustrates the predefined coordination work of several work activities such as scheduling, patient registration, X-ray image production and distribution. The sequential sharing of the written examination request is managed by its placement on a table in the reception of the radiology department, its distribution to a shelf in the hallway outside the image production room, its distribution to another table in the diagnostic area, etc. The sequence of work steps is very clear to all actors involved. Each actor is dependent on the information produced by the actor in the subsequent activity. The case shows that wherever the written document is placed in specific locations, it represents signals, which trigger action. The written documents' appearance also provides a good overview of the work progress.

6.2 Coordination work during a chest diagnosis at the Sahlgrenska University Hospital

This case illustrates the radiologists' work in diagnosing a chest examination.

Figure 4: Graphical illustration of the setting.



The radiologist is working in the diagnostic area (Figure 4). Diagnosis of a chest examination has been requested by a clinician of a patient selected by the radiologist in the work-list.

Figure 5: A radiologist reading PACS images.

The radiologist zooms and uses the tools provided by PACS to magnify and change the contrast of images. The manipulation of images allows a range of densities to be seen in the image, just as it allows the instant measurement of various findings. Images are compared through the shift between images showing different views of the patient's chest (Figure 5). He looks again at the electronic request and realises that there are some old X-ray films from an earlier examination. He leans over the trolley behind him and looks for the films, but the required films are not there. He stops one of the administrative staff who is walking down the hallway and asks her about the films, but she cannot assist him in this matter. He picks up the phone, which is located on a table behind him, and calls the (film) archive to ask them to send up the appropriate films. He requests a secretary to bring the films from the film archive. He places the chest examination request in a pile called 'wait', awaiting the old films. Fetching and positioning old films from the archive may take anything from 15 minutes to half a day depending on the urgency of the case. The film images that need to be compared may be anything between 2 and 150 images, positioned on one or several light boards.

Meanwhile, the first patient is placed in the 'wait' pile, a surgeon is visiting the radiology department unexpectedly. He needs to discuss a patient of his with the radiologist. The radiologist retrieves the PACS images related to the surgeon's patient on one of the workstations. Suddenly, a transporter arrives with the missing films from the first patient (currently placed in the 'wait' pile). The radiologist asks the transporter to put the films on the table by the lightboard. He walks out into the hallway and asks an administrative staff to support him positioning the X-ray films just delivered from the archive. He returns to the surgeon and apologises for the interruption. The radiologist and surgeon continue their discussion of the treatment of the patient. They decide that no further radiological examinations should be made prior to patient surgery. In complex conditions like this, there is no straightforward way to treat patients. When discussion is completed the surgeon returns to his ward. The radiologist walks over to the 'wait' pile and fetches the first patient's examination request. All old films are now positioned on the lightboard, he reads and compares the images on screens and light boards to complete the patient's diagnosis. The radiological report is long, so the radiologist dictates the report on a tape recorder.

There is a phone call from the emergency department, informing the radiologist that an emergency patient is arriving shortly. The radiologist needs to rapidly compose a small heterogeneous collaborative unit. But who is working where, with what, he needs to improvise, make phone calls, get support from other staff to locate medical staff. The contemporary unit needs to develop rapid complex strategies, they have to make a number of innovations, which in turn provoke unexpected rearrangements of work context. The heterogeneous collaborative unit is dissolved when patients have been diagnosed and treated. Everything returns according to the examination schedule.

It is time for lunch, so he glances at the schedule on the board on the wall behind him to find out who is working where, and then joins one of his colleagues for lunch.

The radiologist had his own ad-hoc order of coordinating things, such as discussions with the clinician, searching for X-ray films, computer work with PACS and RIS, discussions with administrative staff, lightboard and diagnostic work. All these steps are at the same time documented in the artefacts implicitly. In case of uncertainties the radiologist could refer to these artefacts and to the very detailed data they include.

The situated coordination of several reciprocal interdependent activities within the diagnostic practice was illustrated in this case. The radiologist had to coordinate related activities, surrounding PACS and RIS, films, medical requests, discussions with the clinician as well as other medical staff, telephone calls, etc. in an order adaptable to contingencies to convey the diagnosis. This coordination is by its nature situated and relying on the individual coordination of the radiologist. It was not determined by formal a priori needs.

6.3 Coordination work during diagnosis in an emergency case at the Lorenz Böhler Emergency Hospital

After registration the patient is taken to the image production room where images are created and saved on the central ASTRA server. The patient, now in the diagnosis room, sits in front of the radiologist. The radiologist loads the new images onto the ASTRA workstation, which has two monitors. Further to his right there is another ASTRA station where an experienced secretary is preparing the reports. Each step is predefined: she retrieves the patient data, opens a new folder for the new report, and types the radiologist's full name and some other codes that identify the type of examination which indicates the costs. He can see and follow each move she makes by means of an additional third monitor located on the right-hand side of the workstation. He uses the mouse to zoom in on the image on one of the screens, and to change the contrast. The patient says he has brought his old films with him. The radiologist decides that he does not need to see the old images, as he knows what the diagnosis and treatment will be. He then starts to dictate the report, and she types it simultaneously. He follows the text on the screen and corrects the last sentence verbally. She changes the sentence literally on the screen. He tells the patient what he has to do next. She sends the report to the printer next to her. She then gives it to him who signs it and hands it to the patient. The patient leaves the room, with the whole procedure having taken only 4 minutes.

The coordinating steps during the diagnosis are predefined, through inscriptions in the computer applications (ASTRA), in order to manage the interdependence between work activities by sharing resources. Images are displayed on the screen by the radiologist. At the same time, ASTRA performs the necessary actions required for diagnosing step by step, such as retrieval of patient data, opening a new folder for the new report, showing old reports to the radiologist, etc., and waits until the required data are entered by the secretary accordingly. ASTRA displays a work trajectory, it helps keep things on track.

The cooperation between the radiologist and the secretary is driven by actions, which must be taken during the whole process. The work tasks are clear to both actors, and the process progresses very quickly which is strongly required in emergency hospitals. This example shows that the artefact, in this case the PACS system (ASTRA) but it can also be a written or digital document or a function of the computer program, indicates that the computer or predefined workflow system has control over the actors' work order. The predefined coordination guided by the organisational (formal) structures happens in a stable, robust, and inflexible milieu, where scripts/documents have a predefined trajectory, i.e. the work sequence is predefined.

6.4 Coordination work during an unexpected urology examination at the Skejby University Hospital

A nurse from an outpatient department calls a member of the administrative staff in the radiology department. A clinician needs a urology examination unexpectedly on the same day. Normally the waiting time for a urology examination is several weeks.

The administrative staff in the radiology department uses her computer to administer time schedules of all examinations carried out in the department. She accesses the time schedule of the urology examination rooms and enters some identification codes and the current date in order to search for an available time slot. The computer system (RIS) suggests the next available schedule on the screen. A urology examination takes about 45 minutes, which is calculated by the computer before the time slot is suggested. Sometimes, there are gaps in the system because a patient did not arrive. The administrative staff can modify the system and enter new patients in these time slots. An available time slot was found. She informs the nurse who is still holding the line, and she books the room for the examination.

The requesting outpatient department then sends her an official request form. A porter brings these forms to the radiology department three times every day. She makes a note and puts the date on it showing that the examination has already been booked. She puts the form onto a shelf, which doctors check regularly. She then prints out the list of all patients who are going to be examined on the same day. This list is accessible to all actors in the department.

The administrative staff had to handle the scheduling system RIS with the telephone call from the outpatient department, when a clinician wanted to book a urology examination unexpectedly. In this activity she had a structured and predefined way of conducting the activity in the RIS, entering the identification codes and current date. The system responded by suggesting the next available slots. She confirmed one available slot and thereafter booked a room for the examination. This example also illustrates a situated coordination by showing how the overall discussions and artefacts are coordinated to convey the booking of an unexpected examination.

7. Challenges for design

Translating the coordinated role of paper documents and other linked artefacts to computer systems is a challenge. Because, artefacts are not just individual objects, they are part of a shared infrastructure that all radiological work depends upon (Hanseth and Lundberg, submitted). Shelves, folders, trolleys, tables, and mailboxes are all designed to fit the examination request, just as the paper request is designed to fit coordination and communication needs in medical work (ibid.). To address problems of design, the links of artefacts in work practices need to be better understood - even if only to explain what life will be like without them (Lundberg and Sandahl, submitted). Translating paper-based examination requests to computer systems means that the coordinated role of the paper document must be overtaken by information systems. For a large network as implemented in health care, it will in practice become impossible to coordinate all agents to switch from one coordinated network to another at the same time (Hanseth and Lundberg, submitted). The large coordination network, linked to many other artefacts, cannot be changed instantly. It can only be changed in a process where smaller parts - sub-networks - are replaced by new ones. The networks need to be convergent and aligned. One way to align heterogeneous sub-networks is to introduce interfaces - gateways - between them (Hanseth and Monteiro 1996). If, for instance, gateways were designed between all hospital information systems, they could keep track of a unique patient identifier that could apply on all hospital services (Lundberg, submitted). If there would be no interfaces between the information systems used patients could have several identifications (IDs), according to a complicated trajectory related to the units where they had been registered, e.g. in the emergency, the radiology, the surgery clinics, or in an inpatient ward. To coordinate a patient trajectory supported by more than one local information system, which are linked via gateways, becomes very complicated.

Through this study we can identify two sub-networks to be changed. The first sub-network contains the interplay of the paper-based examination request with different artefacts, for instance, shelves, tables, trolleys etc. supporting *predefined* coordination work. Systems like ASTRA (used at the Lorenz Böhler Emergency Hospital) must be extended to provide more transparency and awareness of interdependencies within the predefined structure of the work. By means of a sophisticated display mode which is accessible from all work stations, it can be possible to inform the medical staff of the work status while they are moving within the radiology department. This can be implemented as a large screen virtually representing tables, shelves and the pile of requests in the reception, image production or image interpretation area in the radiology department. For instance, a radiologist can automatically be informed about the reception of an urgent request. A similar display mode can also be introduced at clinical departments, in order to represent e.g. the 'in-shelves' and the received radiographic reports inside them. In these cases, the display modes on large screens (both in radiology departments and clinical areas) can be considered as gateways.

The second sub-network is the net of resources supporting overview and awareness in the *situated* coordination, in which unexpected contingencies in work processes requires ad-hoc arrangements of contemporary groups and collaborative work. To support situated coordination, a small mobile computer device, like a palm pilot, can be introduced. These devices can be granted to radiologists and clinicians, in similarity to their personal callers. The applications available on these devices should support inter-personal awareness, in similarity to the Internet application ICQ ('I seek you'). Such a mobile system could give the medical staff information of who is available at work and more importantly, it could get messages across in real time. The system could use sounds or vibrations to notify medical staff when something is happening. The medical staff can send messages or files. This can be e.g. the medical history of a patient. Similar to ICQ, the system must also make it possible to be invisible to other users. This is important and necessary, because some medical work do not allow interruption.

As shown by several ethnographic case studies, informal practices are as important as formal procedures. For instance in radiographic health care this speeds things up (Symon et al. 1996, p.23). "It is likely that any computer-based system which forces participants to adhere to formal procedures and inhibits informal practices would ultimately disrupt the work activity" (p.25). We need technical infrastructures, which support both modes of working, enabling switching between working within the predefined procedural trajectories and practising informally dependent on the current situation.

We have in this paper seen an opportunity to illustrate how different interdependencies derive complex coordination processes. It is found that coordination work is in constant change between a more or less predefined or situated coordination, due to contingencies aligning with whatever the situation calls for. Designers are encouraged to build coordination tools supporting situations where medical staff may need to form ad-hoc collaborative units, just as they are encouraged to build systems that do not allow actors to design the coordination of work activities. The trajectories are instead predefined in the system.

The ethnographic studies within health care have enabled us to reflect upon the larger issues of the relationships between fieldwork findings and how different kinds of interdependencies can be supported by various computer supported coordination tools. There is a need for different kinds of coordination tools because interdependencies between different work activities have different properties. For instance, the interdependence involving the sequential sharing of resources is process-oriented, re-iterative and predefined, and calls for a technology that aligns and supports these features. This can be a technology supporting a particular structure in a stable, robust, and inflexible milieu. While the properties of the reciprocal and sometimes simultaneous interdependence are unexpected, unique and unfolding, they call for a technology supporting improvised coordination according to unfolding events and contingencies. In this work we have seen that computer systems supporting coordination work call for both new mobile technologies and more conventional process-oriented technologies. The challenge is not only to design these two types of technologies, but also to find a way in which the two are smoothly integrated and aligned in daily work.

8. Discussion

Coordination work has for a long time been a central issue within the information systems design. In spite of this there are few existing technologies supporting the coordination of work activities, at least within health care. We have asked ourselves what makes these systems so difficult to design? There are no simple and straightforward answer to this question. However, one of the aspects we regard as central is the lack of detailed understanding of complex coordination work in which we stress the understanding of:

- different interdependencies in work, deriving various kinds of coordination dimensions,
- how coordinated artefacts are linked to other artefacts used in work processes,
- resources invested, by means of knowledge and skills, in order to use coordinated artefacts,
- how spaces have been shaped according to the coordinated artefacts' properties and relations, and

- the way work practices have been shaped according to all artefacts and interdependencies.

We believe that such a detailed understanding makes it possible to generate design ideas to develop computer support for coordination work.

We have observed that many distributed, intertwined, and interdependent work activities need to be coordinated in order to make the schedules in time. Coordination was needed to handle the messy situation as well as the predefined process-oriented work. In practice, moving documents from one table to another, inscribing documents with medical information, making phone calls, using boards to support the scheduling of medical staff, etc. deal with different kinds of interdependence and support different types of essential and complementary coordination.

Coordination work involves both actors' initiative and judgement which are guided by actors' knowledge and skills, and artefacts that are controlling and triggering activities guided by organisational formal structures. As the paper-based artefacts are used traditionally for coordination of an increasing number of actors and activities, it becomes harder to replace these with new computer-based artefacts.

In our cases the coordination work surrounding the patient was carried out in a more or less predefined or situated way. We have seen that predefined coordination was derived from a sequential interdependence, the process-oriented coordination work containing scheduling, registration, image production, diagnosis, etc., while situated coordination was derived from a reciprocal and sometimes simultaneous interdependence, involving a large number of contingencies. This is also confirmed by Strauss et al. (1985) who argue that coordination is needed when the activity is exposed to a high degree of unexpected contingencies. In SC contingencies are not planned but well known that they can occur at any time; for instance, all emergency cases, the patient may become more seriously ill, new or other radiological examinations than those available may be required, a clinician may suddenly need a diagnosis of a severely ill patient, ad-hoc telephone calls must be answered, improvised medical support may be required, etc. This implies that in the SC it is the person who initiates and make decisions of unfolding coordination work. In the PC it is the artefact (written or digital document or a function of the computer program) which indicates that the (computer or predefined workflow) system exerts control over actors' work.

In the case at the Skejby University Hospital the unexpected urology examination needed by a clinician changes the handling of scheduling procedures at the radiology department. The scheduling task is usually the responsibility of the computer system used (RIS). But, in an exceptional situation the administration staff can change the order of work necessary to book an examination. The flexibility is given by the computer system. This means that a situated way to coordinate must coexist and complement work that does not follow the predefined path, in order to maintain stability.

We have seen that diagnostic coordination work at the Sahlgrenska University Hospital is supported by very general plans. These plans recommend how radiologists are to initiate and accomplish coordinating decisions dependent upon contingencies in events. Radiologists must accomplish considerable coordination work that is very time consuming, for instance, coordinating the ordering, positioning and reading of films/images with telephone calls, discussions, improvised teambuilding, etc. However, in the case of the Lorenz Böhler Emergency Hospital the former general plans have been translated into formalised procedures inscribed in the PACS system (ASTRA), e.g. the coordination work including predefined coordination has here been a priori inscribed in the computer system. This of course improves the efficiency of work.

Since most hospitals have been using information systems (e.g. HIS) for several years, there is a common problem in radiology departments to integrate these old systems with the new technologies like PACS or RIS. The integration problem has another dimension which is based on the interfaces between PACS and RIS, supporting more or less of PC and SC work. All these systems should be designed as complementary and supportive to end-users, since it is the integration of these systems that is the 'system' in on-going work practices. The PC is made of fully rationalised typologies, and the SC supports "heterogeneity and practicality of organizational life" (Suchman 1994, p.178). SC must be open to uncertainties, heterogeneities, and practical expediencies.

The shift in between different coordinated modes indicates that the contextual support of coordination work needs to be flexible, supporting whatever the coordinated situation calls for. According to Schmidt and Simone (1996) particular artefacts are introduced in order to manage the coordination in work. In the SU case the examination request has developed into an important common coordination object in two senses. First, written documents' material and visible presence on a shelf or on a table (according to their structured trajectory in a medical department) allows the linking of actions and events over different sites and times without personal interaction between actors. The paper acts as a token and the shelf on which the documents are placed represents the state of work (Lundberg and Sandahl, submitted). This does not only mean that particular coordination artefacts support coordination, but also, that some artefacts support coordination in itself. Secondly, the radiological request is formatted in ways that trace work, which enables various communities of practice to coordinate particular activities among themselves. This is done in such a way that one actor adds information to the radiological request that is both supervising and required by the next actor in order to take action. The coordinated role of the radiological request is what keeps the progress of work up in the radiology department. It is essential by means of 'keeping the work practice together'.

9. Concluding remarks

This paper analyses and illustrates how several issues such as moving of documents from one table to another, the accumulation of medical data in documents, phone calls, face-to-face discussions and the use of boards to support scheduling influences different kinds of interdependence in medical work. Furthermore, it shows how the properties of these interdependencies call for different dimensions of coordination work in hospitals. We have briefly referred to these dimensions as situated and predefined coordination. The SC focuses on what is specific and heterogeneous in coordination work. It is the improvised response to a set of unexpected contingencies arising in medical work practices. We have seen how the radiologist had to coordinate related activities, e.g. phone calls, face-to-face discussions with clinicians as well as other medical staff, reading of films and paper requests in an ad-hoc order to convey the diagnosis. The PC focuses on the standardised order and recording of work activities over time according to a predefined trajectory. It is guided by the organisational (formal) structures, in a stable, robust, and inflexible milieu, where scripts/documents and the work sequence have a predefined trajectory.

In our cases we have illustrated how a more predefined way of coordination work is required to shift to a more situated way of coordination work in order to manage various interdependencies in work. The ability to shift in between different modes of coordination work is important in work practices. Considering coordination work as a predefined process-oriented work is too restrictive if we wish to understand complex coordination processes. To address problems of systems design in changing organisations, the unexpected contingencies and their role in complex coordination processes need to be better understood as well. In this process we stress the detailed understanding of interdependencies and links in work and the ways work practices, spaces, knowledge and skills have been shaped accordingly.

We have found how the different properties in computer technologies supporting coordination work must fit the properties of the various kinds of coordination work. This means that there is a need for different kinds of coordination tools because the interdependencies in work have different features and properties. For instance, the sequential interdependence is process-oriented, re-iterative and predefined, calls for a technology that aligns and supports the triggering of and control over activities guided by organisational formal structures. While the reciprocal and sometimes simultaneous interdependence is unexpected, unique and unfolding, it calls for a technology supporting improvised coordination according to unfolding events and contingencies. It involves both actors' initiative and judgement which are guided by the actors' knowledge and skills. These issues are important to consider for practitioners in the design of coordination technologies. In addition, this paper illustrates how detailed work place studies generate ideas that inform designers.

We have contributed with the understanding of complex coordination work in large and heterogeneous organisations as health care. In this work we explored the concepts of situated and predefined coordination in order to understand and explain interdependencies between radiological work activities. We believe that we, as designers, need more differentiated set of concepts to grasp the different ways the different actors handle the different situations. This may be important in the design of computer support for coordination work in any organisation, not only in health care.

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