

*H. Gellersen et al. (eds.), ECSCW 2005: Proceedings of the Ninth European Conference on Computer-Supported Cooperative Work, 18-22 September 2005, Paris, France, 163–183.  
© 2005 Springer. Printed in the Netherlands.*

# The Duality of Articulation Work in Large Heterogeneous Settings – a Study in Health Care

Louise Færgemann, Teresa Schilder-Knudsen and Peter H. Carstensen  
IT-University of Copenhagen, Denmark  
*faergemann@itu.dk, teresa@itu.dk, carstensen@itu.dk*

**Abstract.** Based on an empirical study of articulation work in a health care setting this paper discusses core characteristics of articulation work in large settings. We argue that articulation work in large-scale settings is characterized by a dual nature, especially by a duality between articulation handled internally in a local work arrangement and articulation activities undertaken across boundaries of local work arrangements appears. We suggest that our understanding of articulation activities is related to a distinction between local and global work arrangements. We illustrate how cooperating actors involved in any given trajectory (e.g., a patient trajectory) have to articulate their activities in accordance with both a local and a global dimension. The distinction between local and global is important when aiming at understanding articulation work in large-scale heterogeneous settings. The differences and their consequences are discussed. The paper concludes in some reflections on the challenges implied by the local/global variations, both for the analysis of large heterogeneous work settings and for design of IT support.

## Introduction

A general trend in modern work settings seems to be that the work becomes more and more complex. Complex in the sense that it is characterized by complex problem solving and decision making activities, rule interpretation, cooperative work processes, etc. The demands for flexibility, faster production time, complex products, etc. are exploding.

The increasing complexity of the work activities, the situations to be dealt with, and the structures to be handled, often require involvement of many actors in the work processes. Since individuals have limited capabilities and capacities, the work arrangement required to conduct the work becomes cooperative. Cooperative work arrangements emerge in response to different requirements and may serve different generic functions such as augmentation of capacity, differentiation and combination of specialties and techniques, mutual critical assessment, and combination of perspectives (Schmidt, 1994).

When several actors having different competencies, perspectives, strategies, etc. are involved in a cooperative work arrangement, they become mutually interdependent in their work, i.e., “cooperative work occurs when multiple actors are required to do the work and therefore are mutually dependent in their work and must coordinate and integrate their individual activities to get the work done” (Schmidt, 1991). Mutual interdependence means not only sharing resources, but also that the involved actors mutually rely on the quality, feedback, etc. produced by the other actors, i.e., no matter how the division of labor is organized, the actors involved will be interdependent and need to interact with each other. In order to get the work done, they have to coordinate, schedule, integrate, etc. their individual activities. The actors have to articulate their work along the salient dimensions of who, what, where, when, how, etc. (Strauss, 1985).

When relatively few actors are involved, or the complexity of the work or its articulation is low, the actors may achieve the required articulation by means of modes of interaction and conventions from everyday social life such as talking, gesturing, monitoring the situation, etc. (Schmidt, 1994). Several studies indicate that actors in these situations are extremely good at handling the complexity of coordinating by means of ad-hoc modes of interaction (Harper et al., 1989, Heath et al., 1993). Problems will, however, often emerge in highly complex work when, for example, the cooperative work setting includes many geographically distributed actors; a large number of intertwined activities, actors, or resources; different areas of competence with different conceptualizations and goals; or when the work is carried out over a long time span.

The understanding and IT support of articulation work has been a recurring issue within CSCW research since Schmidt and Bannon (1992) suggested to make it a central theme. Articulation of the work in small scale settings and fairly delimited organizational settings such as control rooms (e.g., Heath and Luff, 1992; Harper and Hughes, 1993; Berndtsson and Normark, 1999) has drawn a lot of attention within CSCW. However, the nature of articulation work in large-scale settings such as health care has been less examined. Our general understanding of the basic characteristics of work carried out in large-scale settings is still insufficient and fragmented — and so is our understanding of the special characteristics of the articulation work undertaken in such settings. Based upon an empirical study this article provides insights into articulation work activities

involving a large heterogeneous collection of actors who are geographically distributed — in our case the health care professionals involved in the period of pregnancy. Due to their geographical distribution the actors have to articulate their individual activities in order to take care of the patient and handle the surrounding patient trajectories.

An improved conceptual understanding of the nature of the articulation work and the underlying conditions are important when designing IT systems aiming at an effective, flexible, and adequate support of the collaboration undertaken. One of the main challenges for computer support in the health care area is to facilitate what is often described as ‘shared care’ among health care professionals. The aim of shared care is to ensure coherence and continuity over the patient trajectory, even though treatment involves several different and geographically dispersed actors. Our understanding of ‘shared care’ follows a definition commonly used in medical communities, namely a definition put forward by Pritchard and Hughs:

"Shared care applies when the responsibility for the health care of the patients is shared between individuals or teams who are part of separate organizations, or where substantial organizational boundaries exist." (Pritchard and Hughs, 1995).

Shared care is understood as an integrated and interdisciplinary collaboration related to a patient trajectory or patient care program where a common responsibility for treatment of the patient is shared between interdisciplinary teams that cooperate across units. Articulating the activities is a core aspect of the collaboration across units. Hence, an examination of the articulation work is an obvious starting point for a better understanding of shared care. Focus in our study has therefore been core characteristics of articulation work, not shared care as such.

As indicated in the introduction many researchers have pointed out that support of articulation work is essential for supporting complex cooperative work activities (e.g., Schmidt and Bannon, 1992), and as far back as in 1985 Strauss investigated medical work and the trajectories of work in order to establish a conceptual understanding of articulation work (Strauss et al., 1985).

Today there is furthermore a growing interest for health care studies within CSCW and a growing recognition of the problems with collaboration and coordination in health care. More specifically there is an increasing interest in electronic medical records within a CSCW perspective. Ellingsen and Monteiro (2003) examined which role knowledge representation — such as paper or electronically based records — play in the clinical work within one unit. Berg (1999) has investigated the implementation of electronically based records on a intensive care unit and presents a new understanding of information technology as embedded in work practice. Reddy et al. (2001) have examined the use of a shared information system within an intensive care unit and documented the need for many specialized representations in order to cope with the coordination demands. They have later also investigated the importance of rhythms in medical

work (Reddy and Dourish, 2002). Bossen (2002) has also studied work and articulation work in hospital wards in order to inform discussions of the concepts of common information spaces, and Bardram and Hansen (2004) refer to a related study in their discussions of social awareness in a mobile hospital setting.

The CSCW related studies within health care mentioned above have primarily been focusing on the usage of artefacts and IT-systems, and most of them have primarily been concerned with the clinical work within one single unit (e.g., Berg, 1999; Reddy et al., 2001; Bossen, 2002; Bardram and Hansen, 2004). These influential and interesting studies contribute to highlighting central issues regarding computer support in health care, but they are not concerned with a deeper understanding of large-scale aspects of articulation work, and they do not explicitly address issues of heterogenous settings. The studies focused on implementation and use of already developed electronic medical records and investigations of the role of information technology in the medical work and clinical practices.

The study presented here has a different focus, namely the dual nature of articulation work conducted in distributed heterogeneous settings. Our study addresses large heterogeneous settings and investigates the articulation work handled, both within units and across unit boundaries.

In the following section, we briefly introduce our research approach. We then characterize the field study and the work setting investigated in our case: the period of pregnancy. Following this, we characterize the essential aspects of articulation work in patient trajectories. The paper concludes in a discussion on the nature of articulation work in distributed heterogeneous settings, and a few brief reflections on implications for CSCW design in such settings.

## Research Approach

To obtain a coherent understanding of complex work settings and the work conducted, field studies can be an essential means (Yin, 1989; Orlikowski, 1993). As Schmidt points out the empirical study is essential for getting a coherent understanding of the nature of cooperative work and how it is unfolding:

"The primary role of workplace studies in CSCW is thus to dismantle the common-sense conceptions of cooperative work, take them apart, unpack and disclose the hidden practices of articulation work, and thus give us access analytically and conceptually to the intricate ways and means of the production of social order in cooperative activities." (Schmidt, 2000, p. 145).

This article is based upon an empirical study, heavily inspired by an ethnographic approach although the amount of time and resources for the project did not make it possible to conduct a full-scale ethnographic field study. The ethnographic inspiration is reflected in a lot of studies within CSCW, for example the studies of London Underground (Heath and Luff, 1992), Instrument Design (Carstensen and Sørensen, 1996), Air Traffic Control (Harper and Hughes, 1993,

Berndtsson and Normark, 1999), Medical care units (e.g., Reddy et al., 2001), and the early studies by Suchman (e.g., Suchman, 1983).

Many researchers have argued for the great potentials of an ethnographic approach within CSCW, and argued, for example, that “the ethnographic approach, with its emphasis on ‘natives’ point-of-view,’ holism, and natural settings, provide a unique perspective to bring to bear on understanding users’ work activities” (Blomberg et al., 1991, p. 123).

Our empirical work was primarily conducted at the Obstetrical Unit at the National Hospital of Denmark (Rigshospitalet). Focus was on interviewing and observing different people involved in the period of pregnancy to cover as many perspectives as possible. We started out by interviewing several pregnant women to get their key-perspective of the whole period of their pregnancy. Following this, we investigated the work and articulation activities of the professionals involved in patient care work. We interviewed midwives, maternity doctors and other specialists involved, as well as secretaries and nurses at the Maternity Ward. Furthermore, we studied how the professionals collaborated and communicated across organizational boundaries and units. Both actors in the Maternity Ward and in other units, such as the Cardiology Unit (involved in the care of pregnant women with heart diseases) and the Ultrasound Unit, were studied. Beside the health care professionals at the hospital, the general practitioners play a central role during the pregnancy period. Hence, our study includes this group too. Along with the interviews, we carried out observations at the Maternity Ward to see how the health care professionals conduct their work. In total, our empirical material includes 16 semi-structured interviews and 5 full day observations.

The field study was conducted over approximately four months and, as mentioned, was primarily based on observation, artifact analyses, and qualitative interviews (Patton, 2002). For all observations, interviews, meeting participation, etc. a summary was produced, and these summaries were then abstracted into general themes. These themes were identified from a first rough analysis. The abstraction of the data into themes was conducted as a collaborative brainstorm-oriented process. Although we did not start with a strict set of hypotheses, we did bring an articulated perspective. We explicitly addressed aspects like the organization of work, a ‘typical’ work day, the actors’ use of artifacts, involved roles and competencies, and the internal and external articulation of activities. This resulted in a first very descriptive characterization of the work. From the first overall analyses, our data were reanalyzed with a more focused perspective. The research approach we applied can be characterized as qualitative research heavily inspired by theories and conceptualizations within CSCW. Conceptualizations suggested by Schmidt et al. of the work arrangement and the related field of work and the analytical distinction between work and articulation work (Schmidt and Simone, 1996, Carstensen, 1996) has played a central role. The understanding of

articulation activities in this framework is heavily inspired by the conceptual work by Strauss (1985) and Gerson & Star (1986) on articulation work.

Studies like the one presented here make only limited claims regarding the generality of the findings. We have in our study focused on the richness of detail and relevance of the problems studied rather than general validity. This must be investigated through further studies.

## Case: The Period of Pregnancy

Before we provide more detailed descriptions of the work investigated, let us briefly introduce the case, i.e., the period of pregnancy, and the organizational setting in which the patient care work is conducted.

During the period of gestation, the pregnant woman alternately consults her general practitioner and a midwife at a clinic for regular examinations, starting out with a consultation at the general practitioner. Furthermore, the pregnant woman is offered a nuchal fold scan and an ultrasound scan, which both take place at the Ultrasound Unit. Our studies illustrated that these examinations play a central role for the pregnant women because they here get to see their unborn child. When the pregnant woman goes into labour, she contacts the Maternity Ward, where midwives, nurses and maternity doctors are responsible for the delivery and post-delivery care.

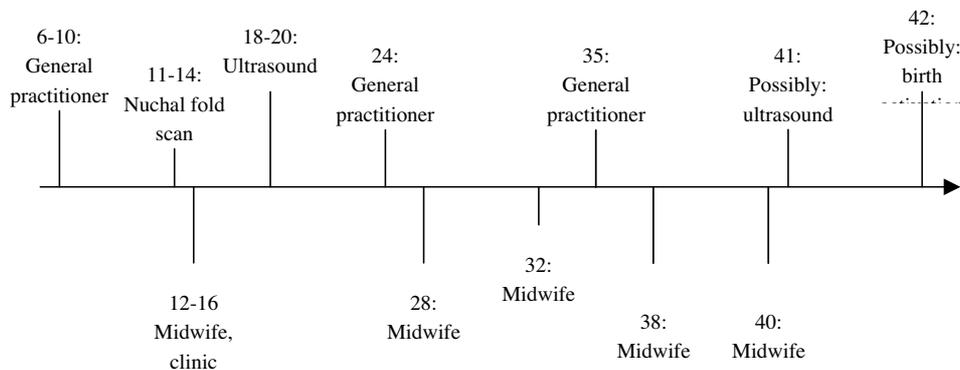


Figure 1: A time line for the period of pregnancy. The numbers indicate weeks.

The health care sector in Denmark is divided into a primary and a secondary sector. Every citizen is attached to a general practitioner, who takes care of patients' general medical condition. When specialist treatment is needed, when operations has to be carried out, etc., the general practitioner refers the patient to the secondary sector, the hospital. The primary and the secondary sector

communicate and collaborate around the patients as they carry out different tasks and thus have different professional responsibilities for the patient. The general practitioner has his own clinic and works more or less on his own. This is in contrast to the work carried out at the hospital. Health care professionals at the hospital constantly collaborate with a lot of professional colleagues, both with colleagues having the same formal background and function and with other specialist groups. Hospitals are characterised by a high degree of specialization and are thus organizationally divided into many different units and employ many different types of health care professionals. In connection with pregnancy the Obstetrical Unit is the primary actor within the secondary health care sector. The Obstetrical Unit at Rigshospitalet employ 170 health care professionals and is divided into different units such as the Maternity Ambulatory, the Maternity Home, Maternity Ward, and a clinic with rooms for women giving birth. The Maternity Home takes care of uncomplicated births while the Maternity Ward takes care of the more complicated. The Obstetrical Unit primarily collaborate with the Ultrasound Unit, the Paediatrician Unit and the Anaesthesia and Operation Unit which all employ differently specialized health care professionals.

Midwives at the Maternity Ambulatory take care of the pregnant women during pregnancy, and they examine the condition of the unborn child such as weight and height. Midwives at the Maternity Ward and the Maternity Home are responsible for the care related to the delivery. The maternity doctors take care of all kinds of patients hospitalized with diseases within the obstetrical area, not only women in labour. The Maternity Home and the Maternity Ward are open 24-hours. The health care professionals thus work in shifts, an 8 hour day shift, an 8 hour evening shift and a night shift. During the day, approximately seven midwives and two obstetricians are on duty at the Maternity Ward. The midwives call the doctors (or physician or surgeons) when needed, for example when a birth is not in progress or when a caesarean operation might be needed. Every duty begins with a briefing among midwives and a conference among the doctors.

Health care professionals engaged at the Obstetrical Unit use a large number of documents and other artefacts to coordinate their work and keep updated information about the patients. Some artefacts such as notes, the obstetrical record, and notice boards in the briefing and conference room as well as phones are primarily used for internal coordination within Obstetrical Unit and between different units within the hospital. Other artefacts such as the record accompanying the pregnant woman (in Danish: 'vandrejournalen') are used for facilitating coordination between primary and secondary health care sector, i.e., between the general practitioner and the midwives at the clinic.

## Articulation of Patient Trajectories

This chapter illustrates how the patient care activities are coordinated and exemplifies the communication among the different actors involved in the patient care. The intention is not to give a detailed and coherent picture of the work and its articulation, but rather to provide examples and illustrations of the different types of articulation undertaken, and to exemplify coordination activities conducted locally and across boundaries, and to show how this coordination involves issues of global articulation.

At the Maternity Ward where our studies primarily took place life is hectic. Following one midwife during her day duty revealed insights into the articulation work needed to take care of the pregnant women and women in labour.

### Briefing

Every duty begins with a short briefing between midwives from the previous shift and midwives who have just arrived. The briefing takes place in the meeting room, which is the only common meeting place for the midwives. At daytime duties midwives arrive just before 7:00. The actors from the night shift report to the day duty about new incomers and the status of the hospitalized women: Are they in labour, how is the birth proceeding, etc.? They go through patients on the basis of their records. The records play an important role during duty. The records contain crucial information about the hospitalized (and not yet hospitalized) women. During duty the midwives update the records when the changes occur when they obtain essential information about the patients. The briefing lasts 10-15 minutes. Briefings are frequently interrupted by the phone or sudden events which call for the attention of the midwives, but each midwife seems to get the information she needs despite the interruptions and disturbances.

The chief midwife from the previous shift is also responsible for briefing the doctors coming in for the next duty. This briefing takes place at the doctors' conferences involving only doctors and the chief midwife and is held every morning at 8:00. After the midwife's briefing, doctors from the previous shift brief the incoming shift about hospitalized patients, and opinions about further treatment of each patient are shared. At the end of the conference, the medical superintendent makes a superior division of labour between the doctors depending upon their expertises and skills, and presents the planned activities (e.g., caesarean operations) to be carried out during the duty. Already planned activities make out an important structuring mechanism for the health care professionals. It helps structuring the duty and to make as much as possible 'predictable'. At the briefing the medical superintendent might, for example, inform his colleagues that three planned caesarean operations have to be carried out, although the norm allows for only one planned operation during a shift. As the Obstetrical Unit take

care of many caesarean operations, a cross-disciplinary team has been established to take care of planned operations. Between 5 and 8 operations are carried out on every Wednesday. Like the midwives' briefing the doctors' conference is characterized by interruptions and disturbances (primarily from the phone), but we observed less private talk at the doctors' conference, and the door is kept closed during the meeting.

Both at the briefing and at the conference the actors try to plan and coordinate the activities for the duty. By taking into consideration the events that occurred during the previous shift they try to predict which activities and actions to expect. During the previous shift the situation of some of the hospitalized patients may have changed and these changes may call for specific actions. Based on the briefings, informal conversations during these, and information derived from records, the health care professionals get an overview of the state of affairs at the Maternity Ward at the beginning of each new duty. When a proper overview has been obtained, the chief midwife and the medical superintendent are responsible for making an overall division of labour for each group. This overall division of labour between midwives is explicated and made available by means of a notice board in the meeting room. The notice board reflects which midwife is responsible for which pregnant woman or woman in labour, and it reflects the state of the patient. The midwives aim at updating the notice board frequently so that it reflects the current situation. Midwives' briefing session and doctors' conferences illustrate articulation work and coordination activities conducted locally, that is, within the Maternity Ward or the Obstetrical Unit.

### An Epidural Blockade

During our observations of the midwives' briefing session the phone was ringing and answered by a midwife. She agreed to take over a woman in labour from a colleague at the Maternity Home. The woman in labour suffered from severe pain and the midwife judged an epidural blockade was necessary. The woman in labour therefore had to be moved from the Maternity Home to the Maternity Ward. Formally, the midwives have to ask for a doctor's advice before ordering an epidural blockade. Due to lack of time and resources this procedure is not always followed. The midwife at the Maternity Ward prepared the woman in labour for the blockade as soon as she arrived and called an anesthesiologist, who is always responsible for giving the blockade. Unfortunately the anesthesiologist was occupied with another patient, as he was treating a badly injured patient hospitalised in emergency when the midwife called him. The anesthesiologist and his colleagues at the department of anaesthesia had to give priority to this patient and the midwife and the woman in labour at the Maternity Ward had to wait 30 minutes for his assistance.

The example illustrates how the health care professionals coordinate internally but also across units (across work arrangement boundaries) involving issues of

what we describe as ‘global articulation’ as well. Further, it exemplifies the interdependence between the different health care professionals. The midwife depends on the competencies of the anesthesiologist, and her working rhythms thereby become dependent of the rhythms of other units (see Reddy & Dourish, 2002 for an interesting discussion of this issue). The priorities of the midwife might be in conflict with the priorities of anesthesiologist. The example also indicates that it often is not possible for the health care professionals to plan, coordinate, and prioritize their individual activities within one single unit in isolation, since many events and activities are part of a larger whole and have to be coordinated accordingly.

As soon as the epidural blockade was done the midwife was supposed to fill out the patient’s record. This is the procedure for all actions the health care professional take. But in the specific situation the midwife didn’t have time because she was called to assist at a caesarean operation. When she showed up in the operation room, another midwife, an operation nurse, an operation-assisting nurse, two obstetricians, a pediatricist, and an anesthesiologist were already gathered. Before the operation the two midwives agreed on the division of tasks related to the operation.

### A Caesarean Operation

A caesarean operation is an example of interdisciplinary teamwork. Health care professionals from different units and with different skills and competencies have to work together to manage the task. This indicates the occurrence of coordinative activities across boundaries involving issues of global articulation work.

After the caesarean operation the midwife went to the meeting room and filled out the record for the epidural blockade and the record for the operation. When carrying out a caesarean operation different records and documents have to be filled out, such as a birth registration, a record of the newborn baby, and a ‘standard sectio’ document. A ‘standard sectio’ is a standardized schema to be filled out when a planned caesarean operation is carried out. This standard document has been pre-produced to facilitate the documentation process, which is a very time consuming activity for the actors.

Caesarean operations take up a lot of resources. The formation and establishment of the sectio team helped the different units and departments in planning and allocating their resources. More than one planned caesarean operation per weekday violates the norm and is therefore not very popular with the other departments that have to assist the Obstetrical Unit. As mentioned earlier, it sometimes happens that the medical superintendent requires more than one operation. This decision can then force other departments and units to allocate spare resources unexpectedly.

## The Centre for Pregnant Women with Heart Diseases

Another formalized initiative is the establishment of the Centre for Pregnant Women with Heart Diseases. This is a virtual center based on an interdisciplinary teamwork of obstetricians, cardiologists, anesthesiologists, nurses, and midwives with special training in heart diseases. This team at first carries out a screening of the woman to judge whether a pregnancy is to be recommended at all. If possible, they produce on a plan for the pregnancy before it occurs, including the different medical perspectives. Depending on her situation, the woman might need a heart operation before her pregnancy, and during pregnancy her medicine must be adjusted and other factors reconsidered.

The center is an example of the need for formalization when conducting interdisciplinary teamwork across boundaries effectively. The initiative illustrates how health care professionals in this case meet to integrate different medical perspectives on the same patients. In this situation the actors not only try to analyse and act upon the current situation. They also aim at establishing a prospective plan for the patient.

Back at the midwives' meeting room a secretary entered the room and informed the participants that a general practitioner had called to tell that he had just admitted a pregnant woman to the Maternity Ward because of irregularities he had identified during his examination. The secretary placed a post-it note on the table with the name of the pregnant. When doctors at the hospital take over a patient from the general practitioner, they make an effort of informing the general practitioner about the situation of the patient. The process of admitting and informing between the general practitioner and the specialists thus illustrate an example of cross-boundary communication and coordination.

Much cross-boundary coordination takes place between professionals that do not know each other and do not have frequent contact. At the same time it is worth noticing that the process of information exchange between the general practitioner and specialists is not formalized. The level and quality of the information tend to be 'accidental', and essential information might get lost since the information-handling process depends upon the individual actor.

The woman admitted by the general practitioner came in and one of the midwives examined her in a delivery room. A scanning of the carriage of the child's head was needed and the midwife decided to call one of the obstetricians. He turned out to be occupied elsewhere and suggested the midwife to carry out the scanning herself, as he estimated that she was qualified to do so. She did not agree with this, but since she was left alone with the patient she had no choice. In situations where more complicated scannings are required the women are sent to the Ultrasound Clinic.

This example indicates that a strict division of labour is difficult during the hectic life at the Maternity Ward. New situations and professional challenges

arise continuously and must be handled on an ad hoc basis. The roles (doctors, nurses, and midwives) are important as the title indicates an area of competencies. However, a flexible interpretation of the role and the matching competencies and qualification is needed during the practical work with the patients.

As our field study indicates patient trajectories are characterized by a high degree of temporal complexity. Patient trajectories are unpredictable and cannot be planned, since complications can suddenly arise. The uncertainty makes it difficult for the health care professionals — i.e., the cooperative work arrangement — to plan and coordinate the necessary activities at hand. Hence diagnosing, treatment, and care are correspondingly becoming increasingly complex. To meet the increased demands, the actors become more and more specialized. The different groups of specialists and units are characterized by high degree of heterogeneity. The collaborating actors have different educations, titles, competencies and qualifications, and often very different goals and perspectives. A consequence of this professional specialization is the geographical distribution of actors across specialized units. At the same time the increasing challenges arising from more complex patient trajectories will inevitably demand more interdisciplinary teamwork in the future. The collaboration, as well as its articulation, are challenged by the distribution and heterogeneity of the work force. Coherence in patient trajectory ('shared care') can only be achieved if actors collaborate and articulate their individual activities within and across units.

From our study we can outline a first rough categorization of the articulation activities. Articulation activities are related to (1) The process of orientation, (2) Access to an overview of the state of affairs of the field of work, and (3) The process of integrating different perspectives on relevant situations.

The process of orientation concerns all activities related to getting access to relevant updated information about the patient. Orientation takes place in a formalized way at briefings and conferences and through patient records and notes. It does, however, also take place in an ad hoc manner during the duty when — for example — two midwives discuss the situation of a patient when they meet in the corridor. Mutual orientation is essential for the patient care work.

Access to an overview of the state of affairs of the field of work helps the actor to consider the patient in a general view. This is important, as examinations done by one unit or shift influence what has to be done by other units and so forth. A general view of the patient has great importance in the attempt to facilitate coherence in the patient trajectories.

The health care professionals also need to integrate different perspectives on the patient in order to establish a general professional view. As for the process coping with orientation and getting the overall picture, the integration of perspectives depends heavily on articulation activities, both within a unit and across work arrangement boundaries. The study also indicates that shifts between

local and global articulation work happens constantly and continuously and that actors engage in both local and global coordination at the same time. It has, furthermore, clearly illustrated the constant change between ad hoc and formalized articulation activities.

## Discussion

Our studies have illustrated that articulation work within large scale settings is characterized by a dual nature, both regarding formalized vs. ad hoc based coordination, and regarding local vs. cross-boundary (global) articulation activities.

The duality of formalized vs. ad hoc coordination is well-described. Suchman (1987) pointed at the gap between planned formal processes and the ad hoc based nature of the situated actions. Many others have discussed the dimension of ad hoc articulation to formalized articulation work (e.g., Carstensen, 1996, Kraut and Streeter, 1995, Schmidt, 1994), and within CSCW a number of studies of the consequences of working in large settings exists (e.g., Grinter et al., 1999).

What we suggest here is a more explicit conceptualization of the local-global duality. An improved conceptualization of the duality can contribute to a better and more fine-grained understanding of cooperative work and its articulation. When unpacking the duality between articulation conducted within a unit (such as the Maternity Ward) and articulation conducted across units in the primary and the secondary sector, we can extrapolate a distinction between local and global work arrangements and the corresponding local and global articulation work.

The distinction between local and global appeared to be highly relevant for the work settings we have investigated, and it has to be addressed explicitly in large-scale heterogeneous settings. However, the question is: What does it mean, and what are the implications and consequences with respect to analysis of work settings and development of IT support? First of all we must investigate the concept of local and global and investigate when the distinction is relevant. Furthermore, we should seek to establish useful boundaries between the local and the global settings, and investigate to what extent these boundaries are static, respectively dynamic.

As fields of work, the patient trajectories are characterized by a high degree of temporal complexity. Complications may suddenly arise. The lack of predictability makes it difficult for the cooperative work arrangements to plan and coordinate the involved activities. As mentioned when presenting our empirical findings, unexpected examinations and activities (e.g., a caesarean operation) are often needed. Furthermore, the patient trajectory itself is geographically dispersed and many units are involved. The fact that health care become more and more

specialized increases the dispersion further. The result are more complex patient trajectories involving many different units and specialties. Each specialty in the care and treatment has different competencies and responsibilities towards the patient. As an example, the general practitioner and the midwives are responsible for different examinations of the women at different points in time during her pregnancy. To put it differently they are both acting in each their *local field of work*. For the midwives at the Maternity Ward, the local field of work is the care of women in labour, and the examinations done at the general practitioners' clinic make out his local field of work. The midwife is part of one *local cooperative work arrangement* — the Maternity Ward. And similarly the general practitioner is part of another local cooperative work arrangement — his clinic. When aiming at understanding the local field of work it is necessary to talk about a corresponding *global field of work*. The global field of work is constituted by all of the patient trajectories to be undertaken at different places by different health care professionals.

The global field of work should be understood as the total web of patient trajectories which health care professionals are involved in at the time. Together the web of patient trajectories constitutes a global field of work with a concomitant *global cooperative work arrangement*. The global cooperative work arrangements are all the health care professionals — despite units — involved in any given patient trajectory. The subset of the web of patient trajectories being parts of a number of patient trajectories constitutes the local field of work of a local cooperative work arrangement at a given point in time. For example, the subset of of the patient trajectories related to the birth giving for non-complicated births constitutes the local field of work for the Maternity Home.

Actors involved in patient trajectories handle a web of distinct activities, such as a nuchal fold scan, ultrasound scan, examinations of heart beat rhythm, or examination of the weight and height of the unborn children. Together, all these individual activities — which are carried out geographically dispersed by different health care professionals — constitute the total amount of examinations and controls, i.e., the activities required to handle the global field of work. This illustrates the distinction between local and global: We consider it local articulation work when actors within one unit collaborate and articulate their activities to carry a single type of examination such as the ultrasound scan. And it becomes global articulation work when focus on this single ultrasound scan is coordinated as just one out of many types of examinations during pregnancy.

There are two central dimensions of complexity of articulation work related to the global field of work, i.e., the total web of patient trajectories in which health care professionals are involved. That is (a) an organizational and spatial dimension implies the different analytical types of articulation work that are carried out internally or across units or sectors. We define these different types of

articulation activities as internal, semi-internal, semi-external, or external (discussed below). And (b) a temporal dimension along which different articulation activities takes place. Activities taking place at different points in time can be associated. Activities are associated when an actor, while conducting an activity here and now, has to take into consideration which other activities have been carried out before, or how the activity will influence activities to be carried out later on. We can thus think of this as *associated articulation activities*. This type of association appear in the processes of getting access to relevant information, getting an overview of the state of affairs and integrating different perspectives. Examples of this could be an actor taking the notes written by another actor in the record into consideration before deciding on the sequence of a set of actions. Associated articulation activities can occur both locally (e.g., a midwife at the Maternity Ward applying notes written by another midwife) or globally (e.g., when information provided by the general practitioner is used for planning).

Let us, for a while, take a look at our empirical observations. Where do the distinction between local and global articulation work express itself? In our case, we identified different types of articulation work in which the actors were involved. As indicated above, our studies suggested four analytical types of articulation work: (1) internal, (2) semi-internal, (3) semi-external and (4) external. By internal articulation work we think of activities where the health care professionals within a single unit — e.g. the Maternity Ward or the Ultrasound Unit — coordinate their activities, etc.; for example, when the midwives coordinated and planned their work at briefings.

The semi-internal type of articulation work is similar to the internal. It occurs when collaborating actors in two closely coupled units (e.g., the Maternity Ward and the Maternity Home) coordinate their work and activities. An illustration is when the midwife at the Maternity Home contacted the Maternity Ward about the pregnant woman with a lot of pain related to her labour. We term it semi-internal because midwives at the Obstetrical Unit have duties on both the Maternity Ward and the Maternity Home. Analytically, we would often think of them as belonging to the same local work arrangement, but it is distinct from internal because the Ward and the Home are geographically separated as two distinct units, each having its own 'clients' and formalized coordinative activities such as briefing meetings and planning the duty.

We use the term semi-external articulation work when two separate organizational units (like the Obstetrical Unit and the Cardiological Unit or the Ultrasound Unit) collaborate and articulate their work. An example of this is when different specialized doctors, physicians, and midwives meet to coordinate and plan their care work with respect to a pregnant woman with a heart disease, as it is the case with the Center for Pregnant with Heart Diseases. Although the articulation activities are conducted within one organization we would usually

analyze it as global articulation conducted across boundaries of work arrangements.

The fourth type of articulation work is external. This term is used when the health care professionals coordinate across sectors, e.g., when the general practitioner admitted a pregnant woman directly to the Maternity Ward and called the midwives to brief them about the situation. In a more indirect manner, it also takes place through the registration of the examination results in the record associated to the pregnant woman, or when the general practitioner admits one of his patients for examinations at the clinic. In these situations all coordination is handled through mediated interaction facilitated by artifacts, not through direct face-to-face interaction. When the articulation work is external we consider it global.

It should be mentioned that these four types of articulation work cannot be regarded orthogonal categories, and it is not essential whether we name the different types of articulation work internal or semi-internal, or semi-external or external articulation work. What is essential is that there are different types of articulation work, and that each type has its own characteristics. We will elaborate this point further in the following.

Having sketched the important dimensions of organizational (and spatial) distance and temporal distance, let us elaborate the discussion of the complexity of local and global articulation work a bit further. The local collaboration and concomitant articulation activities are often characterized by a high degree of ad hoc coordination. Actors within a single unit — a local cooperative work arrangement — often have direct access to each others' medical knowledge and capacity. When working together within a local cooperative work arrangement, it is easy for the health care professionals to monitor which colleagues are available at a given time. Our study showed that face-to-face interaction plays an important role for the collaboration, and that local articulation work often is based on immediate access and visibility. Within a local cooperative work arrangement, it is also fairly easy to gain an overview of the state of the field of work.

Handling the global articulation work across boundaries is much more complex. Actors do not in the same way have direct accesses to each others' knowledge and capacity. Often, they will not even know to whom to direct questions, comments, or suggested re-planning or re-scheduling, and they usually have no overview of who is available from the other units at the time. There is no immediate access to the state of affairs in other settings, and applying the traditional social skills of face-to-face coordination is not an option. The geographical distribution also complicates the possibility for gaining an overview of the state of the field of work. Lack of overview has severe consequences for handling the shared care. The collaboration and articulation work across unit boundaries is therefore much more demanding and is more dependent on a high

degree of formalization in the interaction and coordination undertaken. Global collaboration, and thus global articulation, means great challenges to the actors' articulation activities.

Our studies cannot provide clear insights into the relation between organizational (and temporal) distance and demands for formalization of the articulation activities, but a relevant hypothesis seems to be that the longer organizational or temporal distance the stronger demand for formalization of the articulation activities. The local/global duality of the collaborative activities makes it difficult for the individual actors to know whom to brief, how much and which information to provide to others, and when to do it. The uncertainty is aggravated further by the fact that much of the articulation is handled via associated global articulation activities. Furthermore, the global field of work (the web of patient trajectories) is dynamic and highly unpredictable. This causes huge challenges for the planning processes. Formalized coordination processes are therefore called for, but at the same time a high degree of flexibility is required in order to cope with all the exceptions. Not only is the field of work dynamic. The articulation work activities are themselves dynamic due to the continuously shifts between local and global articulation, and the shifts between synchronous articulation interaction and asynchronous associated articulation activities. The uncertainty and the dynamics of the articulation activities were clearly illustrated in the example where a midwife and an anesthesiologist had to re-schedule how an epidural blockade was to be given and by whom.

The global dimension is very important and has to be taken into consideration, but the distinction between local and global dimension of articulation work is analytical. The dimensions mutually constitute each other and cannot be addressed in isolation. For example, the local articulation work conducted by two midwives in a unit is part of a whole (a global field of work and a global cooperative work arrangement), and the midwives must often take global aspects into consideration when articulating their activities, even when their work can be considered local. From the point of view of the actors we can state that, in order to be able to coordinate and plan their activities properly, the actors needs a sufficiently detailed picture of the state of affairs in the global field of work. The case is often such that the actors are well informed about status in the local field of work, whereas it is hard or impossible to quickly glance the state of the global field of work (of which the local field of work is a part). This poses both challenges and possibilities when it comes to IT support of global articulation work activities.

Above we have presented a very preliminary conceptualization of some of the central aspects of coordination and planning activities conducted in a global setting. A more detailed, coherent and elaborate conceptual framework for understanding the situation is called for. We need concepts for analyzing the

global work arrangement and for characterizing the required global articulation work. It is out of the scope of this paper to present a detailed discussion of this, but we will submit a few open questions and problems.

For practical work analysis — conducted in order to establish a proper basis for discussing and designing support systems — a number of new challenges naturally occur. First of all, when analyzing a local work arrangement in a large-scale setting, the global dimension must be explicitly addressed. Conceptualizations of how the local unit is associated to the larger global setting and which aspects of the external relations that need detailed investigation are required. For now, it is not clear how to identify which global factors play a role for the local field of work and the corresponding local cooperative work and what the role may be.

When considering specific design of IT support, issues on how to support the different types of articulation work — it being local or global — become essential. We should consider how to support the process of information collection, getting an overview, and integration of perspectives across the spatial and temporal dimensions in the global work arrangement. Our study partly indicated that the longer the organizational or spatial distance is, the more formal structures for articulation activities should be considered. This could indicate that IT support of cross-boundary articulation activities should formalize the processes, but an IT-based system could also be a means of making ad hoc planning and coordination across boundaries possible, for example by making the global field of work more easily observable. To support actors in undertaking the required global articulation activities the actors must be provided with an understanding of the global associations. This raises questions as to how to make the associations evident for the actors when they undertake their work, planning, and coordination. For the specific case of shared care of patients, the question will be how to provide an overview of the global articulation work with respect to the patient trajectory, for example how to ‘visualize’ the global aspects related to the activities actors conduct in order to undertake their (local) obligations. Issues related to this also concern the publishing of relevant information from one actor to others in the global work arrangement, but outside of the local work arrangement. Our study has pointed at a number of occasions where actors have a wish for providing information to other actors without knowing whether the information is required or who will be the user.

## Conclusion

Based on an empirical study of a heterogeneous large-scale health care setting we have shown that articulation work is characterized by a dual nature of local vs. global collaboration and articulation work activities. We have also exemplified the dimension of formalized vs. ad hoc articulation. We have documented how

cooperating actors involved in handling the care and treatment required for patient trajectories have to articulate their activities in accordance with both a local and a global work arrangements (and the concomitant local and global field of work). We have furthermore discussed how the articulation work can be regarded as internal, semi-internal, semi-external, or external. In the discussions we have described how the local and global settings and activities are heavily intertwined, and we have illustrated that both local and global aspects must be taken into consideration during the articulation of the work. Over the last 20 years CSCW has been confronted with severe problems related to how to support what we would call local articulation work. What we argue here is that in order to support collaboration in large-scale heterogenous settings, we need a much richer conceptual understanding of the global aspects of the articulation work. This opens a variety of new questions and challenges for CSCW research and design.

## Acknowledgements

This research could not have been conducted without the participation of the actors we have interviewed and observed. A warm and special thanks our contacts at the Obstetrical Clinic at the Rigshospitalet in Denmark for their openness and engagement in this project. Kjeld Schmidt and the anonymous reviewers provided many useful comments to previous versions of this paper. All errors remain our responsibility. The work has partly been funded by the HIT-project funded by the Danish National Research Councils.

## References

- Bardram, J. E. and Hansen, T. (2004): 'The AWARE Architecture: Supporting Context-Mediated Social Awareness in Mobile Cooperation', in C. A. Halverson and L. Terveen (eds.): *Proceedings of ACM Conference on Computer Supported Cooperative Work*, ACM, Chicago, 2004, pp. 192-201.
- Berg, M. (1999): 'Accumulating and Coordinating: Occasions for Information Technologies in Medical Work', *Computer Supported Cooperative Work*, vol. 8, 1999, pp. 373-401.
- Berndtsson, J. and Normark, M. (1999): 'The Coordinative Functions of Flight Strips: Air Traffic Control Work Revisited', In S. Hayne: *GROUP'99 - International ACM SIGGROUP Conference on Supporting Group Work*, ACM, Phoenix, Arizona, 1999, pp. 101-111.
- Blomberg, J., Giacomi, J., Mosher, A. and Swenton-Wall, P. (1991): 'Ethnographic Field Methods and Their Relation to Design', In Schuler and Namioka (eds.): *Participatory Design: Principles and Practices*, LEA, pp. 123-154.
- Bossen, C. (2002): 'The Parameters of Common Information Spaces: the Heterogeneity of Cooperative Work at a Hospital Ward', In C. M. Neuwirth and T. A. Rodden (eds.): *Proceedings of ACM Conference on Computer Supported Cooperative Work*, ACM, New Orleans, 2002, pp. 176-185.
- Carstensen, P. H. (1996): *Computer Supported Coordination*, Risø National Laboratory.

- Carstensen, P. H. and Sørensen, C. (1996): From the social to the systematic. Mechanisms supporting coordination in design, Computer Supported Cooperative Work. *Computer Supported Cooperative Work*, vol. 5, no. 4, 1996, pp. 387-413.
- Ellingsen, G. and Monteiro, E. (2003): 'Mechanisms for producing a working knowledge: Enacting, orchestrating and organizing', *Information and organization*, vol. 13, pp. 203-229.
- Gerson, E. M. and Star, S. L. (1986): 'Analyzing Due Process in the Workplace', *TOIS*, vol. 4, no. 3, 1986, pp. 257-270.
- Grinter, R. E., Hersleb, J. D. and Perry, D. E. (1999): 'The Geography of Coordination: Dealing with Distance in R&D Work', In S Hayne (ed.): *GROUP'99 - International ACM SIGGROUP Conference on Supporting Group Work* ACM, Phoenix, Arizona, pp. 306-315.
- Harper, R. H. R. and Hughes, J. A. (1993): 'What a f-ing system! Send 'em all to the same place and then expect us to stop 'em hitting. Managing technology work in air traffic control', In G. Button (ed.): *Technology in Working Order. Studies of work, interaction, and technology*, Routledge, London and New York, pp. 127-144.
- Harper, R. R., Hughes, J. A. and Shapiro, D. Z. (1989): *The Functionality of Flight Strips in ATC Work*. The report for the Civil Aviation Authority, Lancaster Sociotechnics Group, Department of Sociology, Lancaster University.
- Heath, C., Jirotko, M., Luff, P. and Hindmarsh, J. (1993): 'Unpacking Collaboration: The Interactional Organisation of Trading in a City Dealing Room', In G. DeMichelis, C. Simone and K. Schmidt (eds.): *ECSCW '93. Proceedings of the Third European Conference on Computer-Supported Cooperative Work*, 13-17 September 1993, Milan, Italy, Kluwer Academic Publishers, Dordrecht, 1993, pp. 155-170.
- Heath, C. and Luff, P. (1992): 'Collaboration and Control. Crisis Management and Multimedia Technology in London Underground Control Rooms', *Computer Supported Cooperative Work*, vol. 1, no. 1-2, 1992, pp. 69-94.
- Kraut, R. E. and Streeter, L. A. (1995): 'Coordination in Software Development', *Communications of the ACM*, vol. 38, no. 3, 1995, pp. 69-81.
- Orlikowski, W. J. (1993): 'CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development', *MIS Quarterly*, September 1993, pp. 309-340.
- Patton, M. Q. (2002): *Qualitative Research & Evaluation Methods (3 Edition)*, Sage Publications, Thousand Oaks, London, New Dehli.
- Pritchard, P. and Hughs, J. (1995): *Shared Care. The Future Imperative*, Royal Society of Medicine Press, London, UK.
- Reddy, M. and Dourish, P. (2002): 'A finger on the pulse: temporal rhythms and information seeking in medical work', In C.M. Neuwirth and T.A. Rodden (eds.): *Proceedings of ACM Conference on Computer Supported Cooperative Work*, ACM, New Orleans, 2002, pp. 344-353.
- Reddy, M., Dourish, P. and Pratt, W. (2001): 'Coordinating Heterogenous Work: Information and Representation in Medical Care', In W. Prinz, M. Jarke, Y. Rogers, K. Schmidt, and V. Wulf (eds.): *ECSCW'01: European Conference on Computer Supported Cooperative Work* (Eds.,) Kluwer Academic Publishers, Bonn, Germany, 2001, pp. 239-258.
- Schmidt, K. (1991): 'Computer Support for Cooperative Work in Advanced Manufacturing', *International Journal of Human Factors in Manufacturing*, vol. 1, no. 4, 1991, pp. 303-320.
- Schmidt, K. (1994): *Modes and Mechanisms of Interaction in Cooperative Work*, Risø National Laboratory.
- Schmidt, K. (2000): 'The Critical Role of Workplace Studies in CSC, In P. Luff and C. Heath, (eds.): *Workplace Studies*, University Press, Cambridge, England, pp. 141-149.

- Schmidt, K. and Bannon, L. (1992): 'Taking CSCW Seriously: Supporting Articulation Work', *Computer Supported Cooperative Work*, vol. 1, no. 1-2, 1992, pp. 7-40.
- Schmidt, K. and Simone, C. (1996): 'Coordination Mechanisms: Towards a Conceptual Foundation of CSCW Systems Design', *Computer Supported Cooperative Work*, vol. 5, no. 2-3, 1996, pp. 155-200.
- Strauss, A. (1985): 'Work and the Division of Labor', *The Sociological Quarterly*, vol. 26, no. 1, pp. 1-19.
- Strauss, A., Fagerhaugh, S., Suczek, B. and Wiener, C. (1985): *Social Organization of Medical Work*, University of Chicago Press, Chicago and London.
- Suchman, L. A. (1983): 'Office Procedures as Practical Action: Models of Work and System Design', *TOIS*, vol. 1, no. 4, 1983, pp. 320-328.
- Suchman, L. A. (1987): *Plans and situated actions. The problem of human-machine communication*, Cambridge University Press, Cambridge.
- Yin, R. K. (1989): *Case Study Research: Design and Methods*, Sage Publications, Beverly Hills.

