ACTIVITY THEORY AND EXPANSIVE DESIGN

Yrjö Engeström
University of California, San Diego and University of Helsinki

INTRODUCTION

In this paper, I will approach interaction design from the viewpoint of cultural-historical activity theory (Leont'ev, 1978, Engeström, Miettinen & Punamäki, 1999). My central arguments may be condensed in the following five.

1. Interaction design needs to be embedded, integrated and made visible in the activity systems within which the targeted products and services are produced and used.
2. Interaction design needs to be directed not only at products but also at relationships, processes, services, organizations and, most importantly, at germ-cell concepts or visions of the future activity.
3. Expansive interaction design creates integrated intrumentalities, not only isolated products. It operates by anchoring its ideas and outcomes upward, downward, and sideways.
4. Expansive interaction design is best performed jointly by producer practitioners and their key customers, supported by interventionists. This requires special reflective intervention methods, 'microcosms' which combine joint negotiated decision making, joint future-oriented envisioning, and simulation of future modes of interaction across boundaries.
5. Expanded in these ways, interaction design tends to merge with implementation and learning; expansive design, expansive implementation and expansive learning are three sides of the same coin.

To open up and substatiate these arguments, I will first introduce some central concepts of cultural-historical activity theory. After that, I will sketch steps in the evolution of design and, in particular, the emergent mode of co-configuration work as a landscape where interaction design will increasingly take place. Next, I will present the case of interaction design within the medical care of chronic patients with multiple illnesses. I will then move to discuss certain key features of expansive design in the context of co-configuration work as exemplified in the medical care case. This leads me to discuss the interventionist methodology needed for enhancing and studying expansive design. I will conclude by discussing briefly the relationships between design, implementation, and learning.

CENTRAL CONCEPTS OF ACTIVITY THEORY

Cultural-historical activity theory looks at artifacts and people as embedded in dynamic activity systems (Figure 1). If we think of a designer as the *subject* of her design work, the initial *object* would be an idea, order or assignment that triggers the design process. The initial object is necessarily ambiguous, requiring interpretation and conceptualization. Thus, the object is step-by-step invested with personal sense and cultural meaning. The object goes through multiple transformations until it stabilizes as a finished *outcome*, for example a prototype or even a commercial product. This process is

only possible by means of *mediating artifacts*, both material tools and signs. The designer may use pencil and paper, clay models, or 3D computer graphics, along with internalized images and concepts that seem relevant for the forging of the object. The process alters, sometimes even generates entirely new mediating artifacts.

The paragraph above describes the uppermost sub-triangle of the activity system depicted in Figure 1. The bottom part of the figure calls attention to the work *community* in which the designer is a member, for example a product development unit or an in-house design unit of a corporation, or perhaps an independent design firm. Within the community, the members continuously negotiate their *division of labor*, including the distribution of rewards. The temporal rhythms of work, the uses of resources, and the codes of conduct are also continuously constructed and contested in the form of explicit and implicit *rules*.
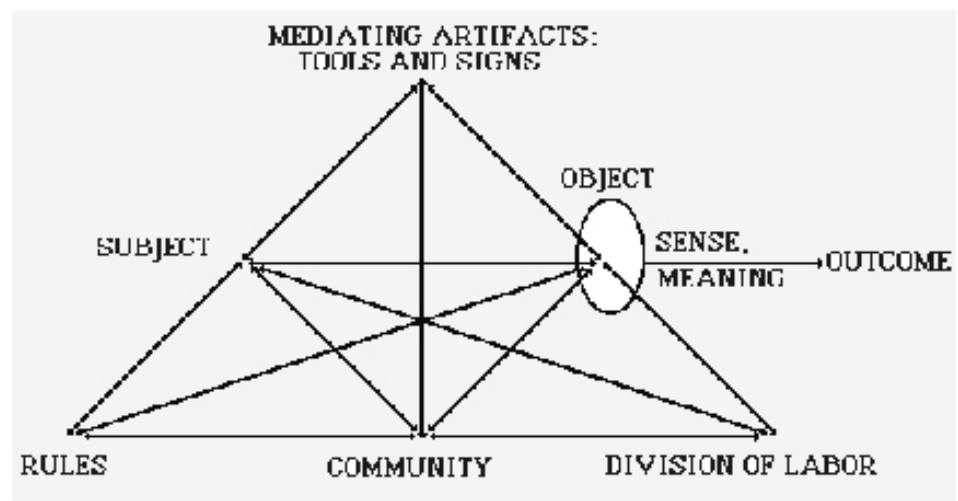

Figure 1. The structure of a human activity system (Engeström, 1987, p. 78)

For designers, as for any practitioners involved in complex organized activity, making sense of their own work as a collective activity system represents an expansive challenge of 'visibilization' (Engeström, 1999). But this is only the first step. Opening up and making visible the activity systems of key customers or users is the logical second step of expansion. This requires that the unit of analysis is extended to include minimally two interconnected activity systems. In Figure 2, the triangle on the left represents the activity system of the designer, the one on the right represents the activity system of the customer or user. Of course the network of relevant activity systems is often more complex, including for example multiple design teams, subcontractors, internal client units within the corporation, and external end-user customers.

The formation of a partially shared object between the designer and the customer/user is a crucial challenge. In Figure 2, object 1 represents the initial problem, assignment or 'raw material' of the design process. Object 2 represents an elaborated image, vision or prototype of the of the object. Object 3 stands for the potential common ground or synergy between the two perspectives.
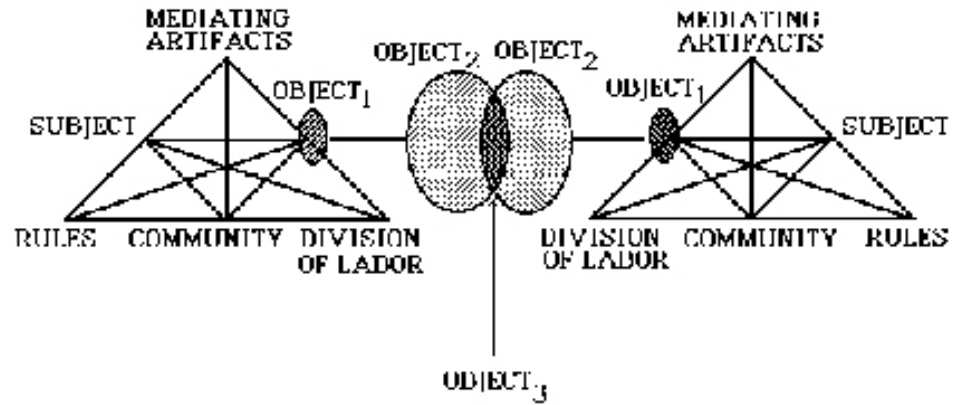
Figure 2: Two interacting activity systems as minimal unit of analysis for expansive design (Engeström, 2001a, p. 131)

Design is an activity that easily becomes self-absorbed. The emerging object of design tends to become an object of affection, an end in itself (Engeström & Escalante, 1996). This may lead to the assumption that the object will have the same centrality and appeal for the end user as it has for the designer. From the point of view of the user, the designer's product is commonly expected to be simply a tool, an instrument among many others. If the product turns into an object that requires constant attention, it often becomes a source of frustration rather than affection for the user, especially when the user is given no or minimal tools to handle, understand and modify the supposedly self-explanatory object (Hasu & Engeström, 2000). Expansive design is demanding as it requires successive radical shifts of perspective in critical transitions between design and use (Hasu, 2001).

THE EVOLUTION OF DESIGN
Without a substantive understanding of the historically changing character of the work done in a given organization, theories of design are likely to remain too general and abstract to capture the past vestiges and the emerging possibilities of design. Bart Victor and Andrew Boynton (1998) provide a useful historical framework for such a reintegration of organization, work, and design. They identify five ideal types of work in the history of industrial production: craft, mass production, process enhancement, mass customization, and co-configuration (Figure 3).
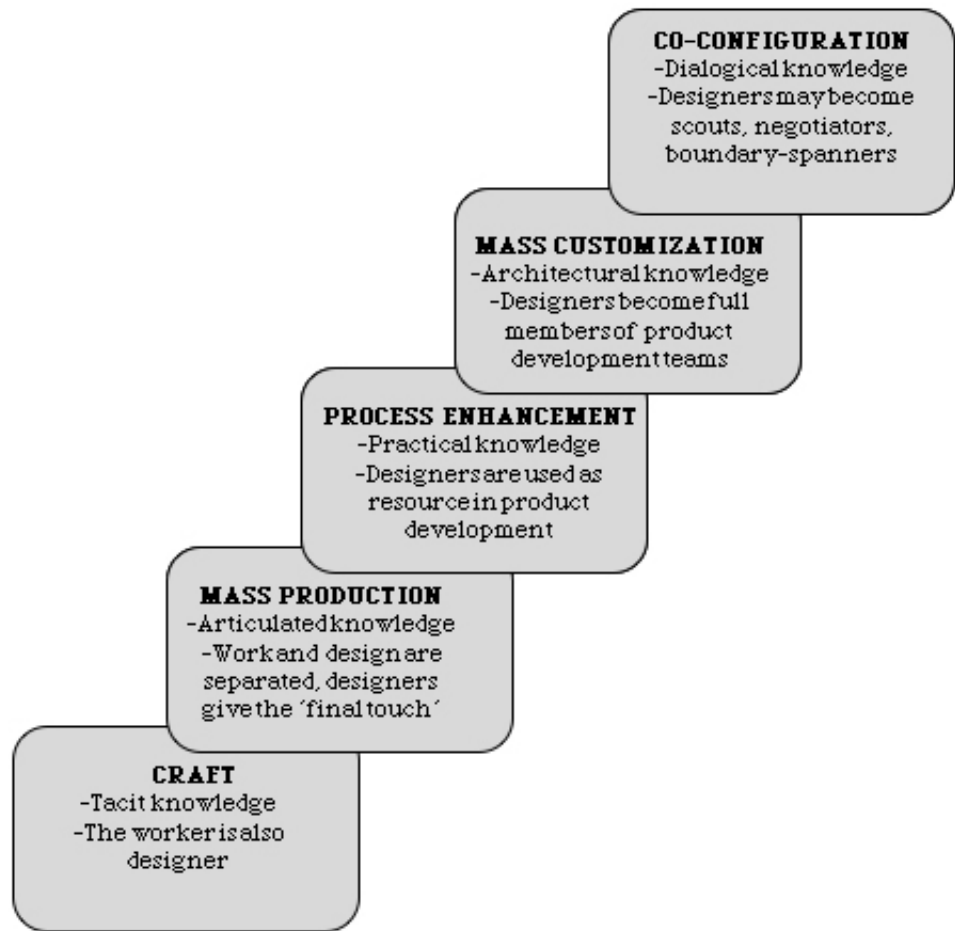
CO-CONFIGURATION
-Dialogical knowledge
-Designers may become
scouts, negotiators,
boundary-spanners

MASS CUSTOMIZATION
-Architectural knowledge
-Designers become full
member of product
development teams

PROCESS ENHANCEMENT
-Practical knowledge
-Designers are used as
resource in product
development

MASS PRODUCTION
-Articulated knowledge
-Work and design are
separated, designers
give the 'final touch'

CRAFT
-Tacit knowledge
-The worker is also
designer

Figure 3. Historical forms of work, knowledge and design (adapted and expanded from Victor & Boynton, 1998, p. 6 and p. 233)

Each type of work generates and requires a certain dominant type of knowledge and design. In craft, the worker and the designer were essentially merged in one and the same person, the master craftsman. In mass production, design was concentrated in the hands of engineers and radically separated from the execution of work. Mass production also creates the demand for professional designers whose task is typically focused on giving a 'final touch' of visual and tactile consumer appeal to products.

In process enhancement, frontline workers are given responsibilities for the continuous improvement of processes and products, while the development of new products and processes is still firmly kept in separate design units. As quality becomes of crucial importance, professional designers are increasingly used in assisting development projects with their particular insights.

In mass customization, the customer is brought into the design process by being offered the chance to put together a unique 'personalized' combination of available standard components. Even in mass customization, the development of truly new products and processes remains separate from the actual production, but feedback from customer choices has an increasingly speedy and direct impact

on product and process development efforts. Professional designers often become true members of product development teams.

ON THE EMERGENCE OF CO-CONFIGURATION WORK

In his ingenious film *Playtime* (1967), Jacques Tati follows in great detail the final steps of construction and the opening night of a restaurant. As the opening approaches, workmen are still finalizing various details of the physical structure. Already before the first guests arrive, some details begin to fall apart, and frantic efforts are made to fix them. As the evening progresses, the are increasingly dramatic breakdowns. Workmen, restaurant personnel, the architect, various customers, and accidental passers-by get involved in intricate schemes of repair and improvisation, dispersed in unexpected ways in time and space. It becomes evident that this restaurant will never be 'finished'; the activities of serving and dining become saturated with simultaneous actions of coping with the falling apart and reconfiguration of the restaurant itself.

Tati envisioned something not unlike co-configuration work, as defined by Victor and Boynton (1998). An observer characterizes the co-configuration efforts she witnessed in the planning, design and implementation of an information infrastructure for a city district as follows.

"The actors are like blind players who come eagerly to the field in the middle of the game, attracted by shouting voices, not knowing who else are there and what the game is all about. There is no referee, so rules are made up in different parts of the field among those who happen to bump into one another. Some get tired and go home."
A critical prerequisite of co-configuration is the creation of customer-intelligent products or services which adapt to the changing needs of the user.

"The work of co-configuration involves building and sustaining a fully integrated system that can sense, respond, and adapt to the individual experience of the customer. When a firm does co-configuration work, it creates a product that can learn and adapt, but it also builds an ongoing relationship between each customer-product pair and the company. Doing mass customization requires designing a product at least once for each customer. This design process requires the company to sense and respond to the individual customer's needs. But co-configuration work takes this relationship up one level – it brings the value of an intelligent and 'adapting' product. The company then continues to work with this customer-product pair to make the product more responsive to each user. In this way, the customization work becomes continuous. (…) Unlike previous work, co-configuration work never results in a 'finished' product. Instead, a living, growing network develops between customer, product, and company." (Victor & Boynton, 1998, p. 195)

We may provisionally define co-configuration as an emerging historically new type of work that has the following characteristics: (1) adaptive 'customer-intelligent' products or services, or more typically integrated product/service combinations, (2) continuous relationships of mutual exchange between customers, producers, and the product/service combinations, (3) ongoing configuration and customization of the product/service combination over lengthy periods of time, (4) active customer involvement and input into the configuration, (5) multiple collaborating producers that need to operate in networks within or between organizations, (6) mutual learning from interactions between the parties involved in the configuration actions.

In other words, co-configuration is more than just smart, adaptive products. "With the organization of work under co-configuration, the customer becomes, in a sense, a real partner with the producer." (Victor & Boynton, 1998, p. 199) Co-configuration typically also includes interdependency between multiple producers or providers forming a strategic alliance, supplier network, or other such pattern of partnership which collaboratively puts together and maintains a complex package which integrates material products and services and has a very long life cycle. Co-configuration requires flexible 'knotworking' in which no single actor has the sole, fixed authority – the center does not hold (Engeström, Engeström & Vähäaho, 1999).

Co-configuration is typically needed in divided multi-activity terrains, or multi-organizational fields, in which the different activity systems have critically important shared objects or customers but little evidence of productive collaboration across organizational boundaries. In such terrains, design needs to take shape as self-reflective renegotiation of collaborative relations and practices.
A precondition of successful co-configuration work is dialogue in which the parties rely on real-time feedback information on their activity. The interpretation, negotiation and synthesizing of such information between the parties requires dialogical and reflective knowledge tools as well as collaboratively constructed functional rules and infrastructures (Engeström & Ahonen, 2001).

Although partially similar, the concept of co-configuration must not be confused with the notion of co-production, put forward by Richard Normann (2001; see also Normann & Ramirez, 1994, Ramirez & Wallin, 2000). Normann (2001, p. 97) points out three aspects of co-production: customer participation (or 'prosumption'), customer cooperation (or customer communities), and value constellations (or cooperation between providers). These characteristics correspond to the idea of co-configuration, and Normann's emphasis on customer communities actually enriches the concept of co-configuration. The difference between the two concepts becomes manifest in Normann's argument about time.

"From being primarily sequential in time, they [co-productive relationships] tend – as a result of connectivity and interactivity – to become simultaneous, synchronous, and reciprocal. By this process we can compress time – we can, in fact, create time since we can package activities more densely into given time slots, thus liberating other time slots for other activities. And we can also proceed by occupying time slots that used to be 'unproductive'." (Normann, 2001, p. 96)

Normann's emphasis on compression of time is in line with the general postmodern argument about compression of time and space (Harvey, 1989). In contrast, the idea of co-configuration is based on analysis of *specific historically new objects*, namely customer-intelligent products and services which have very long half-lives and require constant collaborative reconfiguration, never resulting in a 'finished product'. This means that the time perspective must be radically expanded, not just compressed (for a more detailed analysis, see Engeström, Puonti & Seppänen, 2003).

The expansion of objects of work in co-configuration happens along four dimensions (Engeström, 2001b). Social-spatial expansion means that a radically wider circle of activity systems is directly involved in

the construction of the object. Temporal expansion means that the constant reconfiguration of the object requires a mastery of its history and a long-term plan for its future evolution – along with very quick improvisation of collaborative action when needed. Moral-ideological expansion means that responsibility and power are constantly redistributed and renegotiated among the participants. And systemic-developmental expansion means that seemingly singular or routine everyday actions are increasingly problematized and connected to their systemic consequences and developmental potentials.

In co-configuration, 'products' are to be understood as complex configurations of organizational arrangements, services and technologies. Thus, product design, process design and organization design (e.g., Nadler & Tushman, 1997, Zell, 1997) become increasingly integrated, and management itself is penetrated by design language (Boland, in press). Professional designers may in these conditions gain a strategic role as scouts, negotiators and boundary-spanners who bring together previously separate activity systems and domains of expertise, facilitating the formation of expanded objects and novel partnerships.

EXPANSIVE DESIGN OF MEDICAL CARE FOR CHRONIC PATIENTS WITH MULTIPLE ILLNESSES

In Helsinki, the capital of Finland, 3.3% of the patients used 49.3% of all health care expenses in 1999. 15.5% of patients used 78.2% of all resources. This is an example of the well-known 20/80 rule, implying that in industrialized countries roughly 20% of patients use roughly 80% of the resources.

Health care in a large city is typically a divided field of multiple, poorly coordinated activity systems, with historically formed hierarchical relations and turf tensions between them. Many of the patients who belong to the '20%' become so expensive because they have multiple serious chronic illnesses which cannot be dealt with by any single specialty alone. These patients often drift and bounce from one caregiver to another without anyone having an overview and overall responsibility for their care. Co-configuration work is a strategic priority because the different caregivers and the patients need to learn to produce together well coordinated and highly adaptable long-term care trajectories.

The design challenge in this field is to construct a new, negotiated way of working in which patients and practitioners from different caregiver organizations and specialties will collaboratively plan and monitor the patient's trajectory of care, taking joint responsibility for its overall progress. This is easier said than done.

The design of an entire new way of working across and between multiple activity systems is typically a task that may be best approached by generating a simple germ-cell concept of the foundational relations upon which the new practice will be built (on germ-cell concepts, see Davydov, 1990). This in turn requires that the existing contradictions within and between the key activity systems are identified. These steps were accomplished in the winter of 1998 in an intervention project called *Boundary Crossing Laboratory* which we

conducted with approximately 60 representatives of the Children's Hospital on the one hand and the local primary care health centers on the other hand. The resulting image of the contradictions may be summarized with the help of activity system models (Figure 4).

To make analytical sense of the situation, we need to look at the recent *history* of the activity systems involved. Since the late 1980s, in municipal primary care health centers, the personal doctor principle and multi-professional teams have effectively increased the continuity of care, replacing the isolated *visit* with the long-term care relationship as the object of the practitioners' work activity. The notion of *care relationship* has gradually become the key conceptual tool for planning and recording work in health centers.

A parallel development has taken place in Finnish hospitals. Hospitals grew bigger and more complicated in the postwar decades. Fragmentation by specialties led to complaints and was seen to be partially responsible for the rapidly rising costs of hospital care. In the late 1980s, hospitals began to design and implement *critical paths* or *pathways* for designated diseases or diagnostic groups.
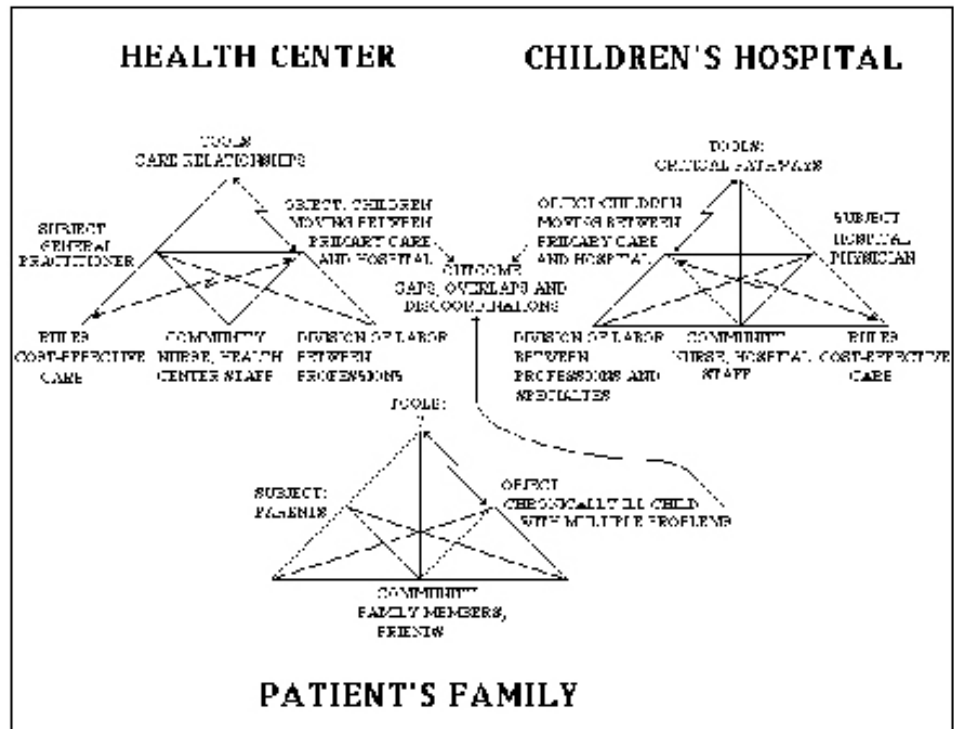

Figure 4. Contradictions in children's health care in the Helsinki area (Engeström, 2001a, p. 145)

Care relationships and critical paths respond to contradictions *internal* to the respective institutions. Care relationships are seen as a way to conceptualize, document and plan long-term interactions with a patient inside primary health care. Their virtue is that the patient can be seen as having multiple interacting problems and diagnoses that evolve over time; their limitation is that responsibility for the patient is practically suspended when the patient enters a hospital. Correspondingly, critical paths are constructed to give a normative

sequence of procedures for dealing with a given disease or diagnosis. They do not help in dealing with patients with unclear and multiple diagnoses, and they tend to impose their disease-centered worldview even on primary care practitioners. Fundamentally, both care relationships and critical paths are *linear* and *temporal* constructions of the object. They have great difficulties in representing and guiding *horizontal* and *socio-spatial* relations and interactions between care providers located in different institutions, including the patient and his/her family as the most important actors in care.

In both the hospital and the health center, a contradiction emerges between the increasingly important *object* of patients moving between primary care and hospital care and the *rule* of cost-efficiency implemented in both activity systems. In Helsinki, the per capita expenditure on health care is clearly above national averages, largely due to the excessive use and high cost of services provided by the central university hospital of which the Children's Hospital is a part. Thus, there is an aggravated tension between the primary care health center and the university hospital. Health centers in the Helsinki area are blaming the university hospital for high costs, while the university hospital criticizes health centers for excessive referrals and for not being able to take care of patients who do not necessarily need hospital care.

A contradiction also emerges between the new *object* (patients moving between primary care and hospital care) and the recently established *tools*, namely care relationships in primary care and critical paths in hospital work. Being linear-temporal and mainly focused on care inside the institution, these tools are inadequate for dealing with patients who have multiple simultaneous problems and parallel contacts to different institutions of care. In the activity system of the patient's family, the contradiction is also between the complex object of multiple illnesses and the largely unavailable or unknown tools for mastering the object.

As concrete patient cases were discussed and different aspects of these contradictions were articulated in the Boundary Crossing Laboratory, we observed a shift among the participants from initial defensive postures toward a growing determination to do something about the situation. The determination was initially fuzzy, as if a need state (Bratus & Lishin, 1983), looking for an identifiable object and corresponding concept at which the energy could be directed.

Excerpt 1 (Boundary Crossing Laboratory, session 5)
Hospital physician: I kind of woke up when I was writing the
   minutes (of the preceding session). …What dawned on me concerning B (name of the patient in the case discussed) is, I mean, a central thing… for the mastery of the entire care. How will it be realized and what systems does it require? I think it was pretty good, when I went back through our discussion, I think one finds clear attempts at solving this. It is sort of a foundation, which we must erect for every patient.
Researcher: That seems to be a proposal for formulating the problem. What is… or how do we want to solve it in B's case? I mean, is it your idea that what we want to solve is the mastery of the entire care?
Hospital physician: I think it's just that. I mean that we should have… or specifically concerning these responsibilities and sharing of responsibility and of practical plans, and tying knots, well, we should have some kind of arrangement in place. Something that makes everyone aware of his or her place around this sick child and the family.

Step by step, the idea of *care agreement* took shape as a germ cell concept with the potential to resolve the contradictions. The practitioners formulated the idea with the help of a diagram (Figure 5). Subsequently the model was enriched, tested in practice, and concretized in our next intervention project where we used a method we called *Implementation Laboratory* (Engeström, 2003, Engeström, Engeström & Kerosuo, 2003).
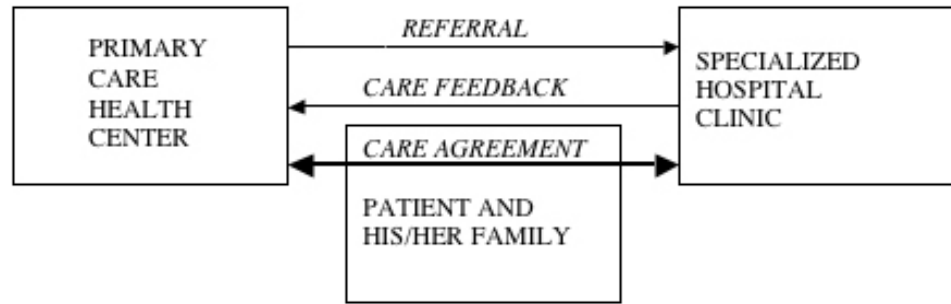

Figure 5. A germ-cell model of the care agreement practice

The crucial point of the care agreement model is that minimally the three key players of care, namely the patient, the health center general practitionerresponsible for the patient, and the hospital specialist in charge of the patient's care, negotiate an overall framework for the patient's care for the next year. They sign a mutual agreement that obliges them to inform each other of any significant care events and changes in the plan.

 In October 2002, the CEOs of the Helsinki-Uusimaa Hospital District and the Helsinki City Board of Health declared the care agreement model as an official framework for the coordination of the care of chronically ill patients in Helsinki area. The administrative decision contains an algortihm, designed in the Implementation Laboratory, which describes the basic steps of this negoatiated way of working (Figure 6).
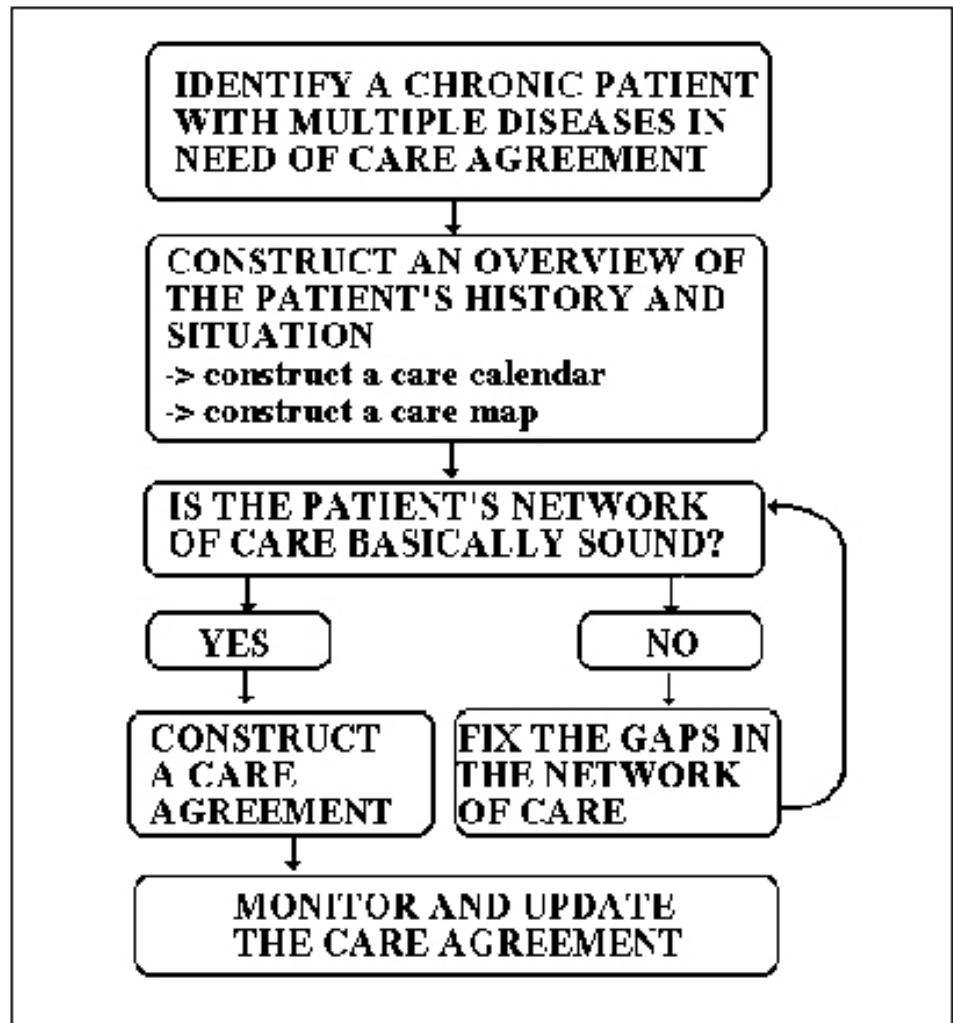
Figure 6. The basic algorithm for negotiated care agreement practice

CHARACTERISTICS OF EXPANSIVE INTERACTION DESIGN: INSTRUMENTALITIES AND ANCHORING

Expansive interaction design is oriented at complex configurations of people, organizational arrangements and mediating technologies, including language, concepts and patterns of discourse. This implies a shift from designing well-bounded singular products to designing tool constellations or instrumentalities.

A tool constellation or instrumentality is literally the toolkit needed in an activity. The tools of a skilled carpenter may fill multiple boxes. They offer the practitioner multiple alternative access points to a task. Thinking is performed with the tools. Thus, the tools open a window into the mentality of the trade. In their study of a blacksmith's use of tools, Keller and Keller (1996) point out the variability a flexibility of tool constellations.

"It is important to note that the ideas constituting the mental components of a constellation often include procedures for correcting or repairing deviations from the image of the desired outcome of a particular step in production. Therefore, tools may well be used in multiple ways even within a given constellation." (Keller & Keller, 1996, p. 103)

The design of instrumentalities is obviously a stepwise process which includes fitting together new and old tools and procedures. In the design of an instrumentality for the negotiated collaborative care of chronically ill patients in Helsinki, three central tools were developed to be used by the practitioners and the patients: the care calendar, the care map, and the care agreement.

The care calendar is a simple template for listing the most important events of the illness and care of the patient for the past few years. The idea is to condense the often prohibitively voluminous historical information stored in the medical records, and in the patient's own recollections and interpretations, into one or two pages that may be easily reviewed in any encounter or planning situation. The construction of the care calendar requires co-narrating between the medical professional and the patient. The care calendar serves the temporal expansion of the object.

The care map is a one-page template for representing graphically the different caregivers and institutions involved in the care of the patient. Ideally the doctor and the patient together construct the first version of the map, marking down also problematic or missing connections between the various parties. Thus, the care map becomes not only a memory tool but also a device for identifying and diagnosing gaps and ruptures in the network of care. The care map serves the socio-spatial expansion of the object.

Finally, the care agreement is a one-page document template which asks the practitioners and the patient to write down the diagnoses and the patient's main concerns, the division of labor in the care (what problems are treated where and by whom) during the next year, the procedures for informing one another, the date by which the care agreement is to be reviewed, and finally the signatures of the involved parties. The drafting of a care agreement requires exchange and negotiation between the caregivers and the patient. Requiring a renegotiation of responsibility and power, the care agreement serves the moral-ideological and systemic-developmental expansion of the object.

In the practice of negotiated collaborative care, the instrumentality becomes alive and new ad-hoc tools are created and used in situ. An example from an Implementation Laboratory session demonstrates this nicely.

At the beginning of the laboratory session, the researchers showed a 4.5-minute video clip from the preceding consultation the general practitioner had with the patient. The actual discussion of the patient case began after that with the case presentation given by the general practitioner. She immediately presented an overhead diagram she had prepared to summarize the patient's situation (Figure 7).

The general practitioner explained her diagram as follows.

Excerpt 2 (Implementation Laboratory, session 7)
General practitioner: […] And we met for the first time only in April,
after Easter. But already then in our first encounter it became clear that there is
a lot of ground to cover. For this patient, perhaps the most central consequence

of our contact was that we found the metabolic syndrome, then we got to treat sugar hypertension parameters, the lady had herself already done a dietary intervention. And here [on the overhead] is the whole range of different kinds of diagnosis and their connections the lady has. […]
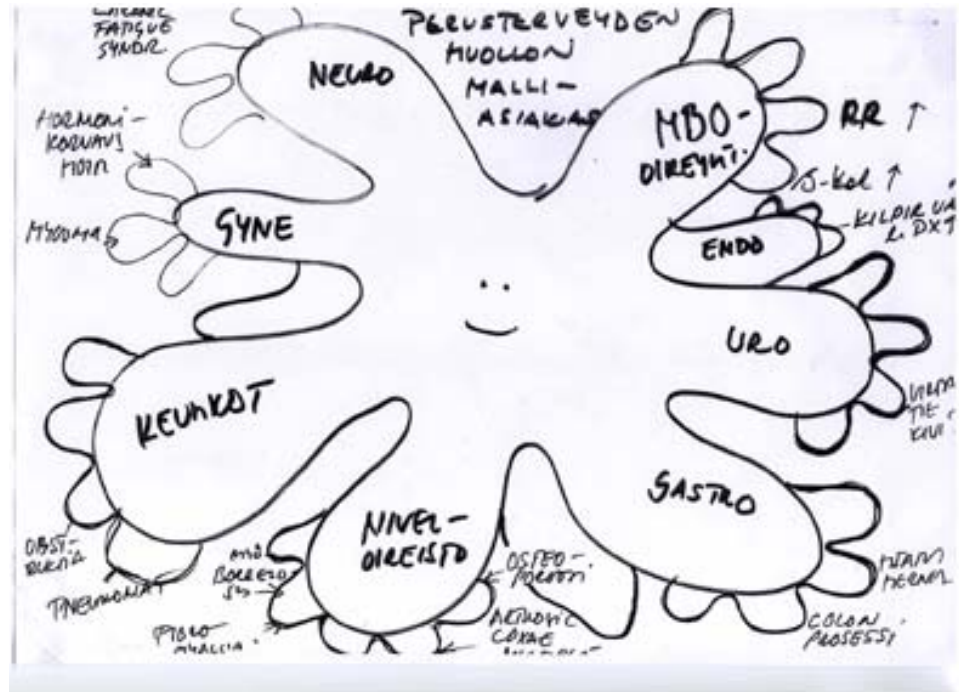

Figure 7. Diagram depicting the patient's overall situation, prepared and presented by a general practitioner

The general practitioner subsequently called the image in Figure 7 'an amoeba'. The different legs of the amoeba represent the patient's various diagnoses and their particular symptoms. Above the amoeba, the general practitioner had somewhat sarcastically written 'Model client of primary health care'. The amoeba figure graphically captures the gist of lateralization, i.e., the search for an overview of and interconnections between multiple parallel threads of illness and care (Engeström, 1995).

The physician went on to present the care calendar.

Excerpt 3 (Implementation Laboratory, session 7)
General practitioner: As requested, I then prepared this care calendar,
     and I found it to be extremely good and helpful in representing the overall situation. May I present it next?
Researcher: Please do.
General practitioner: So if we think about Rauni as a person, she has
     made a tremendous career abroad. And this is manifested in the list of diagnoses […]

Subsequently, the general practitioner also introduced on another overhead a care map she had constructed, depicting the different caregiver organizations involved as boxes grouped around the patient. She also introduced a draft for a care agreement she had prepared.

Excerpt 4 (Implementation Laboratory, session 7)
General Practitioner: Then the last overhead, it is this care

The different tools may be categorized with regard to the questions they are meant to ask and answer (Figure 8; see also Engeström, 1990). The hierarchy of Figure 8 indicates that on the top, one germ cell model opens a very wide landscape of applications, while at the bottom, images and stories are typically quite specific and bound to a particular situation or case.

In the health care case discussed above, the general practitioner's amoeba model represents a situated image or prototype (what is wrong with the patient?). The care calendar represents partly a narrative (*what happened when to whom?*), partly an algorithm (how has the illness developed?). The care map represents a classification on the one hand (*in which locations* are the caregivers related to one another?), and a systems model on the other hand (*why* is coordination between them not working?). The care agreement represents an instantiation of the germ cell model (*where to* are we moving in the care of this patient?). Interplay between the different tools makes the instrumentality robust.

This entire health care instrumentality evolves and revolves around the germ cell model depicted in Figure 5. Without such a vision for the future of the activity as a whole, the intermediate instruments may easily become mere techniques or, in the worst case, empty forms or rules imposed from above. The germ cell model is an example of *anchoring* a newly designed instrumentality *upward*.
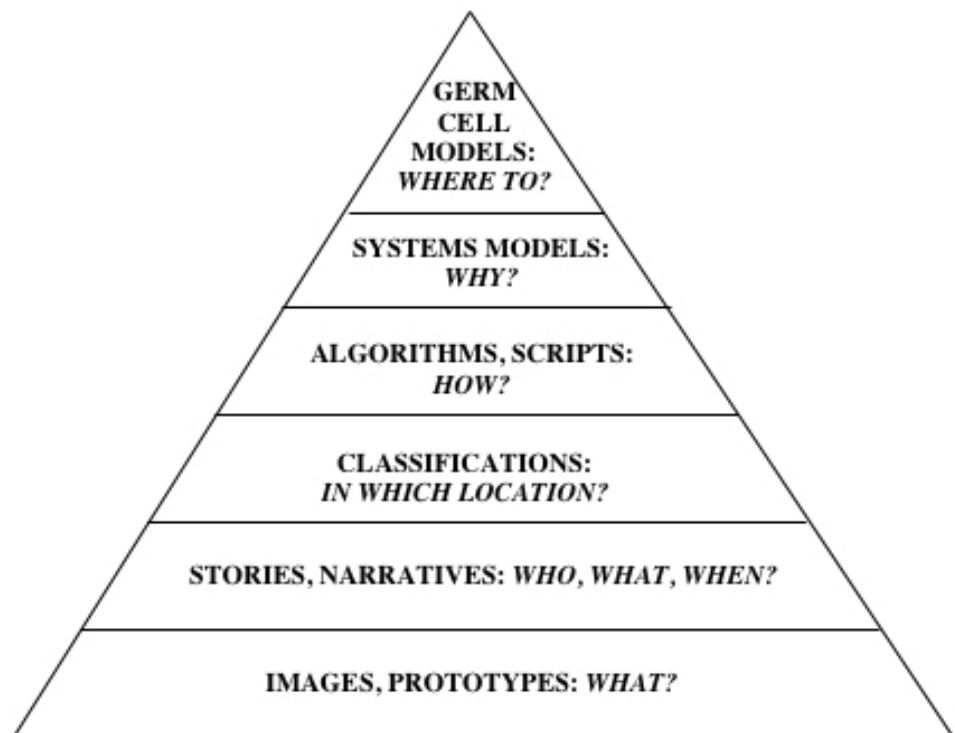

Figure 8. A hierarchy of tools

On the other hand, the new instrumentality must be anchored in daily actions and decisions with immediate consequences. The general algorithm of the steps of negotiated care, presented in Figure 6, anchors the germ cell model *down* to practical procedures and gives a general format for the actions taken by practitioners. The emergence of the amoeba model in the example given above is a situated indication of such *anchoring downward*: the general practitioner took on her own the action of crystallizing her image of the patient's overall situation in a durable and transferable graphic form (see also Engeström, Engeström & Kerosuo, 2003).

Perhaps the most crucial form of anchoring in co-configuration work and expansive design happens *sideways*. This implies that the emerging new instruments are negotiated and shared in use with partner activity systems, above all customers or users. In the medical care case, this anchoring sideways, or cross-appropriation (Spinosa, Flores & Dreyfus, 1997), happened both between the different medical practitioners and – most importantly – between the doctor and the patient. Joint story telling, or co-narrating, is a typical action used to achieve anchoring sideways (Engeström, in press). To facilitate such sideways anchoring in design, specific 'trading zones' may be constructed (Galison, 1997). These are physical and discursive spaces that offer neutral ground for exchange between members of different activity systems.

INTERVENTION, AGENCY AND RESISTANCE
In a well-known paper, Ann Brown (1992) put forward the concept of design experiments. She wanted to create a methodology that would simultaneously generate elements toward a general theory of learning and facilitate practical formation of intentional learning environments, radically different from the passive receptive tradition of school classrooms.

"[…] consider the design experiment that my research team is currently trying to engineer in the classroom. This includes effecting basic change in the role of students and teachers, modifying assessment, introducing a novel curriculum, establishing a technologically rich environment, setting up cooperative learning situations, establishing a classroom ethos where individual responsibility and group collaboration are the norm, and so forth. In short, we intervene in all aspects of the environment. Our interventions are deliberately designed to be multiply confounded. Although I was taught to avoid such messy things like the plague, I do not see an alternative." (Brown, 1992, p. 166-167)

Brown's acceptance of complex confounded constellations as the object of design experiments is commendable. At the same time, I find her treatment of agency in design experiments very problematic.

Brown maintained that in her interventions, students are "designers of their own learning" and "partially responsible for creating their own curriculum" (Brown, 1992, p. 150), even "coinvestigators of their own learning" (p. 165). Agency is shared in some unbelievably benign and harmonious way between very different actors, namely university researchers, school teachers, and school students. The foundational differences and tensions between the objects, motives and activity systems of researchers, teachers and students are blurred or disappear in Brown's account. However, as Norman Long (2001)

convincingly shows, interventions never take place without struggle and resistance.

"Intervention is an on-going transformational process that is constantly re-shaped by its own internal organizational and political dynamic and by the specific conditions it encounters or itself creates, including the responses and strategies of local and regional groups who may struggle to define and defend their own social spaces, cultural boundaries and positions within the wider power field." (Long, 2001, p. 27)

Long points out that it is crucial to identify and come to grips with "the strategies that local actors devise for dealing with their new intervenors so that they might appropriate, manipulate, subvert or dismember particular interventions" (2001, p. 233). From an activity-theoretical perspective, I would add that it is necessary to dig into the historical contradictions taking shape and generating disturbances within the activity systems the interventions are aimed at (recall Figure 4 above).

In other words, the conduct and study of design experiments is necessarily a tension-laden process of negotiations itself. If the researchers and designers seriously want to engage in such negotiations, they need create spaces where their authority can be contested and their ideas can be overridden. This requires that such spaces are not alien to but fit the work practices of the participants.

The laboratory methods mentioned above were attempts at creating such spaces. The laboratory sessions focused on concrete patient cases, so they resemble usual patient-centered shift-change meetings. Secondly, the laboratory sessions included practitioners from multiple clinical settings and specialties, they dealt with clinical work practices beyond the particular patient case, and they followed a script prepared well in advance – features that resemble clinical practice-centered meetings common in medical settings. Thirdly, in laboratory sessions the participants envisioned and drafted strongly future-oriented organizational changes, resembling management meetings in hospitals. Putting together these three aspects led to a hybrid form.

However, to make the hybrid work, we added four important new elements, namely (a) the presence and participation of the patient herself in the session, backed up with medical records and videotaped excerpts from the patient's recent care experiences, (b) the systematic development and use of new models and conceptual tools to envision and represent the expanded object (in this case, the care calendar, the care map, and the care agreement), (c) the repeated articulation of the historical challenge and mission of the sessions (in this case, the challenge of coordinating the care of chronic patients with multiple illnesses and multiple caregivers), and (d) the presence of more than one researcher-interventionists who engage in the laboratory debates, also disagreeing among themselves. Thus, the laboratory sessions represent a blend of elements familiar from existing practices and new elements brought in by the researchers. They were designed to serve as microcosms where potentials of collaborative care and 'knotworking' negotiations could be experienced and experimented with.

"A microcosm is a social testbench and a spearhead of the coming culturally more advanced form of the activity system. (...) the microcosm is supposed to reach within itself and propagate outwards reflective communication while at the same time expanding and therefore eventually dissolving into the whole community of the activity." (Engeström, 1987, p. 277-278)

Obviously our laboratory sessions were marginal microcosms in the sense that only a limited number of practitioners were involved in them and they were not meant to become a permanent feature in the routine functioning of the organizations. However, there are two kinds of marginality, centrifugal and centripetal. In one, the marginal practice is pushed out and tends to disappear. In the other, the marginal practice finds inroads and tends to spread into the central structures and interactional routines of the organization. The CEOs' decision to adopt the negotiated way of working and care agreement instrumentality as systemwide practices in the care of chronic patients with multiple illnesses in Helsinki is an indication of the centripetal potential of the laboratory sessions.

DESIGN, IMPLEMENTATION AND LEARNING
In their classic study, Pressman and Wildavsky (1984) point out that the implementation of complex new programs is a creative process of design and learning.

"As programs are altered by their environments and organizations are affected by their programs, mutual adaptation changes both the context and content of what is implemented,. The study of implementation is shaken from its safe cognitive anchorage in prior objectives and future consequences that do or do not measure up to original expectations." (Pressman & Wildavsky, 1984, p. xvii)

Correspondingly, expansive design should be seen as a longitudinal process which includes implementation and learning. It is in these lengthy processes that we typically see the importance and productive potential of resistance and turning points. These are nicely demonstrated in Table 1 which depicts the implementation and appropriation of the key tools of negotiated care over the span of ten patient cases discussed in successive Implementation Laboratory sessions.

Patient Case, Main Ailment	Care Calendar	Care Map	Care Agreement	"Own Tools"
Case 1 Rheumatoid Arthritis	X	X	-	Patient's care map: - Problems in the flow of information
Case 2 Heart Ailment	X	-	-	-
Case 3 Heart Ailment	X	X	-	Care calendar a list of epicrisis.
Case 4 Diabetes	X	-	-	-
Case 5 Diabetes	X	X	X	Combined care calendar and care map. Care agreement proposal on a hospital referral.
Case 6 Nephropathy	X	X	X	-
Case 7 Diabetes	X	X	X	Depiction of a model client at the health center as an amoeba.
Case 8 Heart and Pulmonary Ailment	X	X	X	Care map as a flowchart.
Case 9 Nephropathy	X	X	X	-
Case 10 Pulmonary Ailment	X	X	-	-

Table 1. Implementation of tools of negotiated care in ten successive patient cases (Kerosuo & Engeström, 2003, p. 347)

Table 1 shows that not all the new tools were adopted in patient cases one to four. The care calendar and care map were used, but the care agreement was not used until case five. In other words, the members of the physician pilot group resisted the use of the care agreement.

Kindred (1999) points out that in addition to open objections, resistance may also be silent. Rejection of the care agreement during discussions of cases one and two may be interpreted as an expression of silent resistance. Adoption of the care agreement was not openly objected to, but neither were agreements completed. More open ways of objecting, as well as a dilemmas in the use of tools, emerged in the third patient case.

Excerpt 5 (Implementation Laboratory, session 3)
Researcher: Do you really have a feeling that one does not need a
kind of written anything here? That this goes well enough [without the documented agreement].
Physician: Yes, in a way now, it is that at the moment the medication
as a whole, the treatment of the coronary disease is undertaken at the health center, Marevan medication is at the health care center, it is at the moment. So, if we want to document it, yes, but there is nothing to negotiate about. The patient herself agrees that it is like this and we all agree. But right now the examinations of her stomach troubles are under way over here, and that - but that is something we cannot make an agreement, because it is not finished.

Another doctor thought that the agreements are 'dead documents' that are signed, sent ahead, put into archives, and have no value for practical use. At this point, another member of the pilot group took up the missing treatment of the patient's leg as well as a follow-up visit not completed with lung specialists that the patient had continued to mention during the laboratory session. She proposed a care agreement that would include information on the treatments, as well

as the visits, where they were provided, and when. Despite this lengthy, multi-voiced discussion, the care agreement was not completed.

Resistance is often interpreted as an obstacle to development and learning. However, resistance is not only an obstacle but also a dynamic force that may be triggered to generate learning. The 'foreign' or 'unknown' must be made one's own. This requires attacking, testing and questioning the new.

As shown in Table 1, the care agreement became was adopted from patient case six onward. However, the turning point occurred already in case five. A general practitioner sent a 'home-grown' care agreement proposal to the hospital, inquiring about the patient's diabetes follow-ups. She did not use the template of the care agreement suggested by the researchers; she simply used a copy from the patient's medical record. The hospital endocrinologist gave a formal reply confirming the prevailing rules about the division of care responsibility between primary and secondary care. However, the general practitioner was not after the formal rule - she knew it well. She wanted a specific reply and negotiation about conducting the follow-ups.

In the laboratory session, the problem of diabetes follow-ups was taken up. At first, the endocrinologist again offered the rules regarding the division of labor between primary and secondary care. However, the general practitioner, a visiting nurse, and the patient himself insisted that there had been problems in information exchange that could not be solved formally. Finally, the endocrinologist admitted the necessity of negotiation and even suggested that it might be worthwhile to sign an agreement which the patient could bring along when entering the different care locations.

Excerpt 6 (Implementation Laboratory, session 5)
Endocrinologist: This [the information exchange] is, as I said, a
        never-ending question. And it has been recognized, and also admitted, the same
        thing, that we should inform, the information should flow, but it becomes
        continuously disrupted on and on. So, I think that until we all have computers,
        a kind of, what could it be, an agreement, a paper that the patient could carry
        with him, where…
Researcher[speaking over]: One page.
Endocrinologist: …one has documented of what is being treated, and
        where, I consider it to be quite a good thing.

After the comment by the endocrinologist, the atmosphere in the laboratory changed. Members of the pilot group began to generate new, practical ideas about the contents and uses of the care agreement. A 'home-grown' version of the designed instrumentality served as a springboard for a turn from resistance to further design.

REFERENCES
Boland, R. (Ed.)(in press). Managing as designing. Stanford: Stanford University Press.

Bratus, B. S. & Lishin, O. V. (1983). Laws of the development of activity and problems in the psychological and pedagogical shaping of the personality. Soviet Psychology, XXI, 38-50.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. The Journal of the Learning Sciences, 2, 141-178.

Davydov, V. V. (1990). Types of generalization in instruction: Logical and psychological problems in the structuring of school curricula. Reston: National Council of Teachers of Masthematics.

Engeström, Y. (1987). Learning by expanding: An activity-theoretical approach to developmental research. Helsinki: Orienta-Konsultit.

Engeström, Y. (1990). When is a tool? Multiple meanings of artifacts in human activity. In Y. Engeström, Learning, working and imagining: Tweleve studies in activity theory. Helsinki: Orienta-Konsultit.

Engeström, Y. (1995). Objects, contradictions and collaboration in medical cognition: An activity-theoretical perspective. Artificial Intelligence in Medicine, 7, 395-412.

Engeström, Y. (1999). Expansive visiblization of work: An activity-theoretical perspective. Computer Supported Cooperative Work, 8, 63-93.

Engeström, Y. (2001a). Expansive learning at work: Toward an activity theoretical reconceptualization. Journal of Education and Work, 14, 133-156.

Engeström, Y. (2001b). Making expansive decisions: An activity-theoretical study of practitioners building collaborative medical care for children. In K. M. Allwood & M. Selart (Eds.), Creative decision making in the social world. Amsterdam: Kluwer.

Engeström, Y. (2003). The horizontal dimension of expansive learning: Weaving a texture of cognitive trails in the terrain of health care in Helsinki. In F. Achtenhagen & E. G. John (Eds.), Milestones of vocational and occupational education and Training. Volume 1: The teaching-learning perspective. Bielefeld: Bertelsmann.

Engeström, Y. & Ahonen, H. (2001). On the materiality of social capital: An activity-theoretical exploration. In H. Hasan, E. Gould, P. Larkin & L. Vrazalic (Eds.), Information systems and activity theory. Vol. 2: Theory and practice. Wollongong. University of Wollongong Press.

Engeström, Y., Engeström, R. & Kerosuo, H. (2003). The discursive construction of collaborative care. Applied Linguistics, 24, 286-315.

Engeström, Y., Engeström, R. & Vähäaho, T. (1999). When the center does not hold: The importance of knotworking. In S. Chaiklin, M. Hedegaard & U. J. Jensen (Eds.), Activity theory and social practice. Aarhus: Aarhus University Press.

Engeström, Y. & Escalante, V. (1995). Mundane tool or object of affection? The rise and fall of the Postal Buddy. In B. Nardi (Ed.),

Context and consciousness: Activity theory and human-computer interaction. Cambridge: The MIT Press.

Engeström, Y., Miettinen, R. & Punamäki, R-L. (Eds.) (1999). Perspectives on activity theory. Cambridge: Cambridge University Press.

Engeström, Y., Puonti, A. & Seppänen, L. (2003). Spatial and temporal expansion of the object as a challenge for reorganizing work. In D. Nicolini, S. Gherardi & D. Yanow (Eds.), Knowing in organizations: A practice-based approach. Armonk: Sharpe.

Galison, P. (1997). Image and logic: The material culture of microphysics. Chicago: The University of Chicago Press.

Harvey, D. (1989). The condition of postmodernity: An enquiry into the origins of cultural change. Oxford: Blackwell.

Hasu, M. (2002). Critical transition from developers to users: Activity-theoretical studies of interaction and learning in the innovation process. Helsinki: Department of Education, University of Helsinki (PhD dissertation).

Hasu, M. & Engeström, Y. (2000). Measurement in action: An activity-theoretical perspective on producer-user interaction. International Journal of Human-Computer Studies, 53, 61-89.

Keller, C. M. & Keller, J. D. (1996). Cognition and tool use: The blacksmith at work. Cambridge: Cambridge University Press.

Kerosuo, H. & Engeström, Y. (2003). Boundary crossing and learning in creation of new work practice. Journal of Workplace Learning, 15, 345-351.

Kindred, J. B. (1999). '8/1897 bite me': Resistance in learning and work. Mind, Culture, and Activity, 6, 196-221.

Leont'ev, A. N. (1978). Activity, consciousness, and personality. Englewood Cliffs: Prentice-Hall.

Long, N. (2001). Development sociology: Actor perspectives. London: Routledge.

Nadler, D. A. & Tushman, M. L. (1997). Competing by design: The power of organizational architecture. New York: Oxford University Press.

Normann, R. (2001). Reframing business: When the map changes the landscape. Chichester: Wiley.

Normann, R. & Ramirez, R. (1994). Designing interactive strategy: From value chain to value constellation. Chichester: Wiley.

Pressman, J. L. & Wildavsky, A. (1984). Implementation. 3rd edition. Berkeley: University of California Press.

Ramirez, R. & Wallin, J. (2000). Prime movers: Define your business or have someone define it against you. Chichester: Wiley.

Spinosa, C., Flores, F. & Dreyfus, H. L. (1997). Disclosing new worlds: Enterpreneurship, democratic action, and the cultivation of solidarity. Cambridge: The MIT Press.

Victor, B. & Boynton, A. (1998). Invented here: Maximizing your organization's internal growth and profitability. Boston: Harvard Business School Press.

Zell, D. (1997). Changing by design: Organizational innovation at Hewlett-Packard. Ithaca: ILR Press.