Human Action in Context

A Discussion of Theories for Understanding Use of IT

Tone Bratteteig & Judith Gregory*
{tone}{judithg}@ifi.uio.no
Department of Informatics, University of Oslo
* also at Department of Communication, University of California at San Diego

Abstract

This article presents and discusses a selection of theories concerned with describing and explaining human action in context: activity theory, actor-network theory, interactionist theory of work, and structuration theory. The theories have some characteristics in common, although their emphasis and basic perspectives are different. The similarities and differences are illustrated by a case in the context of health care. The theories are compared and discussed with respect to use of IT, change, and design.

Keywords: activity theory, actor-network theory, structuration theory, interactionist theory of work (Strauss)

BRT Keywords: AE, AJ, BD02, HB15, IB0301.01

Introduction

During the last years, a number of theories about human action and its interrelation with context (be it local, organizational, or sociohistorical contexts) have been discussed in IS literature. Most theories have been used to understand use of IT in work, some also can be used to understand design. We find that many of the theories are strikingly similar—in interesting ways, and that they are different in interesting ways as well. This article aims to discuss what kind of explanations and questions some of these theories offer to systems development; to understand use of IT, and to plan and carry out change and design.

The article is organized as a discussion of a case: a telephone conversation between a nurse and a patient, and the work that the nurse carries out to follow up and document what s/he has come to know during the conversation. The case is chosen because it tells about a technology-supported work-at-a-distance integrated with local technology-based work and collaboration. We analyze and discuss the case from four perspectives: activity theory, actor-network theory, interactionist theory of work (Strauss), and structuration theory. The last section summarizes the discussion with respect to some more general topics in information systems development: use, change and design.

A case: telephone triage

The case example is of a registered nurse (RN) conducting *telephone triage* in an outpatient Cardiology and Internal Medicine department during a morning in October 1996. The examples come from two consecutive days of "telephone messaging" activities video recorded for the purpose of contributing to the design of computer support for clinical message handling in an electronic health record (computer-based patient record) prototyping project[1]. In addition to the design of new tools for clinical message handling, telephone encounters are of interest as they can be conceived as *virtual encounters* with patients in the context of the continuity of care and interactions with patients and among diverse clinicians caring for patients over time.

Telephone triage has long been practiced as an essential means of communication for nurses, as telephone encounters are for physicians. Telephone messages to and from patients and telephone assessment and medical advice occur in a continuous stream of communication variously in between, following up or as precursors to in-person patient care encounters. In this outpatient context, telephone triage is the assessment of the symptoms and problems described by patients who have called in by telephone for help. Anselm Strauss and colleagues' definition of *assessing* is useful here:

> "Assessing is concerned with estimating and evaluating the graveness, controllability, and rectifiability of risks and dangers. In turn, these are associated with the medical interventions, with the illness itself, and with various expected or unexpected contingencies which have appeared, and weighing those risks and dangers so as to judge courses of action effectively for preventing, controlling, and rectifying. Assessment implies assigning priorities to hazards."(Strauss et al., 1997 (1985), p. 88)

Patient calls and messages are prioritized according to the acuity (severity) of the problems presented, including the RN's judgment of degrees of risk in the context of the patient's overall health status. In this specialty care department, telephone triage is conducted by registered nurses who are qualified to provide medical advice and who determine and expedite referrals to a physician (a cardiologist or an internist) or to an urgent care or emergency service. That telephone triage is considered the domain of nurses reflects going definitions about work. When this activity is handled by a physician, it is defined as *telephone consultation*; doctors do not do telephone triage.

The RN telephone triage and message handling initiative was proposed by the RNs to locate these activities within the clinical department rather than within the centralized appointments center whose (non-clinical) staff generally receive and route telephone messages from patients. The RNs' initiative in organizing the work of telephone triage in Cardiology and Internal Medicine is a local innovation experiment indirectly related to the design and development of a new electronic health record system that can be interpreted as a novel, emerging activity. "Messaging" has a long history within the organization, first, as the most frequent target for continuous quality improvement (CQI) in the organization's twelve medical centers during the preceding decade. Secondly, message handling is an activity that has eluded standardized forms of work organization. Rather, as one administrator put it: "It's like a pendulum. We try centralizing messages, then a couple of years later, the pendulum swings back to

[1] The electronic health record prototype project is the empirical basis in (Gregory, 1999).

decentralization."

Not surprisingly, telephone encounters are targeted for support in the electronic health record system through on-line protocols and other new tools for messaging activities. Telephone triage and clinical message handling are practices for which current tools and systems are not adequate; there is a need to design new tools. The information system for patient appointments was not designed to handle clinical messages (nor is it a confidential medium). The organization's paper-based patient records systems are divided between outpatient and inpatient records with separate chartrooms dedicated to each. Clinical information systems are also segmented between outpatient and inpatient (hospital) patient data; emergency medicine is classified as outpatient care, physically located at an entrance to the hospital. The difficulties of developing new tools for message-handling should not be conceived only or even primarily as technical software problems, given the complexity of defining telephone encounters (their elusive problematization) and the complexity of devising organizational strategies to improve message-handling, the long-standing and multi-faceted problems to which more than a decade of CQI efforts attests.

For analysis of the case study below, dilemmas that present themselves in practice are especially important. The Oxford English Dictionary (OED) defines a dilemma as follows: "a dilemma involves 'a choice between two (or, loosely, several) alternatives which are or appear equally unfavourable." Drawing on the OED definition, Billig et al. describe another sense of dilemmas that characterizes dilemmatic practical activities: "To experience a dilemma is to live out an opposition, so that one is divided upon it in the failure to achieve a resolution" (Billig et al. 1988, p. 91). The work of nurses conducting telephone triage is highly dilemmatic in that they experience moment-to-moment time conflicts, torn between urgent responsibilities that demand attention simultaneously and for which time delays may entail risk to one or more patients. The example of telephone triage also illustrates how types of dilemmas—ideological, structural or practical—are intertwined rather than distinct and particularly how practical dilemmas engage moral and ethical values. The terms in which caring for patients are expressed have changed over time as systemic contradictions are expressed in language; clinical work practices become increasingly dilemmatic as both ideological and practical dilemmas confront care providers. Two instances of dilemmas are marked in the case example that follows (dilemma #1 occurs 9:42:56 to 9:42:26, dilemma #2 occurs 10:07:39 to 10:13:28).

An example of telephone triage in an outpatient Cardiology and Internal Medicine department

The case example is limited in several ways; two limits will be obvious to readers. First, we have only one side of the telephone conversation, that of the registered nurse but not of the patient, due to confidentiality agreements governing the research. Second, in this paper, we do not include the content of the clinical message documented by the nurse.

09:33:37

The RN arrived at approximately 8:20 a.m., reviewed messages from yesterday when one of her RN colleagues handled messages and telephone triage, reviewed voicemail messages and scheduled one appointment immediately, walked around the module to let everyone know she is present, and picked up new messages transmitted from the central appointments scheduling system (which opens at 7:30 a.m.) at two printers (one at the reception desk, the other across the hall in the Gastroenterology Department) and any

messages received during the evening and night (a responsibility handled by the Pulmonology Department down the hall).

The RNs use a system of four laminated cards to prioritize the messages: First Priority, Second Priority, Non-Urgent, and Expecting Return Call. The four cards are displayed from left to right across the desk with a cascade of messages arranged under each category. The RNs devised a "tracking system" for messages, keeping a carbon copy of each message in an accordion file for the month, alphabetized by patient name. A file cabinet contains the archives of the messages by month for the past year.

RN: *Then I look at the three that I have here [First Priority]), which one should I really call first? Sometimes it's a toss up. But because it's Cardiology, I tend to lean toward anything that has to do with the heart first before I deal with a cold. Before I do it, I try to call them up in the computer so that I can get more information. . . .*

The RN enters the patient's medical record number and studies the computer screen.

RN: *The primary doctor is not Dr. A [the senior cardiologist], the primary doctor is Dr. Z [the pulmonologist]. The cardiologist is Dr. A. That's significant. Because if I am talking about a cold, this person really should be followed by Dr. Z, but this person is not complaining of a cold so. They called in for* ["spells" with the heart]. *So I am going to look and see if there are any problems coming up with Dr. A already* [scans screen], *but there isn't. I can see that this patient has eye problems because . . . he has a lot of appointments with the eye and possibly, it looks like he is going to have some eye surgery. So that makes us even more. . . to make sure that everything is okay with his heart. So the next thing I want to do is to look at his history. When is the last time he saw his cardiologist? Sometimes this is a great surprise* [scanning screens] *and sometimes he hasn't even seen him. Because sometimes he hasn't even seen him because this computer is only going to be outpatient and if he saw a cardiologist inpatient, it is not going to show up here.* [appointment history in computer] *This patient saw Dr. A last April for a re-check, so April 1996. So that's a significant amount of time since he's last seen his doctor. Or she's seen a doctor. So then I know that much when I call.*

09:35:38 to 09:42:56

The RN places a telephone call to patient.

RN: *Hello, this is [the Medical Center]. I was trying to get a hold of Ellen Jones. Okay, so you called for her? [pause] I see. Okay. [pause]*

Yes, Ellen. I'm calling, I know it was your husband who said he had called for you. He said you had had some "spells" with your heart? Okay, can you describe to me what the spells--or what is happening and how often? [writing to message form] *Okay, so you get chest pain? And this is when you are doing activity like walking in your backyard, things like that? And you take nitroglycerin for that. Does that help?* [documenting] *So the chest pain goes away at the time that you take the nitroglycerine? You take at least two? Okay. So then if you go back out, it happens again? Right, and this is new for you? This didn't happen like this before? This has been occurring in the last month?* [documenting] *And how many times? Is it a daily thing or a weekly thing?* [documenting] *Now the other question is does it ever happen when you are not doing any activity, have you ever had it happened when you are just sitting or you are sleeping or anything like that? Right. But how about when you are just sitting, watching tv or -- have you ever had the chest pain wake you up from sleep in the middle of the night? No, okay. Well, definitely, you need to see the doctor. [Let me look at something]*

Computer screen for appointment history as reference.

I noticed that you saw him last in April. So it has been a little while since he's seen you. I am assuming that he has you on some medications of sorts. Uh huh. Okay, and you are

taking those regularly? [documenting] *Okay, but the nitro has always taken the pain away? So you've never had to come to the Emergency Room? Right. When was the last time that you had one of these episodes? You had one yesterday* [documents to notes]. *But you feel okay today. [inaudible]* [listening, documenting]
Computer screen, looking for an appointment.
RN: *I see. I see. Right. I am looking at the computer and somebody cancelled today for Dr. A tomorrow. Can I put you in to see Dr. A tomorrow? He's not in today. Okay. Let me grab that real quick before somebody else gets it and then I will explain it to you.*
The RN has the authority to schedule appointments directly according to acuity (as in this case) and for any two open appointment slots, in other words without checking with the physician and without going through the central Appointment Center. She goes ahead and schedules the appointment for this patient.
RN: *So, it's in for tomorrow October 4. It's the first one in the afternoon so you won't be waiting a long time. It's at 1:20. So if you are here at 1:10, we'll check you in, we'll probably put you straight in, you'll be the first one he sees.*

[Patient question] *I'm sorry? He's in Module [xx]. Right.*

What I would like to ask you, I know you live in Sun City but if you could come at about 1:00 o'clock, we'd like to get an EKG done before you see him, of your heart, you know how we have that right here? So if you come at 1:00, I'll make a slip out and the girl at the desk will know and she will give you the slip, we'll get the EKG, that just saves a little time.

Okay, you go to Module [xx], there's a receptionist right there. In the clinic building, well actually in the hospital building because remember there is a building out front there, too. It's the same place that you came last time that you saw Dr. A. Right. Fourth floor, Cardiology. Then come about 1:00, we'll do the EKG and then he can compare your EKG with the previous --

Now the big thing here, though, is between now and then if things get worse, don't hesitate to come to the hospital, to the ER. If it is an extreme emergency, just go to the nearest hospital. But if you feel it coming on you, you just don't feel comfortable with waiting, then you certainly can come straight into the ER here. Alright? Okay, alright. Then it's probably best to rest today. Don't do too many walks today till you see him tomorrow. Okay, alrighty. Bye bye.

09:42:56 to 09:43:26 [Dilemma #1]
The receptionist comes to the RN's office to let her know that there is a walk-in patient presenting "tightness in the chest" in the waiting room. The RN writes a reminder to herself, concerned about the delay in being able to complete the documentation of the telephone interaction with the patient whom we call Ellen. She faces immediately competing demands—the patient presenting tightness in chest and the need to document patient presenting chest pain.
RN: *Okay, I got that appointment booked. But I don't have it documented, everything she said and it's pretty serious stuff. So I know that I have got to document it. I don't want anybody to touch my computer* [tapes a note onto the computer screen]. *Or me to forget to document it. And because this guy at the front desk has got "tightness in chest" I can't exactly wait ten minutes for that* [pulling stethoscope from desk drawer*] so that's where I will go* [takes progress notes page and leaves office quickly].
09:44:01 to 09:57:45
No activity in RN telephone triage and messaging room.
09:57:48
RN returns to the office.

RN: *I have to finish that message.*
RN has picked up inter-departmental mail and sorts it. And since we were gone, there is a message by voicemail. Sorts mail while listening to the message left at 9:44 a.m. RN documents message while listening to it. RN documents to the previous message for same patient.
10:00:33
RN: *Okay, I am going to move that to first priority because since she just called, I want to deal with that right away. But I have to deal with this* [takes down her note from the computer]. *I have got to redo, prioritize the new ones* [taps sheaf of new messages].
10:00:54 to 10:05:13
Okay, so. Okay, this is the lady I booked. [Computer screen, looked up appointment] *This is for tomorrow. So booked* [aloud re documenting actions taken]. *I need to go back and write into the remarks* [points to computer screen for appointment] *why she is coming. I didn't do it at the time because I didn't want someone else to get that appointment while I was doing that.*
Enters reason for visit to the remarks field in the on-line appointment system.
And I will indicate in the remarks that I want her to get an EKG prior. That's to assist the people at the counter, so they don't forget because I am not going to be the one standing there.
Goes into drawer. Looking for the EKG slip.
I make out the slip. [Searching for the slip] *For some reason, I don't have any [EKG] slips here. I usually have them right on my desk.* [Looks in drawer again, looks in lower file drawer]. *Okay, I'll have to go down there and get one.*
Resumes documenting.
Now, this message because it is a real significant message, it is referring to someone who if they weren't seen it could be detrimental [pulling out a progress notes page) *I personally tape it on the progress note because to make sure it gets in the chart. I like to. I write the name of the patient.* [documenting]

And because this is an appointment for tomorrow, the OPAS does not automatically order the chart for that appointment for tomorrow. And because I am booking it so late in the day, there is a good possibility that they have already pulled the charts for tomorrow so I'll order the chart so that I can be sure that it will be here tomorrow because it will really be a problem if it is not.
Computer screen for ordering the chart.
And on the message I will say, "For appointment tomorrow." So when it arrives in the module, I don't have to be standing there, the girls that work there know that that is a chart that they had better hold for tomorrow.
10:05:23 to 10:06:21
The RN puts together the notes and paperwork for the patient.
RN: *And also, since this appointment is for tomorrow for Dr. A, and I want to make sure he sees my note, why I put this patient in for him, what I do is, I do not send this note to the chartroom right now. I put his name on it with a post-it that says, "this appointment is tomorrow and that it's at 1:20" and what I'll do is that I'll take this* [holds up set of papers with post-it note on top] *down to the nurses' area and I will put it in his area where his charts are kept so tomorrow morning if something happens and we don't get a chart, at least we have the note of today and why I did it. So he's got something.*

And then to remind myself, since I'm out of EKG slips anymore, I'm going to put a little note for myself so that when I walk down there, I want to get that EKG slip and give it to the receptionist.

10:06:21
Okay, now I am going to call this lady that returned my call. [Picks up message]
The receptionist comes back regarding another patient who has come to the front desk in need of antibiotics seven days prior to surgery. The RN leaves her office to go to the reception desk.
10:07:39 to 10:13:28 [Dilemma #2]
No activity in RN office.

Note that the RN never had a chance to sort the last group of messages. On the desk, we see the prioritized messages arranged in piles and a tiered pile of new messages and other records to the right. When she returns, she still needs to review new messages and needs to call patients in the Priority #1 group.
10:13:28
RN returns to office.
RN: *I need to call these people, but I've got another stack.* [Tearing messages] *And in this stack could be somebody with chest pain or some issue that is real urgent. . . . [This one] could be non-urgent.* [Reading message] *Okay, this is a message that you can't tell if it is serious or not. It could be and might not be, not enough information. You can see that I keep going back, did I really read that right? Because I don't know*

Discussion: IT design and organizational interventions

Design of new IT tools for telephone triage and messaging entails transformations, not only from paper-based forms to interactive electronic media but, for this activity, more basically from implicit protocols (from professional training and experiential expertise) to explicit written and on-line protocols. Such transformations can be understood as translations from situated and embodied knowledge and practices (Haraway 1991; Suchman 1987; 1994) to inscriptions of programs of action (Berg 1997a; 1997b; Hanseth and Monteiro 1997; Monteiro and Hanseth 1996).

To think about IT design for telephone triage, we might begin by asking: What does the RN search for and what does the information signify? The RN begins by searching the patient's appointments history as proxy data for finding out who are all the doctors and other care providers responsible for the patient. In the prototyping project in which the Cardiology and Internal Medicine department is participating, the electronic health record design includes an *interactive patient profile* that can potentially help RNs and other staff by providing a *provider profile* to readily display all the care providers caring for the same patient. A core requirement of the system is that it will, eventually, integrate clinical documentation along the continuum of care from all outpatient and inpatient services (all points of care). Distributed access to on-line electronic patient charts (journals) which include interactive patient profiles for problem lists, medications, allergies, procedures, provider profile, family history and social history (risks), and encounter history will change the activity system—but full development of the new system is some time in the future.

Interactive templates in the electronic health record are expected to support on-line clinical protocols for conducting telephone triage. Previously, a notebook of paper-based telephone triage protocols was developed within the Medical Center for RNs dedicated to telephone triage, physically located next to the Emergency Room. On-line protocols entail several degrees of complexity: their development cannot be accomplished only locally (see the actor-network analysis below); their design must support patient-care provider interactions flexibly and fluently (consider, for example,

how patients' presentation of problems differs from medical-logical sequences) and variable clinical contexts of individual patients (patients live with multiple acute and chronic problems that may or may not interact); clinical and medical knowledge are constantly changing; and proposals for on-line templates for clinical protocols are implicated in organizational pressures for changes in the division of labor among care providers, particularly redistribution of roles and responsibilities among nursing staff (RNs, licensed vocational nurses, and clinic assistants).

New messaging tools are among the four core functionalities of the electronic health record system-in-the-making, however, the early versions of the electronic health record prototype do not include new functionality for clinical messaging *per se*. When the RN and the cardiologist (Dr. A) use the first version of the electronic health record prototype (introduced during the year after the video recording discussed herein), they devise a work-around to communicate about clinical messages by using the system's feature for "co-signature" to electronically share clinical documentation. They collaborate in mentoring each other in the course of iteratively changing messages, mutual devising new conventions as to what should be included in Dr. A's progress notes that will enable the RN to act more independently and what should be included in the RN's clinical message documentation that will enable Dr. A to proceed with determining a disposition or other next steps.

There are also many opportunities to intervene while new IT tools are in construction or in combination with the development of new IT tools or independent of new IT tools. In this Cardiology and Internal Medicine department, the division of labor was that only one RN handles telephone triage and messaging for any given clinical half day, there is no one to continue telephone triage when the RN needs to assess a walk-in patient who is presenting "tightness in the chest" and to respond regarding prophylactic medications for a walk-in patient about to have surgery. Why not change the division of labor to increase RN staffing? In the physical layout and allocation of equipment in the Cardiology module and the neighboring Gastroenterology module, the RN must pick up new messages from two printers along the long corridor and across the hall. Why not provide a printer in the RNs' messaging room? If dictated emergency room progress notes are made available on-line, the RN would know the emergentologist's assessment or diagnosis in this case (whereas the patient either does not recall, did not fully grasp, or was not fully informed of the diagnosis). If inpatient data were available on-line, particularly transcribed summary reports for admission and discharge, the RN could see diagnoses as determined during hospitalization.

Activity Theory

An activity system may be considered as the unit of analysis for sociohistorical research and for developmental work research as the application of activity theory to work practices. Engeström's activity system triangle embeds the theoretical framework in a graphic depiction of an activity system (c.f. Engeström 1987: see figure 1). The schematic graphic triangle is a tool for creating a dynamic picture of an activity system while exploring specific activities, mediating artifacts, rules, the division of labor and other dimensions that constitute the system as a whole (a life world).

Leont'ev (1979), delineating the concept of activity and the internal structure of activities, schematizes activities, actions, and operations oriented respectively by motives, goals, and conditions—all of which are dynamically interrelated. Leont'ev's point is

important regarding analytic representations of an activity or activity system: "the analysis that leads to distinguishing these units is that *it does not rely on separating living activity into elements.* Rather, it reveals the inner relations that characterize activity. " (Leont'ev 1979, p. 65, emphasis added)

When activity theorists stress the material, objectified form of artifacts, they presuppose that all human artifacts are *idealized*. "Ideality," "idealized culture" and "spiritual culture" are created by human activity and all of nature and the world around us is idealized (Bakhurst 1991; Ilyenkov 1977). By saying that human activity "idealizes nature," human activity "means not the projecting activity of individual minds, but real, sensuous, social, object-oriented' activity" (Bakhurst 1991, p. 190, following Marx). Bødker expresses the sense in which individuals are then confronted by the structured order of the world and of work.

> "The individual will meet this order through power relations, institutions, and grouping of interest in society, under which the human being lives, at the same time as she can contribute to their change. In most societies, the division of labor has caused a separation of the needs of the individual and the goal of the activity in which she takes part. Furthermore, the needs of the individual as part of different collective activities might differ and even conflict. We can say that the human being has not one need in the concrete activity but a whole cluster, some of which are conflicting." (Bødker 1991, pp. 23-24)

In developmental work research, analysis is focused on the communication, coordination and collaboration required of members of teams and participants in networks to accomplish actions that are guided by *goals* of the actions at hand and to instantiate the *object of the activity* that motivates the activity system. Important themes in activity theory and developmental work research include: communicative activity understood as labor and invention; the collaborative and interactive nature of expertise and distributed teamwork; and the significance of the organization of work in relation to skills, learning and power; communication, cooperation and collaboration within and between multi-disciplinary multi-professional teams and networks (Engeström *et al.* 1991); identification of emerging activities and structural dilemmas; envisioning design and use of new tools and experimentation with new ways of working. Engeström (1987) articulates a methodology for organizational "learning by expanding" in which envisioning and proposals for new ways of working are important as lenses for critiquing the present and for bringing about systemic change. In developmental work research, disturbances, breakdowns and "trouble scenarios" are important junctures for innovation. Structural dilemmas and contradictions are openings for expansive transitions that go beyond situated problem-solving to potential transformation of an activity system through the emergence of new ways of acting, talking, thinking, and imagining (Engeström 1990).

Engeström (1987) adds transformative cycles and expansive transitions—"learning by expanding"—to analysis of activity and activity systems. He restates Wartofsky's schema of primary, secondary, and tertiary artifacts as primary artifacts (what?), secondary artifacts (how?), tertiary artifacts (why?), and adds a quaternary artifact type (where to?) (Wartofsky 1979; Engeström 1990). "Why?" and "where to?" artifacts are created through innovation and are constitutive of innovation but not predictably or deterministically. Creative thinking involves continuities and discontinuities; continuities and discontinuities are important in relation to production, reproduction and change. These principles are illustrated, for example, in the work of the Change Laboratory of the Center for Activity Theory and Developmental Work Research (Helsinki). The Change Laboratory developed by Engeström et al. is framed as

organizational design rather than IT per se (Engeström et al., 1996). Analysis of use and contradictions in the present inform possibilities for alternative futures through structured participation of users whose analysis may include “expanding the object” (redefining the object of activity to include new services, for example to include psychosocial as well as medical aspects in conceptions of health).

Kuutti proposed an activity theoretical framework for determining units of analysis for CSCW design and analysis. He regards determination of a unit of analysis as a fundamental research question: "One should be able to delineate the object of research and to draw a boundary between the object and the background, and one should be able to find an entity to which all the threads of research can be conveniently connected." (Kuutti 1991, p. 249) In activity theory, the basic unit of analysis requires "an intermediate concept -- a minimal meaningful context for individual actions ... an activity. Because the context is included in the unit of analysis, the object of our research is always essentially collective, even if our main interest lies in individual actions." (ibid., 254) Kuutti points to affinities between the proposals of Bannon and Schmidt (1991), Lyytinen (1990), and Suchman (1989, 1991) and his proposal of an activity theoretical framework for CSCW in that they share conceptual principles: : (1) work is mediated by artifacts; (2) socially constructed meanings and cultural aspects are taken into account; (3) "Work and the means for it are continuously reconstructed, and thus the unit should be suitable for studying transformation and development." (Kuutti 1991, p. 253); (4) activity has detailed internal structure (Lyytinen 1990); and (5) activity enables consideration of control and conflict (Kling 1991). Considering IS development as activity, IS "has a collective subject--the development group—which uses a development methodology as a tool in order to transform an object--the working practice to be improved." (ibid., 257) The concept of human agency in AT includes the creation of artifacts. "Therefore, artifacts actually are not 'given' and they should never be treated as such." (ibid., 255) The emphasis in activity theory on expansive learning cycles represents a new approach to CSCW in which "the ultimate computer support for work is reconstruction of the work by creating computer artifacts for the work by workers themselves." (ibid., 262) Kuutti suggests that: "It has been possible to generate some new design metaphors by starting out from the structure of an activity." (ibid., 263)

IS/IT analysis and design from an activity theory perspective includes the early, influential work by Bødker on user interface design for work practices (Bødker 1991) and work by Kaptelinin on human computer interface design and use (Kaptelinin 1996a, 1996b). Within the activity theory community at large, there is considerable work in progress in relation to IS/ÌT systems design and development as is evident from the recent International Socio-Cultural Activity Theory Congress (Aarhus 1998), a forthcoming special issue of CSCW, and articles in *Mind, Culture, Activity*. A few examples of such work are mentioned here. A few examples of such work are mentioned here. Smørdal finds an activity theoretical perspective generates new metaphors that are promising for expanding object oriented modeling of computer mediated cooperative activities (Smørdal 1998). Bardram takes up reflective and collaborative problem-solving activities of co-construction in IT systems design and his analysis of situated planning in the development of a patient appointments scheduling system in a Danish hospital (Bardram 1997, 1998). In the context of health care information systems development in Nigeria, Korpela combines an activity theory framework with principles of participatory design with members of the communities of practice to analyze the structure of an activity, related networks of activities, and the wider sociocultural context (Korpela 1998). Engeström proposes “expansive visibilization” of collective work activities as an

intervention methodology, explicating a complex innovation in a Finnish children's hospital that resulted in the transformation of the work of a nurse and physician and the associated creation of a new shared patient record form (Engeström 1999). Sjöberg combined grounded theory, activity theory concepts (particularly voice) and actor-network concepts (particularly arena) to analyze "argumentative design" resources and multi-disciplinary collaboration among in a participatory design project in clinical information systems development (Sjöberg 1996).

Figure 1 depicts a preliminary mapping of the activity system of telephone triage. Although an instance of telephone triage occurs as a conversation between an individual nurse and an individual patient, the activity of telephone triage engages multiple subjects and communities co-constructing an object of activity using mediating artifacts (physical tools and data systems, representations and communicative media, resources of imagination that include models of patient care and alternative visions of future practice), following—trying to follow—complex rules (which interact and often conflict) within divisions of labor that are partially regulated and fixed, partially fluid and contingent, and may be contested.

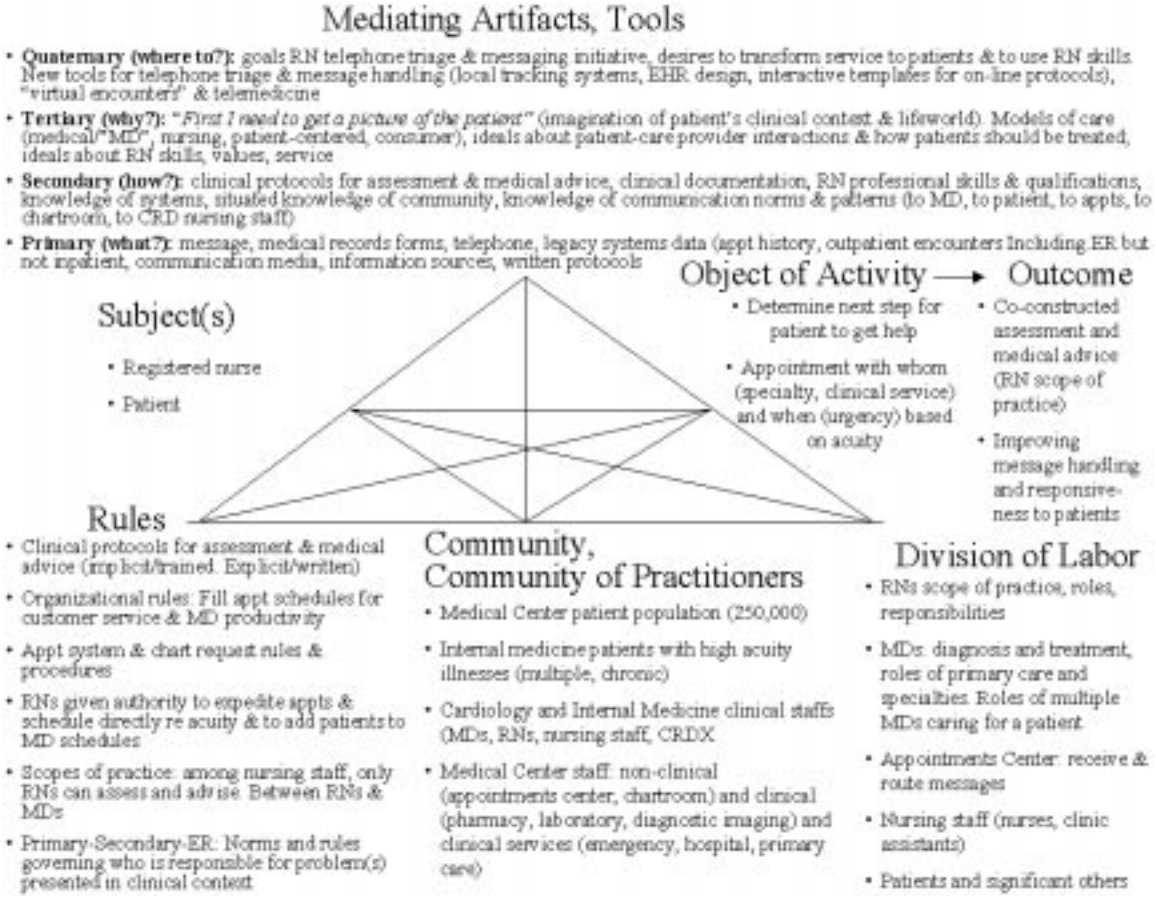

Figure 1. Elements of the Activity System of Telephone Triage

The RNs' initiative is motivated by desires to improve service to patients by using RNs' skills and thereby demonstrate values of RNs' expertise in ambulatory care (these goals are included among quaternary mediating artifacts). Among nursing staff, only registered nurses are qualified to assess and advise patients (RNs scope of practice). Clinical protocols are represented as mediating artifacts and tools and as rules for assessment and medical advice. Protocols can be regarded as resources in situated planning (Bardram 1997, 1998) for situated activity (Suchman 1987). Getting a sense of

the patient's clinical context involves not only searching for information but also resources of imagination and interpretation (tertiary artifacts). "First I need to get a picture of the patient,. . ." the RN explains the first step involved in telephone triage, in responding to a message. Existing computer systems ("legacy systems") for appointment scheduling, laboratory data and on-line transcription of physicians' dictated reports are perused to create such an initial "picture of the patient." Telephone triage by RNs also offers a window onto the underestimated complexity of outpatient nursing skills and responsibilities, seen for example in the work of making sense of relationships between the signs, symptoms, and problems a patient presents and a patient's history of encounters, episodes, and events.

Actor-network theory

As for the other theoretical frameworks we consider for understanding human action in context, actor-network theory insists on a practice perspective. It is distinguished by its conceptualization of heterogeneous ensembles of nonhuman and human actants instantiating practices. "We never see either social relations or things. We may only document the circulation of network-tracing tokens, statements, and skills." (Callon and Latour 1992, p. 351; see also Latour 1987, 1991)Walsham identifies selected key concepts in Actor Network Theory as promising for IS research. Among them are: actor (actant), actor-network, enrollment and translation, delegation and inscription, black box, and immutable mobile (Walsham 1997, p. 468, Table 1). Actor Network Theory's most original (and controversial) move is its symmetry principle regarding non-human and human actors (actants). Callon and Latour (1992) insist on thorough-going symmetrical consideration of actants (human and non-human) as a different starting point in principle than in theories that begin with dualized terms such as subject and object, structure and action, society and nature.

> "Our general symmetry principle is thus not to alternate between natural realism and social realism but to obtain nature and society as twin results of another activity, one that is more interesting for us. We call it network building, or collective things, or quasi-objects, or trials of force (…); and others call it skill, forms of life, material practice (…) " (Callon and Latour 1992, p. 348)

Among others, Berg, Bowker, and Star exemplify actor-network analysis of work practices and information technology tools. Bowker, Timmermans, and Star (1995) show how nursing informatics classification schemes make some aspects of nursing practices more visible than others that remain invisible. Berg (1997b) proposes analytic tools for "a sociology of the Formal in order to develop "an understanding of the generative power of such tools which does not attribute mythical capabilities to either tool or human work." (Berg 1997b, p. 141)

> "…the gap between the formal representation (the *map*) and the actual sphere of work (the *terrain*) is not crossed in one step. Rather, we see a chain of representations (Star 1989; Bowers 1992): a series of intermediate, representational activities performed by materially heterogeneous entities. At each step, input from the territory is condensed, elaborated and transformed until it matches the abstract level of detail of the map." (ibid., p. 144)

Although the protocols employed in the telephone triage case example are not clinical research protocols about which Berg writes, his characterization is apt regarding

the generative power and role of protocols in "capturing the clinic." (Berg, 1997a) “Research protocols attempt to replace the contingent flow of reactive activities with clear-cut, inter-institutionally comparable, standardized actions." (ibid., p. 161) In doing so, protocols introduce "'reproducibility and standardization' that will make a true science out of medical practice." (ibid., pp. 60-61)

Hanseth and Monteiro (1997) employ a “minimalist variant” of actor-network theory, particularly making use of the concepts of *translation* and *inscription*, to conceptualize information infrastructure to analyze case studies of standards development for information infrastructure building.

> “A translation presupposes a medium or a ‘material into which it is inscribed’, that is, translations are ‘embodied in texts, machines, bodily skills [which] become their support, their more or less faithful executive’ (Callon 1991, p. 143).” (ibid.)

> “The notion of inscription refers to the way technical artefacts embody patterns of use. . . . the notion of an inscription may be used to describe how concrete anticipations and restrictions of future patterns of use are involved in the development and use of a technology.” (ibid., p. 330)

To say that designers inscribe a program of action into a technological artifact does not mean that users will use an application or system as designed (see, e.g., Law 1997). In other words, users may follow a different program of action by using IS/IT tools differently, or they may enact an anti-program through non-use or through appropriation to purposes other than the inscribed program of action (Akrich 1992).

From an actor-network theory perspective, standards and standardization of information infrastructures are conceptualized as actor-networks.

> “The primary characteristics of standards is that they are not neutral, technical specifications but large actor-networks including systems architectures, message definitions, individual data elements, standardization bodies, existing implementations of the technology being included in a standard, users and user organizations, software vendors, text books and specifications. Programs of action are inscribed into every element of such networks. To reach agreement and succeed in the implementation of a standard, its whole actor-network must be aligned.” (Hanseth and Monteiro 1997)

Network-building always implicates multiple networks (Star 1989), thus involving several programs of action with varying strengths of inscriptions (Berg 1997b; Sandahl 1999). How a technology is linked to its context also depends on what is inscribed into other networks whose interests, actors/actants (human and artifactual), and representations must be translated, enrolled, and aligned into the larger actor-network required for information infrastructure building and standardization.

Selected concepts from actor-network theory will immediately extend the preliminary analysis of the case example. First, the symmetry principle for considering the distributed roles of non-human and human actors (actants) suggests additional ways to think about the case. The medical problem that causes the patient to call the clinic may be considered as an actant, as will the computer systems, the messages, and clinical and operational protocols. The legacy systems that the RN peruses for patient data (“to get a picture of the patient”) and uses to schedule the expedited appointment inscribe programs of action and patterns of use. Protocols (implicit/trained and explicit/written) used by the nurse are important embodied and inscribed programs of action organizing telephone triage practices. Protocols and legacy systems are intermediaries organizing relationships between signs, symptoms, illnesses and actions to be taken, between the patient, the RN,

the cardiologist, the appointments clerks, the chartroom personnel, and the patient's chart(s) and records in which previous signs, symptoms, illnesses and actions taken are represented as histories that also co-construct these relationships. Processes of information infrastructure building and standardization are implicated in clinical information systems development generally and to the design strategy for the particular electronic health record system related to the case example. Translating protocols into on-line protocols in interactive templates is of special interest to the designers and developers of the electronic health record system-in-the-making.

In the telephone triage case example, protocols are actants that are changing (in media and strength) from embodiment in skilled RNs to inscription in new clinical information tools that will redistribute roles and responsibilities among actors (human and non-human). Transforming protocols cannot be accomplished locally but requires alignment of their translations and inscriptions throughout the actor-network. Previously, a notebook of paper-based protocols for telephone triage was developed by a committee of nurses and nursing administrators at the Medical Center but the notebook of protocols "died on the table"; we might say its alignment was too weak for it to live within the actor-network in which hybrid clinical-and-operational protocols could act as "boundary objects" (Star 1989). To transform protocols into strong inscriptions in a tightly aligned network, the extended actor-network that must be aligned may include (but is not limited to) regional decision-making bodies and reviews by clinical, administrative, and operational practitioners; technical design and designers; communication media; existing and continuously evolving clinical and medical knowledge; signs, symptoms and their interactions with medical problems; disease algorithms and clinical practice guidelines; clinical and non-clinical organizational staff; domain experts (for particular problems); medical records committees and medical records forms and their contents; and controlled medical and clinical vocabularies in electronic health records systems. . Furthermore, regarding clinical and non-clinical telephone messages, there is no a priori boundary in practice despite classification schema for the electronic health record design that strive to set such a boundary. A telephone message that begins as a non-clinical inquiry to confirm that date and time of an appointment may quickly change into a clinical message once the patient begins describing symptoms of a new or recurring problem. Similarly, protocols are clinical-operational hybrids; there is no purely clinical or medical-logical space.

Applying the concept of enrollment into an actor-network to analyze telephone triage illustrates the non-deterministic nature of programs of action and the multiplicity of networks. To enroll the patient, the nurse must translate the problem narratively presented by the patient into a particular type of appointment based on a type of medical problem constructed from the patient's verbal descriptions of signs and symptoms; to enroll the cardiologist, the departmental nursing staff, the appointments clerks, and the chartroom staff requires a chain of translations anticipating how to get everyone "with the program" for the patient and how to get the necessary artifacts into the chain of actions; for certain translations, legacy systems are intermediaries for some but not all parties whereas for other parties, the nurse creates additional artifacts to increase the likelihood of successful enrollment. Imagining a future scenario in which the nurse works with on-line interactive protocols, an actor-network perspective helps us to see that the medical problem presented by the patient must also be enrolled by the protocol, yet a particular medical problem presented by a particular individual can easily elude the formal medical-logical design of a protocol. In addition, a protocol may be developed for a disease whereas patients live with multiple problems; this is especially likely for a patient

diagnosed with a cardiac problem and/or already assigned to an internist or sub-specialist for care. The medical problem must be considered as an actor to be actively translated and enrolled.

An interactionist theory of work

Strauss' theory of work is a methodology to approach an understanding of human action—a Grounded Theory approach—it is not a grand theory. The theory is based on empirical observations of actual work carried out by people and does "not give primacy either to macro- or microlevels in analysis and explanation" (Strauss 1993 p.13). Strauss belongs to the Chicago school in sociology with a basis in symbolic interaction. The school has a longstanding interest in work normally categorized as non-work: invisible and unrecognized work, work with very low status (e.g., prostitution).

Strauss' theory of work is a theory of "*interactions* between and among group members" (Strauss 1993 p.21). Actions are embedded in interactions, past, present, and imagined future. Actions have temporal aspects, and the duration of an action varies with the perspective of the actor. Work is carried out through actions that are dependent on other actions: the division of labor results in a need to coordinate actions with other actors. A work task is carried out in accordance with an agenda, and requires resources; people (individuals, groups), time, and space. Work tasks are ordered in task chains, and intersecting task chains constitute a complex structure of interdependent task chains called the production lattice.

To carry out work implies situated alignment of resources and commitments, but the resources often do not fit the work as there are too many resources (slack) or too few (slip), or that they are misaligned with respect to requirements and conventions.

Strauss distinguishes between *primary work* and *articulation work*. Articulation stands for the coordination of lines of work. This is accomplished by means of the interactional process of *working out* and *carrying through* work-related *arrangements*. *Arrangements* refer to the agreements established among various actors. The arrangements are made with regard to the actions necessary for carrying out the work, as conceived by the participants to it. *Working things out* refers to the interactional process through which arrangements are established, kept going, and revised. This process consists of a series of strategies and counterstrategies taken by participants, in response to what is said or done by others before and after the actual work begins. Strategies include negotiating, making compromises, discussing, educating, convincing, lobbying, manipulating, threatening, and coercing. *Stance* denotes the position taken by each participant toward both the working-out process and the work itself. The position is taken in relationship to perceived power for gaining control over the broader structural and organizational conditions upon which the arrangements stand.

Articulation work is characterized by Star as the invisible work that is needed to carry out the primary work—Star thus includes more than coordination with other actors in the notion (Star 19xx). Star also introduces the notion of boundary object: "objects that are plastic enough to be adaptable across multiple viewpoints, yet maintain continuity of identity." (Star 1989, p. 37).

Gasser (1986) introduces computing work as the work concerned with using a computer. Computing work can be part of both primary work and articulation work. Gasser discusses the situation that an IS does not fit with work, and how strategies for overcoming this become normal work. He distinguished between three types of strategies

to handle misfit between work and computers:

1. fitting (the IT organization, work plans and commitments)
2. augmenting (verifying and revising data, evaluating cause-effect of errors and misfit, comparing different data sources, training, archiving routines)
3. working around (rearranging data or procedures, backup systems)

Thoresen (1998) makes a grounded theory about use that include work related explanations of differences in use patters between organizational members.

Within CSCW (Computer Supported Cooperative Work) Strauss' theory of action has been quite influential. Schmidt & Bannon (1992) claim that groupware should support articulation work, and that CSCW should be the study of work in order to develop technological support. This view is further developed in the work of Schmidt & Simone on interaction mechanisms (1996; cf. also Carstensen & Sørensen 1996).

A different aspect of Strauss' work is emphasized in the work of Fitzpatrick et al (199?): time and space as dimensions of social worlds.

The Grounded Theory approach basic in the interactionist theory of work emphasize the details of the actual, concrete work as it is carried out, in order to identify unrecognized and tacit parts of work carried out by the RN or other actors—including the patient. The concepts describing the actual work constitute a local theory, grounded in practice.

The RN in the case performs a lot of articulation work as she relates to a number of systems. The nurse carries out several conversations through her actions, and all of them influences her actions. She has a conversation with the patient identifying symptoms and agreeing on actions (work) for both parties, she communicates with the system about the representation of the patient in the system, she communicates with the medical doctor so that she acts in accordance with the commitments she has made on his behalf, and with the appointment clerks, and with the department receptionist and nursing staff so that they know how to meet the patient. Her work is very much to translate between these systems during the actual telephone conversation (see e.g. Wynn (1979)).

The RN uses a variety of resources in her communication: she communicates with the doctor, clerks, and department staff via clinical documentation to patient records, handwritten yellow sticky notes (outside the patient records), medical records forms such as the EKG order slip, and by entering meaningful information to the appointment system.

The RN does computing work as part of her primary and articulation work. The system does not fit her work, and she has to work around it: she shortcuts the appointment making routine in order to get the patient an appointment while she is in the midst of the assessment with the patient on the phone, afterwards she enters the systems (both the paper based and the computer based) to "fake" a routine: she works around the system so that she makes all the correct steps in the routine, but in the wrong order (she goes back making it fit the routine). In order to be sure that her workaround will be OK, she adds explanations and pointers by post-its: she adds notes to communicate to other people which task chains are intersecting and interdependent with her task chain—which she has worked around. This requires quite sophisticated knowledge about the systems as well as the work and use of the system, both her own and other colleagues' use of it.

The systems used by the RN are boundary objects: the doctor's schedule (to be used by her, the doctor, the clerks) and the patient information system. She has to follow the standards so that the documents matches the standards and so that other people can make sense of her work. She uses post-its and conversations when she needs more flexibility than the system can offer (which means that the system as a whole admits quite

a bit of flexibility).

Another interesting aspect of the case is that the patient carries out some work, and that the nurse takes care to instruct the patient about this. She takes care to explain to the patient how to get to the hospital and to the Cardiology offices, and how to interpret symptoms to decide whether to go to the emergency room before the appointment or not.

> "[T]here are two striking features of health work shared only with certain other kinds of work. One consists of the unexpected and often difficult to control contingencies stemming not only from the illness itself, but also from a host of work and organizational sources as well as from biographical and life-style sources pertaining to patients, kin, and staff members themselves. A second and crucial feature of health work is that is 'people work.' . . . Two things follow: (1) the patient can react and so affect the work; (2) the patient can participate in the work itself, that is, be a worker." (Strauss et al. 1997 (1987), p. 9)

Strauss emphasizes ideology: what it means to be a nurse, and ideology and values seem to be important in the work. The RN practices nursing when making sure that the patient is taken care of when the RN herself is not there. She also discusses with herself when deciding and making priorities: there are several conflicting value sets that she relates to that influence her choice. The urgent category—STAT—for ordering a patient chart cannot be used so often that her reputation—and the reputation of her team as well—will be harmed. Using STAT chart requests too frequently can also result in her urgent cases being met with skepticism by the rest of the chartroom personnel. On the other hand, the physician and her team are evaluated by statistics about patient appointments.

Structuration theory

Structuration theory (Giddens 1984) provides a conceptual framework for describing and discussing the relations between human action and social structures in general and independent of concrete situations. The theory is

> "an attempt to provide the conceptual means of analyzing the often delicate and subtle interlacings of reflexively organized action and institutional constraint." (Giddens 1989, p. 204)

The theory is an attempt to develop an ontological conceptual framework for the study of social activities as well as a new approach to interpretation and classification of classical sociological thinking (Giddens 1989). Structuration theory can be seen as a meta theory (Walsham & Han 1991).

Giddens criticizes the dualistic conceptualization of the relation between the individual and society as it is expressed in sociology as the division between subjectivity and objectivity. Giddens reformulates this as the relation between action and structure, as two sides of a whole—a duality.

> "The basic domain of study of the social sciences, according to the theory of structuration, is neither the experience of the individual actor, nor the existence of any form of societal totality, but social practices ordered across space and time." (Giddens 1984, p. 2)

Structuration is a process that involves the mutual interaction between human actors and structural properties of organizations. The basic principle in the theory is the

duality of structure: human action is both enabled and constrained by social structures, and the social structures are a result of human action. We act within structures that we change through our actions. Giddens views human action as a continuous stream of behavior, a durèe (Giddens 1984). An actor has the ability to change his/her environment. An action is defined by the human ability to perform the action rather than by its intentions. This ties the action to power:

> "agency concerns events of which an individual is the perpetrator in the sense that the individual could, at any phase in a given sequence of conduct, have acted differently." (Giddens 1984, p. 9)

Human cognition is a necessary and continuous part of human nature. There are three continuous and necessary processes that characterize human action: reflexive monitoring, rationalization, and motivation of action. The three processes are located at different levels of consciousness. Unconscious motivation is a characteristic of human action (Giddens 1984). The knowledgeability of an actor is basic for the human ability to social life. Actions can be intentional if the actor knows or believes that the action will have a particular result. An action can also result in unintended consequences that constitute conditions for new actions.

Structure refers to structural properties that make it possible to recognize systems of similar social practices over time and space (Giddens 1984). The structural properties of social systems can be seen as institutionalized or durable properties of social practice that give stability to the systems over time and space. Social systems are not structures, but express some structural properties. Structure exists in time and space only in its instantiation of practice and as cognitive elements that advise human agents in their interaction with their environment. Structures can be analyzed at three abstraction levels based on the institution of practices at different levels:

1. structural principles that constitute a society as one of a kind, e.g., class society
2. structures
3. structuration elements / axes

The most important aspect of structure comprises rules and resources that are recursively implied in the reproduction of social systems. Rules and resources enable the agent to perform action as well as delimit the same action. To know a rule is to know how to act in accordance with the rule—which links rules to practice. Resources can be allocative (control of objects and material phenomena) and authoritative (control of people): structural properties express forms of dominance and power. Structure can be expressed through two roles that rules play: in the constitution of meaning and by their connection to sanctions (normative elements). Giddens thus introduces three dimensions that can be combined in different ways in social practice (Giddens 1979):

1. Structures of domination are "asymmetries of resources" that agents draw upon in exercising power. Resources reflect the capabilities of actors to act intentionally.
2. Structures of legitimation refer to norms ("rules") that actors draw upon in the sanctioning of their own and others' conduct in interaction. Norms include rights and duties expected of actors in interaction.
3. Structures of signification refer to rules of what constitutes meaning. Actors draw upon interpretive schemes that mediate communication, and by this actors reproduce structures of signification.

Giddens uses the notion of modalities to relate the knowledgeability of an agent to structural properties.

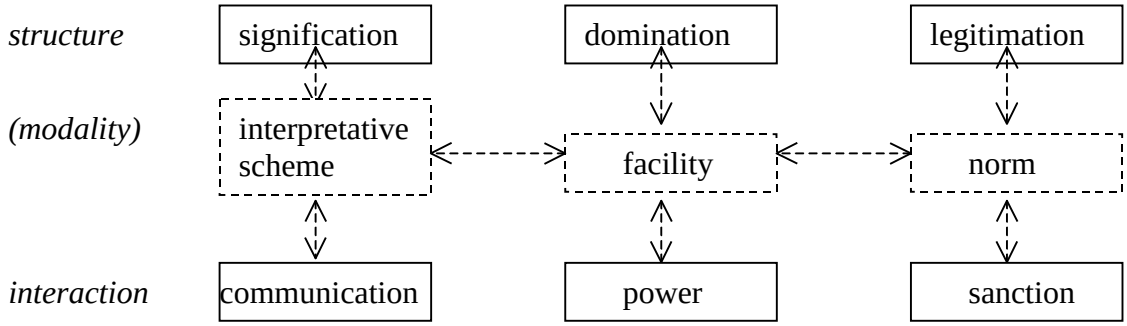

Figure 2: Dimensions of the duality of structure in interaction (Giddens 1984, p. 29)

Structuration theory is not very easy to apply as it is abstract and general (Dreiem 1998; Jerdal 1994; Rønning 1994). Nevertheless, the theory has been used in a number of studies of IT implementation and use (DeSanctis and Poole 1994). Orlikowski (1992) analyses IT as a structure: she sees technology as a form of structural properties. Lyytinen and Ngwenyama (1992) also view CSCW applications as structures: IT-programs incorporate rules that define important aspects of social behavior. IT thereby mediates and transforms communication practice, organizational rules and norms, hierarchies and distribution of roles. Use of technology is a modality.

Walsham (1993) criticizes this way of applying structuration theory because of the difference between the physical structure of the system and the social structures emphasized by Giddens. Walsham locates technology at the modality level:

> "A theoretical view of computer-based information systems in contemporary organizations, which arises from structuration theory, is that they embody interpretative schemes, provide co-ordination and control facilities, and encapsulate norms. They are thus deeply implicated in the modalities that link social action and structure, and are drawn on in interaction, thus reinforcing or changing social structures of signification, domination and legitimation." (Walsham 1993, p. 64)

According to this interpretation, IT mediates structure, and an IS should be seen as a modality rather than a social structure. Scheepers & Damsgaard (1997) share this view in their analysis of intranets.

Karsten (1996) and Dreiem (1998) argue that the division of action, modalities and structures are analytical constructs and that technology should be analyzed at all three levels: the focus of the particular analysis should decide which of the three levels are preferred.

Even if structuration theory is a general theory, it is closely connected to practice: structures and structural properties are only visible through practice, through action. At the overall level, it is relatively easy to recognize that the work of the RN in the telephone triage is both enabled and constrained by social structures in the form of rules and resources that are common to many health care systems and organizations.

We follow Karsten and Dreiem in that technology can be analyzed both as action, modalities, and structure. The technology can be seen to express structural properties in the organization, e.g., the categorization of a patient as urgent or not structures other people's work. It constitutes a structure aligned with other structures. The technology mediates structural properties (a modality), e.g., mediating power structures as the nurse is given the right to add two urgent appointments to the doctor's appointment schedule (on top of his full schedule) because she assess the case an emergency. The system can also be seen as action as enabling action beyond its apparent constraints, that the RN uses

the system as action.

The three dimensions of structuration are useful: signification, domination, and legitimation. The RN draws upon interpretive schemes from a number of sources (professional, medical, business, the patient's understanding of her own illness) in the communication, and by this she reproduces structures of signification. Her communication with the patient and with the rest of her team / the hospital unit is strikingly knowledgeable, and her action is motivated by her anticipation of consequences of her actions.

Domination and acts of power are visible in the "asymmetries of resources" that the RN draws upon in her work. Resources reflect the capabilities of actors to act intentionally. The RN has limited power compared to the physician—the situation as such expresses power structures through the limited resources available in the telephone triage situation (e.g., only one nurse).

The RN's actions are also influenced by norm systems and possible sanctions to her behavior. There are at least two influential norm systems: medical and business, which may conflict. The norms include rights and duties expected of actors in interaction. The RN is careful to follow the norms that may structure other people's work, e.g., the decision to use the urgent priority for the expedited appointment, and making the patient aware of her responsibilities for deciding on the seriousness of symptoms until she sees the cardiologist (while taking care not to make her worry too much).

Discussion: use of artifacts, change, design

Each of the theories considered here generates distinct contributions to the case example. The emphasis in activity theory on conceptualizing a unit of analysis for an activity and considering the elements of an activity system as dynamic and perpetually open to change, with its core emphasis on mediation and multiplicity of artifacts, provides a useful starting point for analysis of work practices for IS/IT design. The analytic toolkit that activity theory and developmental work research provide can be used for quickly mapping the elements of an activity system, and for developing a shared understanding of object(s) of activity motivating communities of practice. Actor-network theory, by including non-human actors/actants, suggests a number of different points of analysis to pursue in the case example: the medical problem presented by the patient, the emerging ontology of protocols in clinical information systems development, the roles of legacy systems and patient records as active intermediaries co-constructing telephone triage practices, the implication of multiple networks (each comprising heterogeneous ensembles of actors/actants) that must be aligned if protocols are to be translated and inscribed into electronic health record systems. The interactionist theory of work emphasizes the interdependencies between the staff, and how these interdependencies are worked out through a number of activities as work is carried out. The trivialities and often invisible parts of work are aimed at making the larger production lattice, the intersecting task chains, run smoothly. The theory makes sense of everyday work practices. Structuration theory adds to our understanding of the case by offering a set of perspectives for our analysis of the durable aspects at all organizational levels: domination, signification, legitimation. The focus on the duality of structure gives attention to structures and expressions of structural properties. Structuration theory, as a meta theory, lends itself to fruitful combinations with methodologies and concepts from compatible theoretical frameworks. Walsham quotes Giddens (1984) as arguing that "he

did not set out to 'wield a methodological scalpel'" and speculates that Giddens would welcome such "theoretical eclecticism." (Walsham 1997, p. 473) Activity theory and structuration theory are complementary in that in both frameworks, human agency is emphasized, and structure and action are considered irreducibly interrelated.

Actor-network theory and activity theory share emphasis on mediation-in-action and mediating artifacts (akin to intermediaries in actor-network theory) in complexes of humans, tools, communities. However, from an actor-network perspective, "Activity Theory's explicit underwriting of the a priori asymmetry between humans and non-humans is problematic." (Berg 1997b, p. 145, note 3)

The theories are social theories aimed at understanding human action in a context: they are more or less difficult to use as a tool for change and design. Activity Theory is an exception as it is based on learning theory and thus emphasizes change, developmental work research has an explicit action research orientation. Structuration theory and actor-network theory are both aimed at making sense of the present situation, partly through going back in history. Grounded theory is a methodology, rather than a theory, and the emphasis is put on the practicalities of work and interaction.

Because activity theory and actor-network theory include concepts for analysis artifacts, we find them easier to apply in systems development (see e.g., Sandahl 1999).

Concluding remarks

Use of IT is of interest to system design as it is the basis for design: knowledge about current work and organization, as well as the goal of design: the future use in a changed organization. Most systems are designed to be used in some work activity, and during design system developers try to imagine and predict how the users will use the system-in-the-making. Use is, however, unpredictable to some extent, and system development research seems to be in need of theories and concepts to address use as a human activity that is partly unpredictable. The theories can also be used to make sense of design processes as social and political work processes.

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