University-community coalitions for developmental work research – a theoretical perspective and two cases

Berthel Sutter and Hans Kyhlbäck

Blekinge Institute of Technology
Box 520, SE-37225 Ronneby, SWEDEN
{Berthel.Sutter, Hans.Kyhlback}@bth.se

The paper presents - from the theoretical perspective of activity theory and developmental work research – the problem of conducting "interactive research" as a way of fulfilling the "third mission" of the university. Two case studies are presented as a kind of test-bench for the research approach. The first case is about software development of a picture-archive communication system based on (and aimed for) the wound treatment activity that is accomplished by nurses. The second case is about the formation of a coalition for development of a complex learning environment ("Fifth Dimension"). The aim of the paper is to explore "joint R&D projects" with participants from the university and other parts of the community. The results are discussed in terms of how the coalitions are formed to make the joint activities possible, the outcome of the joint projects, and the sustainability of the R&D relations between the university and community partners.

University-work in cooperation with other partners has being encouraged for some decades in Sweden as well as in other countries. In Sweden this collaboration is established in the "Högskolelag" as a special mission besides higher education and research. Even if it is an ongoing debate whether this so called third mission should be accomplished by means of the two traditional missions of the modern university or if it also can be achieved as a more independent activity, and even if there are many arguments in favour for a certain independence of the university, there seems to be much of an agreement for an increased collaboration between partners from the university and partners from "the surrounding society." The question is how such "working together" might look like. Currently, ideas of university-community collaboration are legio, and they address the collaboration on different levels and diverse scales, from Triple Helix visions covering waste regional or national districts to more limited local or regional networks.

The aim if this paper is to discuss an approach to low-level or grass-root initiated university-community collaboration. It is an approach, which can be said to work on "framework for local project" level, that is, on the level of local initiatives and local agents (research projects or research groups, districts of municipality organised health care, and classes or schools). In other words, it is about small-scale university-community collaboration. Its strength is that it can be initiated and launched by small groups of people. Its limitations are just – its limited scale and the problem of sustaining the joint activity.

The point of departure of the paper's discussion is two strategic documents that address university-community links for research and development. One document stems from the municipality council of Ronneby, and the other from Vinnova, the Swedish agency for innovation systems.

Ten years ago, the municipal council of Ronneby launched a strategic project in order to finally turn the local industrial society into a novel municipality characterised by modern information and communication technology, *Ronneby 2003*. According to a research report (Alsén et al., 1999) "[t]he idea was to initiate the same type of dynamic processes in Ronneby that had made Soft Center attractive. Emphasizing investments in the cultural and educational sector, as well as in fibre optics and computers, social processes and a mobilization of the local community for the future should be facilitated."

This year Vinnova has launched a strategic plan for the years 2003-2007 entitled "Effective innovative systems and problem-oriented research for sustainable growth." In short, it presents 18 "growth areas to regenerate business and society," and in addition to that four "knowledge platforms for increased growth" (biotechnology, efficient product development, learning and health in working life, and IT implementation). Finally, "six critical prerequisites for sustainable growth" are identified: understanding client demand, availability of suitable skills, flexible labour market and sustainable working life, venture capital, effective IT and transport infrastructures, and strong incentives. As can be seen, Vinnova´s concern is large scale innovation systems - at a national, sectorial and regional level. A general conception upon which Vinnova´s strategy is founded can be put like this: To be effective, the Triple Helix of research bodies, businesses, and political institutions must work together.

Ten years bridge the plan of Ronneby and the plan of Vinnova, ten years characterised by a turbulent IT boom and the burst of the IT bubble. Today, there seems to exist no fear that IT will go away, but a general expectation that ICT will be further expanded, deployed and implemented, although not with such an one-sided and dangerous relation to speculative economy as before. What remains, however, and what seems to be more and more acknowledged, is the idea of the crucial importance of the collaborative effort of various societal subjects to promote viable growth and welfare. The HSS conferences are not the only sign of that.

Our presentation will make a contribution to the basic idea that university-community coalitions might be good for research as well as for the development of activities, or in the idiom of Vinnova, for "products, services and processes." Vinnova has a national and regional perspective on innovations, and stresses technological innovations. Ronneby 2003 was an attempt to initiate a municipal and social counterpart to the business and university oriented Soft Center. As already mentioned, our approach is of a smaller scale. It is about local projects – which do not exclude national and international collaboration. We call our approach "developmental work research" (DWR)[1]. The focus is on innovation systems at the local level as part of an infrastructure of inter-institutional

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[1] The DWR approach originates from the Center for Activity Theory and Developmental Work Research at Helsinki university. Our research team, The DWR Group at BTH, is a sister organisation. It is presented at www.dwr.bth.se

coalitions for learning, development and research. Let us briefly outline the basic theoretical and methodological foundations of the DWR approach.

Developmental work research (DWR) is a kind of "action research" or "interactive research" (Svensson et al., 2002). The activity theory perspective presented has its origin in several research approaches based on (or working close to) cultural-historical activity theory – "romantic science and utopian methodology" (Michael Cole, 1996), "practice research" (Morten Nissen, 2000), "the phenomenology of social free space" (Kurt Aagaard Nielsen, 2002) – but primarily it is a variant of the "Developmental Work Research" perspective developed by Yrjö Engeström and his colleagues at their Center in Helsinki.

The principles of developmental work research can be summarized like this:

"First, a collective activity system can be taken as the unit of analysis, giving context and meaning to seemingly random individual events. Second, the activity system and its components can be understood historically. Third, inner contradictions of the activity system can be analyzed as the source of disruption, innovation, change, and development of that system, including its individual participants." (Engeström, 1993, p. 63)

The basic methodological approach is the "methodological cycle of expansive developmental research" (Engeström 1987, p. 323), which minimally includes: a) description and analysis of the activity, b) formation of new instruments for the change process in dialogue between practitioners and researchers, c) trying out of the change instrumentalities, and finally d) evaluation and reporting of the outcome of the activity of intervention.

To summarize, the basic ingredients of activity theory and developmental work research are:

- A general model of an activity system (Engeström´s triangle model).
- A methodology: the cycle of expansive developmental research
- A practical-organizational instantiation of the theoretical and methodological principles: The Change Laboratory

The Change Laboratory is a microcosm for change, where a microcosm is to be understood as a miniature "of the community upon which the new form of activity will be based" (Engeström 1987, p. 296). It is a temporary activity system comprising practitioners from the "central activity" (that is, the activity the change of which is put on the agenda) and researchers. One can also say that Change Laboratory is an organizational tool for pursuing developmental work research aiming at two general outcomes: development of the activity in question, and production of research findings.

In the paper we will outline some principles for university-community organized developmental work, and we do that with departure from two case studies. In our discussion we will focus on three themes:1) How might "research and development" be conducted? 2) Who is involved in the activity? and 3) How can the activity in question be sustained?

In the kind of action research that DWR stands for, learning, development, and research are basic elements. In a way, all goes back to the distinction between learning of the culturally given on one hand and learning of the new on the other hand, has been made clear especially by Yrjö Engeström. As we see it, it is a consequence of his definition of the activity of learning as an activity-producing activity and of his elaboration of learning connected to work activity. We believe it would have been difficult, if not impossible, to make this line of demarcation between *traditional learning and teaching* and *collaborative mastering of the new*, if Engeström had only conducted research within a school context. The distinction has impact on how to conceptualise the relation between learning and development. Let us describe it by a changed quotient that goes from learning/development to development/learning, or, in other words, from development as a secondary phenomenon (usually conceived as individual learning only) to development of an activity as a leading part (where the participants are "learning the new" while doing the new).. It should be observed that this distinction, although it has its origin in studies of learning and development at work, is valid for learning and development in general, be it at school, at work, or in some other activity. We sum it up in Table 1.

|	LEARNING AS APPROPRIATING THE GIVEN NEW	LEARNING AS COLLABORATIVE MASTERING OF THE SOCIETAL NEW
Learning as a specific activity	E.g., organized as traditional school-instruction	E.g., organized as in-house instruction at work; Learning by expanding
Learning as a general phenomenon	Learning as by-product of participating in activities	Spontaneous innovative work actions

Table 1 Learning related to the "given new" and the "societal new"

Traditional school-instruction is a way to organize learning of what is societal important but that is not spontaneously appropriated. The same holds true for in-house instruction at work. In both cases it is about learning as a specific activity. Learning as a by-product of participation in any activity is about learning of actions and strings of actions. It is the most common way to learn. One learns what is given in the culture by participating in the culture. On occasion, spontaneous innovations occur as actions in response to challenges in work practice (see, for example, Sutter and Lindberg, 1994). This conception of learning and development is a fundamental feature of our DWR approach.

Another feature that is making up DWR is the mutual collaborative efforts between researchers and the practitioners from the activity to be developed. Nissen (2000) calls it "joint venture." The term refers to the fact that "joint venture" concerns two projects, on the one hand the developmental project, and on the other hand the research project. "The point of the model" he points out "is that the important angle of approach is neither the reseachers´ use of practice as empiric data, nor the practitioners´ use of research as evaluation, but the collaborative work that is growing as a result of the project" (2000, p. 35).

Engeström (1991, p. 80) has described the key idea of the form of "action research" that DWR represents as "expansive re-mediation in developmental work research." In DWR, practitioners and researchers work together in a certain way. Supported by "the activity system framework" which the researchers provide, the practitioners "design and implement novel solutions to contradictions they encounter." The outcome of the collaboration is "new 'intermediate' conceptual tools" (ibid., p. 79), which are usable for the researchers in their theoretical work and for the practitioners in the development of the work practice. "The task of the researchers is twofold: to facilitate and to document each step in the expansive learning process. This dual task demands that the researchers pay special attention to the documentation and 'distanced' analysis of their own roles in the process." (ibid., p. 80)

So, what we expect from the joint-venture projects we participate in are two main outcomes from the interplay between university and the community partners of the local joint-venture R&D project: One outcome that is beneficial for the work activity, namely a changed work practice, and another outcome that is beneficial for the academy, something concerning description, theory, method, or software development. Figure 1 summarizes the idea.
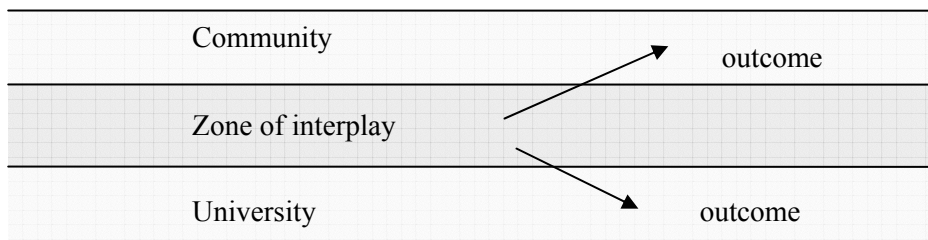
Figure 1 Community – Zone of interplay -- University

Figure 1 tells what our approach and experiences have taught us, and this is what feeds our expectations of the future: The joint venture project is a new provisionary inter-institutional activity with multiple aims – developmental work activity, research, and learning activity. That much we can tell in advance.

However, we cannot tell in advance what will happen in the joint-venture project. The future is an open space of possibilities, and the bridge to the future consists of attempts we make when trying to learn the new while creating the new. Where the new is created we call the Zone of interplay.

Learning to know what is happening in the zone of interplay in diverse kinds of projects, we believe might be a source of knowledge and rules of thumb for future joint projects and innovative endeavors.

Thus, the question is: What do our two case studies teach us?

The two case studies

The two case studies – "Wound Documentation" and "Fifth Dimension" – differ in many ways, which is a point as we use the cases as a test-bench for our ideas of "action-research" of a "third-mission" kind. For example, the "Wound Documentation" case focuses on technology development and aims at supporting the wound care work practice. The Fifth Dimension case is about learning at schools and the university. The former case has a shorter history of cooperation between the partners (two years) and the second case has a longer history (six years).

The wound care documentation project is a joint project between a research group at Blekinge Institute of Technology and some nurses and their manager at the Municipal Elder Care of Ronneby. The aim is to develop decentralized (local, "more democratic") technology supporting wound care documentation work at special accommodations in Ronneby elder care. The intention is to integrate digital images and other information into distributed software that ensure decentralized control of created information and secure storage and mediation of data. The technology, a peer to peer groupware, is intended to be developed in a process that integrates the end users requirements and their perceived future needs.

The Fifth Dimension (5D) project consists, shortly, of a weaving together of many kinds of teaching-and-learning activities – those of a first grade class in Ronneby, high school students within the field of "child and leisure", university students studying "computer supported cooperative learning." In addition, there is the work of the school teachers and the researchers, both addressing teaching-and-learning.

Our intention is to present the cases by means of rather detailed accounts. The purpose is to demonstrate that the influences of the planned as well as the casual interplay between the partners are consequential for the outcomes. The space available in the paper, however, forces us to make a choice. To be able to render detailed case accounts, we have chosen to put more emphasis on one of the cases, the wound care documentation project, and it is an easy choice because the 5D project also gets another presentation during the conference.

The Wound Care Documentation Project

The case of municipal wound care documentation is an example of a local joint-venture R&D project, characterized by interplay between technological innovation, work activity in elder care, and research. In the current phase, the project consists of different paper case-book versions that are merged and transformed into the specific peer to peer groupware intended to be utilized as an electronic documentation support system.

The work practice background to the project is that the nurses, since 1999, are documenting their wound treatment work in a paper case book comprising, for each care recipient, three pages stored in an ordinary binder. The origin of the case book is found in another municipality where documentation of "diabetes foot"-related treatment was developed. That work concerned late and severe complication due to diabetes disease. In the Ronneby municipality the adopted case book was extended to documentation of other categories as well, including wounds due to complication of cardio-vascular diseases mostly appearing on lower part of the leg and wounds caused by pressure on the skin of a fragile and often elderly person.

Prehistory of the current "wound" project

The project originates from a small scale working-together where the need for improved wound documentation and an idea of utilizing digital photos met, when, in summer 2001, one of the researchers tried to establish a new contact with thee field to find additional material for diabetes related research work. The municipal nurse with an assigned special responsibility for diabetes treatment articulated a need for better documentation work.

Wounds are possible to heal, but it takes a lot of patience, and the whole process might last for years. In order to understand a particular wound, besides the assessment of other properties, it is needed to make some measurements to be able to see changes of the wound's size. The nurses have tried to lay a cling film, that is a transparent, on the wound and draw an outline but "It was not easy to draw" according to the nurse. The researcher suggested the use of digital photos integrated in some computer software. In the interest of remembering and keeping record on the plane extension of a wound, the nurse imagined photos "in the computer" as a promising technique. A digital camera was then introduced in the nurse's work practice.

During the autumn of 2001, five students at Blekinge Institute of Technology were assigned for a project work and become engaged in our idea of integrating digital photos in a case book system, and the students developed a prototype. The project was carried out under the name of "Digital photos for professional use" as a real commission of software construction where the students realized the supplier role and the researcher was the customer and a kind of representative of the nurses at the municipal elder care. The course is a half time engagement lasting for five months where the curriculum aims at constructing knowledge in project and quality management. The main objective of the course is articulated as "an undertaking culture" where the students are supposed to take a lead role in establishing requirements, set up a contract and take necessary actions for building a process of analysis, design and implementation of a product. A written statement was put up to motivate the start of the project as "Assessment of changes can be supported if a sequence of images reflects the wound extension for a period of time".

At an early phase, contact was established between the students, the researcher and the nurse at the municipal elder care. A digital camera was bought and a traditional requirements specification was set up based on digital photo characteristics, standard desktop properties for code execution and graphical display, but in the first place the actual paper case book was taken as a starting point of analysis. The health care task of providing wound treatment was alien to both the researcher and the students and because of that it was necessary for them to learn about it. At four planned workshops, the nurse, the students and the researcher carried out analysis work in order to understand the treatment task, explore particulars of the case book and develop a mock-up informed by user centred design ideas.

In the project, the students made a paper-based mock-up of the future user interface in collaboration with the nurses in several sessions. Two of the sessions were audio and video recorded and thus the software development was provided with a stable reference to the target domain. Because the actual paper case book at this time was considered as all right except for the missing images, it was taken as close to a ready-made mock-up. As a consequence, it turned out that the final software prototype looked a lot like the three A4 size paper forms except for the digital images integrated and made possible to choose as a dominant view of the screen display.

A special Liquid Crystal Display viewfinder makes it possible to look at the wound image on a distance from the camera and in effect, handling the device becomes easy in the typical setting. Almost at once the nurse was successful in taking digital photos on wounds. This was really an encouraging result of our practical exploration and inevitable it raised further expectations on digital photos as a promising technique. However, moving the photos from the camera to the computer revealed some tricky and troublesome questions.

In the camera all images are stored automatically in a sequence, but in the process of moving photos, the nurse have a choice to discriminate, some images are good but others are not. Storage procedures require naming standards and a proper location on the nurse's digital file repository as well. Naming each photo was seen as a contradictory problem because it is a potential security matter if the individual's identity can be revealed in connection with the image of a wound. According to the national legislation, such private information must not be accessible for those it does not concern. Only people directly involved in providing care have a legitimate interest to access this kind of information. All those involved also have an explicitly stated obligation to protect the individual's privacy and in particular, documentation on wound treatment. It is then a contradictory task to keep a case book in order, which imply assigning names to different items, and also preserve a security policy. This was perceived as a main challenge for any future network distribution of an electronic case book.

The R&D relation between municipal elder care and the university			
Time	Municipality	Zone of interplay activity	University
Summer 2001	Need of improved documentation. The three pages paper case book in use since 1999.	The idea of using digital photos in the computer.	Research interest in people with diabetes and supporting technologies.
Autumn 2001		Introduction of a digital camera. Instructions on shooting digital photos on wounds.	Five students project course, "High Five". Development of stand-alone software *Hedvig* integrating various notes on treatment and digital photos on wounds.
	Nurse succeeds in taking good quality photos on wounds.	Two joint design sessions (one nurse , one researcher and the five students). The paper case book is used as a *mock-up* (full scale paper model).	
Winter 2001 – 02		The software prototype *Hedvig* is tested.	The five students project course completed

Table 2 The R&D relations in the earlier phases of the project

The five student's project work resulted in the prototype "Hedvig," an electronic case book on a single desktop computer. Digital photos were perceived as "easier to look at the screen" by the nurse who at the evaluation time, in late spring 2002, had a considerable experience of using the camera. She continued that "the digital photo reflects the wound in such a natural manner" and that "it is really not misleading". An obvious use of digital photos in wound treatment was then seen as something possible to realize by the municipal nurse when speaking about the image quality displayed on a standard screen. Next issue to consider is how to make a computer display to fit in the nurses ordinary work practice. It is out of question in this elder care to delegate a specific responsibility on shooting photos, downloading image files and administrating software on only one individual nurse. There are a total of twenty-three nurses working in the special accommodations for elderly people in the municipality and they are all generalists cooperating and substituting each others within smaller teams organized around treatment for individual care recipients. Consequently, an electronic case book must be easy to handle and maintain for every one of them. The nurses are typically on the move most of the working time, now and then prepared for rapid shifts between different treatments tasks, planned and appearing in the actual situation. A desire for a computer solution was raised by the prototype Hedvig, but it also emphasized requirements for a case book to be available not only at a single office but as a distributed software, easy to access for the nurses on the move and on visits at different locations. The R&D work so far can be viewed as an emerging interplay between the field and the university as can also be seen in Table 2. A promising point for further development was set, and next move got a start in the summer 2002.

Decentralized network control and the Authorization Layered Model

In our R&D project the use of digital photographs revealed a developmental potential of the nurses´ work practice. At the time, a year of field studies and software design work gave recognition to the fact that that nurses´ decentralized control is a crucial factor for a transition of a paper print form to a distributed electronic case book. The potential support of the digital images for remembering and learning was clearly perceived but a new type of case book must be trusted in terms of security and privacy issues, and must also be available for nurses on their real work setting. Treatment of a wound is a recurring task, occurring once a day up to every third day. The nurses make a plan of their working shift with for example three visits to care recipients and for preparation purposes they take a brief look in the documentation. Memory about the wound is then supported and choice of bandage, cleaning and lubricating agents and other equipment is a part of the work task as well. In connection with provided treatment the nurse is obliged to make a short periodical note in free text form on a description of the wound status and of provided treatment measures. This documentation work might ideally take place at the care recipient's home and consequently the case book should be accessible at several different locations with an ease of reach and use. Whatever the case of designed information systems, the nurses will be present at several different locations on a working shift, and frequently on the move.

A number of ordinary binders are currently the most prominent technology that today provides a safe and handy storage of the case books. There is one case book on each care recipient, a piece of information put together with a lot of other paper sheets on health care documentation. The binder has a good quality in that it is a physically and visually distinct and discrete item of which one can rely on as long it is within reach. In today's work practice this means that the nurse have to bring along four to five binders in a bag on wheels along with a diary and some treatment materials. It is easy to have confidence in, but it takes a lot of space and is not always easy to share between the nurses. They simply need to be at the same spot because there is only one "working copy" of the documentation. How then to preserve safe and trustworthy properties of the case book in transforming it into a computer network system? A theoretical and practical answer to this question has to be given in the R&D project.

In a design session, early summer 2002, the researcher and the nurse elaborated on the challenge of making information available for a specific group but safely guarded for most other people. The idea of an Authorization Layered Model (ALM, see Figure 2) was agreed on as a key information structure to be shared on a computer network. If the first level of the care recipients personal data and social information are only available for the key members in the activity system that provide treatment for the individual in question, the other information can consequently be regarded as *loosely coupled* and anonymous. If the nurse with designated responsibility for the specific care recipient, that is the PAS (Swedish acronym for "patientansvarig sjuksköterska", in English patient responsible nurse), still will be the one that creates the case book and maintains the power to let or not let other people have access, then a similar decentralized control can be mapped from the current situation to the future with an electronic version adopted to the work practice. Some good security qualities of the paper version we expect to preserve, at the same time as we utilize the computer network making it possible to distribute and share the treatment information. With the explicitly stated intention of

preserving the nurses decentralized control, the researcher and the nurse agreed to push the entire project further and expand it to involve more nurses, students and researchers. The nurse on the one hand, felt confident to take next steps and propagate our ideas among her colleagues. The researcher on the other hand found well grounded motives and reasonable expectations in trying to arrange for more extensive interplay between the field and the university.
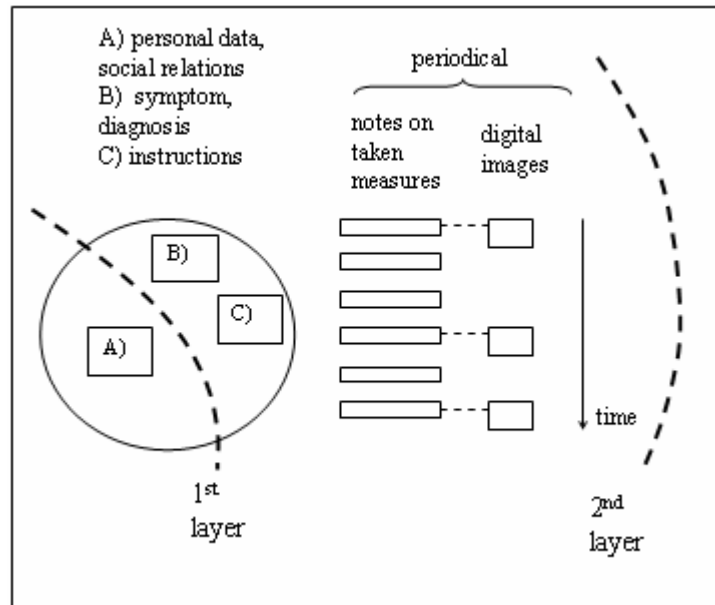
Figure 2 the Authorization Layered Model (ALM)

The next move in our R&D project found a promising combination of the need in the field, the agreed upon ALM and an additional idea of utilizing *Peer to peer technology* in, up to now, untested application domain of municipal elder care. A significant characteristic of the phenomenon of peer to peer computing is the decentralised control for the users that are connected to each others by means of the Internet technology (Oram, 2001). In the nineties it was recognized as an unforeseen event, or accident, that use of specific music file sharing applications attracted thousands of Internet users. This is widely known as the Napster software made freely available on the Internet, but there are also other examples of peer to peer systems. People found a way of downloading music files and many of them also provided uploads available to others occasionally connected to the Net. This network usage was conceptually not dependent on a central authority controlling access or membership in communities with a mutual interest to share music file resources. It was however a legal problem as copyright issues was violated, and eventually the Napster system was condemned and shut down. Besides of music interest, the two-way communication pattern and the decentralized control of the Net was (re)discovered and put forward as the new technology to make justice to the everywhere available Internet with it is web of networks and powerful computers connected to the nodes of the system. The most prominent peer to peer applications gather people with very specific and narrow interest, as sharing music files, and an important feature is to be an anonymous user of the system. Other applications gather people within the frames of more diverse interest and as such they are variations of the peer to peer concept in that the users are known to each others as members of a group – but still the concept of not relying of a central authority is a foundational feature.

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Peer to peer methodologies and techniques are topics of significant interest at the university and this now seems to meet the need for a decentralized network system in the municipal elder care. Assistant researcher Hannes Persson was assigned for evaluation of existing peer to peer groupware systems and for a further push of the Hedvig prototype towards a distributed application. Hannes found that commercial available applications were too big and not well suited for our case book solution. However he explored implementation techniques and prepared the arena for a serious try to transform the wound document into a peer to peer groupware accommodated to the work practice of the nurses. With the ALM in mind and the nurses decentralized control as key aspects, the research team explored further the possibilities of separating personal information on the one hand and data about the adherent wound on the other. For people within the health care, but in the periphery of treatment activity systems, there might be a legitimate interest to study the healing process for a specific wound. Provided that the care recipient allows for this, it might be a good idea to share the anonymous information to a wider group of health care personnel and learners. Some parts of the documentation can be interesting even if perceived on distance without knowledge of the individual person that suffers of the wound. This idea, as an additional feature of our software product, resulted in *peer membership rules* designed to be key elements for our novel network peer to peer architecture (Kyhlbäck and Persson, 2003, in press). The available technology and the identified needs in the field now got together as expectations on possibilities to realize *decentralized control* by means of *credential, apprentice and group manager peer roles* as the defining concepts of the groupware.

To merge and transform the case books

In late summer 2002 the stage was set for continued interplay, and the idea to engage students from the Software Engineering and from the People, Computer and Work study programs was articulated. At the third year of undergraduate studies, the students Bachelor thesis work is accomplished in the largest project course of which the university has gained reputation for high quality education. Those practice-driven learning courses characterize the curricula for the SE-students since more than a decade when the education program was originally "designed around the principle of exploratory learning, whereby the students are trained to build knowledge by themselves and actively search for solutions to the problems they experience" (Ohlsson and Johansson, 1995). The large SE-project is carried out during 15 weeks in the sixth semester of the study program. The education based on practice-driven projects in cooperation with real companies has proven to be a successful tradition (Johansson, 2000). Many students have been hired by the cooperating companies and in fact there is a competition in getting a developmental task as accepted for a large SE-project work. Our SE-project was the first to break a long array of software and telecommunication companies as partners for the cooperation with the students, and for the first time a municipal SE-project did win along with two telecom projects. The municipal wound care documentation project was accepted in the late autumn of 2002 and 17 students (15 SE and 2 students from the People, Computers and Work study program) assigned for full time studies and project work during spring 2003. This large SE-project course is now characterised by redefining the requirements for the software to be constructed and a *user centred approach* where a number of deliveries make it possible to get feedback in early stages of the development process. Following an *evolutionary design process* the municipal project will try to accomplish a mapping

between the nurses work activity and the core features of the software system. Consequently the nurses play a vital role for establishing requirements, actively make proposals and for evaluating and testing the design.

At the same time as the large municipal SE-project was started, the research work at the field was intensified. Formal presentations of the co-operation work were done and the ideas disseminated to all municipal nurses and higher level officers and politicians in the municipality. Researcher and students started to follow and observe the four nurses that have announced special interest in participating in the continued project work. Ethnographic methods are conducted to gather data as input information to the software development process at the same time as communication between involved parties get more intense and stable. As it may look like, accidentally, one nurse brought up another paper version of a case book originating from the nearby primary care ("Bensårsjournal" in use at Lyckeby primary care, in English: "Leg wound journal"). Actively she started to evaluate this dense, one page case book together with one of the students performing field studies. The nurse marked, underlined and crossed over different parts with a pencil for the purpose of taking the best and bring into the electronic case book to be developed. Other nurses were at the occasion present and the conversation emerged into a cooperative design session. All of this should be of no surprise since the three pages case book in use is considered as a "home made" variant. A need for a more unified and integrated case book is made explicit by the nurse manager (Kyhlbäck and Persson, 2003). In a continued user centred approach, the interplay was further strengthened through a number of structured workshops with the case book as the central object of design.

In the course of the second student software project, a novel kind of care treatment documentation is now to be considered. The first software prototype Hedvig followed very close the content and layout of the paper case book but when more nurses are involved a further changed artefact is imagined. The paper version in use have an origin in diabetes foot-care but the other case book from nearby primary care has a different orientation, which is reflected in the directly translated name "Leg wound journal". The latter seems more in line with the culture of medical and surgery specialist care in the county council organisation. At the moment we are witnessing, an influence from the other principal authority on the work practice matured within the realm of the municipal elder care. As already mentioned, the nurses are typically generalists and have to deal with all kind of wounds and consequently have an interest to cover all such treatment in their documentation work. Now when our project is established and students are observing the work practice, organise design workshops and construct real software, a way of making a unified and integrated case book is conceived as a worthwhile endeavour.

The nurses want to take the best from the both case books and design a new one that emanates from their interest to utilize a system that supports their treatment work. Some parts might not be needed to record, but other specific record items are added. Much of this design work is facilitated by the concrete making of mock-ups where also the layout and graphical properties are issues of interest. The items in the primary care paper case book are squeezed into a single A4 size page and a comment was that "it shall not be such a tight layout". Results of those design workshops are generated in parallel to the ongoing development of software. New interests are revealed and additional items to

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integrate in the software are suggested. This is to some extent possible due to the software design process where changed and extended requirements are negotiated in three evolutionary development cycles during the large SE-project time.

Members of the student's team facilitate the workshops but they also take a responsible attitude as technical specialists explaining what constraints to respect and what ideas that are possible to realize. Nurses from the field and students from the university work close together in merging the better of two separate artefacts into a new software version. At the time of this writing a third major component is added to the designed mock-ups. Notes on a care recipient's allergies and other oversensitivity is considered as important to alert the nurses when a case book is opened, and this "CAVE" panel appear in the first view according to the mock-ups (See Figure 3). However the mock-ups in this phase of the SE-project are now taken as stable even if choice of words in menus and labels still might be fine tuned. The number of interface views is set, and so are, roughly, most of the documentation items ranging from check marks to fields for free text writing and digital images as special display objects.
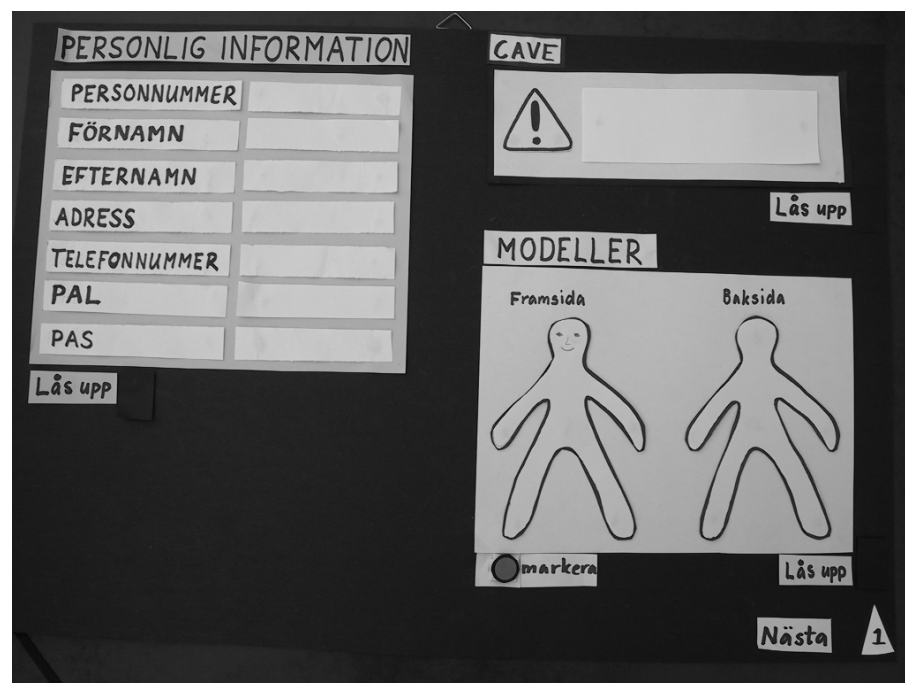

Figure 3 Mock-up, accessible view for a "credential member"

From the technical side of the SE-project, changes in content of the mock-ups do affect the design of data structures that are the information to be distributed on a computer network. Changes in requirements must be taken into account by the software development process at the same time as core peer to peer issues are the most fundamental and demanding to further develop. The SE-project has accomplished a technical new design where the *Authorization Layered Model* and the *credential, apprentice and group manager peer roles* are key elements in this peer to peer architecture. Newly created modules are built on top of, and make use of standard web

technologies and a set of specific peer to peer communication protocols[2] as well. As a treatment case book, the SE–project's resulting product will meet specific health care needs in this municipal organization. As a peer to peer application it is unique, preserving a decentralized control at the nodes of a network of wound care work practice. A lot of the technological work carried out in the project is then not like standard procedures but to be regarded as novel solutions, partly because its opposition to established client/server architecture that is heavily dependent on a central point of control.

The idea is that the peer to peer solution and the ALM concept will allow nurses to communicate and share a case book between their connected nodes in the network without the need for a server on top of a system hierarchy. Each case book concerns only one care recipient and one PAS, that is, a nurse with specific responsibility towards the recipient. This nurse will have the distributed power to administrate which of her colleagues that will have full access to the book in question. If the system will map the work practice rules of nurses substituting each others, the PAS is expected to give those related nurses both first and second level authority. Their activity system will be reflected in the case book in that they all will be able to record notes on periodically performed measures and produced digital photos. In this position they are regarded as *credential members* of the activity with full privileges to handle this particular case book. Other health care personnel might however have a legitimate interest to just look at the healing process of a particular wound. Providing the care recipient allows for this, and the PAS assigns *apprentice membership* status for those, they will be able to open and read the anonymous part of it, but not information that reveals the identity of the care recipient. In such second level authority, health care staff in the periphery of the activity system will be invited to only read some of the information. Those apprentice members will not be allowed to read personal data indicated on the left hand side of the mock-up in Figure 3; such information will only be available for the credential members in that specific case book.

Those *credential, apprentice and group manager peer roles* are the defining concepts of our groupware. Each nurse with a PAS assignment will be the only one with power to let other people be members with access to the documentation system. In effect, we expect the today´s situation with *decentralised control* of the case book to be maintained, but we also expect that this new artefact that will be deployed will make it easier to share information and learn about the actual elder care work practice.

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[2] JXTA is a set of open-source protocols for building peer-to-peer applications. Project JXTA *v2.0 Protocols Specification*, publicly available at http://spec.jxta.org/v1.0/docbook/JXTAProtocols.html

Important interplay events between municipal elder care partners and the university partners			
Time	Municipality	Zone of interplay activity	University
Late spring, summer 2002		Design session on the *Authorisation layered model* (ALM) (nurse and researcher). Agreement to go further aiming at distributed software based on the ALM and peer to peer concepts.	A research assistant develops *Hedvig* a bit further, exploring Peer to peer concepts and JXTA technology.
Autumn, Winter 2002			- Continued field studies observing nurses work - Student project course (15 SE-students, 2 People, Computer Work-students). -The Wound Care Documentation Project.
Winter and spring 2003	Another paper case book with origin in nearby primary care is considered	Students interview and observe four nurses work in the elder care. Three Workshops on design of mock-ups to be utilized in the implementation of the Peer to peer groupware (4 nurses, 5 students). Merging case books and transforming into an electronic distributed case book.	Development of a *distributed electronic case book* using Peer to peer concepts and JXTA
May, June 2003		Possible trial period where the Peer to peer software is further tested and evaluated	Students project completed

Table 3 Sustainability of the interplay

Case two: The Fifth Dimension at Esp

First some words about 5D in general. 5D is a mixed system of learning activities that, at least, involves children, undergraduates or high-school students, and researchers. Initially, and still most often, 5D is carried on as an after-school activity. Usually, computers have a role as central artefacts, but a lot of other artefacts are part of the set-up, and sometimes a Fifth Dimension site is running without computers at all. However, essential for a 5D activity is a cultural-historical or sociocultural perspective on learning and development, and the arrangement with high peer-to-peer interaction and mutual

support. 5D is a microcosm or miniature world for the study of learning, a "field experiment laboratory" for the study of potentialities of learning and development. In that way it comprises an imaginary world. But 5D is also a real world of learning, an alternative or a complement to school-learning.

The case studied is spanning a period of three months of in-school 5D activity. The documentation of the learning process and the learning outcome with focus on the learning of the individuals consist of fieldnotes (by undergraduates, high-school students, teachers), and of produced material (text, pictures, drawings) by the children and their collaborators.

However, with focus on the development of the activity system, the Fifth Dimension at the Esp school, the context had to be widened and include a description of earlier 5D-Esp. 5D-Esp is designed as an inter-institutional school project, or more specifically as a community of learning, where first graders, high school students, undergraduates, teachers, and researchers collaboratively learn and develop the activity system they are part of. In the winter/spring semester 2002, the 5D-Esp activity was organized so that students from three different schools participated: first graders, high school students from an educational program oriented at children and leisure, and undergraduates from a program called People Computers and Work.

The core of the 5D activity was conducted as it has been done for several years at the school. The recognizable 5D site is situated in the small library of the school, equipped with ten computers (the multimedia room), a maze in wood, a map of the maze, task cards, a software library, the children's binders, and other artefacts. Half of the first grade class, together with their appointed high school partners, worked in the multimedia room for the first part of the 5D meeting. The other half of pairs of first graders and high school students worked downstairs in a classroom (without computers). After half of the meeting time the two groups shifted local and focus of the activity. This design of the activity is roughly as it has been for the last years.

A novel ingredient in the actual 5D was that four undergraduates as part of a course requirement at the university formed an editorial staff group that, at every occasion together with two pairs of first-grader and high-school students, had the mission to take still pictures and write text in order to produce a weekly letter for the Esp-5D community.

Another ingredient, also partly new, was that the activity in the classroom was not something separate from the 5thD activity, but rather a part of it. The activity in the classroom was organized in a "Fifth Dimension like manner" as the classroom teacher herself expressed it. As a result, the 5thD activity was organized in three locations, where three sub-activities took place: the editorial room, the multimedia room and the classroom.

The content of learning in the 5D-Esp was determined in diverse ways. In the central multimedia room - central physically as well as conceptually for the 5thD activity - the maze and the task cards provided a framework for the learning actions. The teacher who acted as site coordinator described the maze as giving "freedom within a framework." When parents or colleagues asked her what learning content they did cover in the 5D - a

first glance impression by outsiders often had been that "they are just playing games, aren't they?"[3] – the teacher /site coordinator could use the maze as an artefact for remembering what had been accomplished in 5D, also in terms of academic performance.

Discussion

We have presented two case studies that we think might give clues about how university-community coalitions might be formed and R&D might be conducted on a grass-root level of local "joint-venture" projects. In the discussion we will not directly address these questions once again, but instead connect to them indirectly by discussing two related questions: Who are involved in the activity, and how might the R&D activity organised as joint-venture projects sustainable?

Who are involved?
The two presented case studies show that the university-community coalitions that were formed are much more complex than the picture that we draw in the beginning of the paper (Figure 1: the zone of interplay between university and community).

In the wound care documentation project we can discern at least the following participants and their core interests for participating:

Researchers
University teachers
Software engineering students
MDA students

On the community side, we can identify

The four nurses and their 19 colleagues
The becoming nurses
The county-organized care professionals
The patients/care recipients

In the 5D-Esp project at least the following participants and interests were involved:

First graders at Esp
Teachers at Esp
Upper secondary students
Teachers at the upper secondary school
University teachers
Researchers

It was our expectation that there might be two main outcomes of the interplay between university and the community partners of the local joint-venture R&D project: 1)

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[3] The expression comes from the title of a bachelor thesis by Andersson and Ådahl who had studied the use of computer games in the 5D. (Accessible at www.5d.org)

something beneficial for the work activity: changed work practice, and 2) something beneficial for the academy: description, theory, method, software development. Now that we know the result, what were the outcomes? In sum, what comes out is that the close activity-oriented collaborative actions between partners in the projects (in "the zone of interplay") to a large part are creating the project. There is a planned framework, but it is all the time overstepped.

How can the activity be sustained?
Sustainability was a main issue for Cole when he initiated the Fifth Dimension. After having reviewed a great amount of funded pedagogical projects, he wondered: "Why, in short, were proven, effective, programs not sustained?" And his "simple answer" is that "when outside funding dried up, they could not compete successfully for internal resources" (1996, p. 288).

A suggested answer to the question why effective programs or inter-institutional projects were not sustained is that the funded research projects were not sufficiently organized as *hybrid activities* (of research and development), that is, as new activities. Instead, they were treated as temporarily research-enhanced, R&D activities, which were supposed to continue after they have learned from the research-intensive period. They were not regarded as new activities, merging R&D and the "old activity." Neither were they regarded as joint venture projects, necessary for research (in the form of action research, interactive research, practice research, or whatever the name) as well as for the "practical activity." In such a perspective, it would seem odd to think that the researchers could withdraw after three years (or whatever period of time the appointed R&D project lasted) and the "practitioners" alone could continue with the new hybrid activity on their own. No wonder that the outcome of the R&D projects was the same old activity, perhaps improved in details. The situation is a little different when the R&D produces products, appearing physical artifacts; then the artifacts itself tend to sustain an activity to make it function.

When should the researchers leave? After the project period is ended, this is what all the approaches seem to imply. However, their practices are not consistent with this more or less taken-for-granted rule of research. In practice, they switch to similar or adjacent projects and they keep informal contacts with the practice field and eventually these contacts are formalized again in a new project. Experiences from DWR are that Change Lab or joint-venture sessions often are repeated, and not seldom followed by informal contacts between practitioners and researchers. We think many researchers recognize the situation. It can be interpreted as researchers´ persistent fight for a living, but we think there is more to it. The felt need of some kind of persistency probably has its ground in a societal need to rethink the relation between research and development. The developmental activities in society often need support from research, and vice versa, research (in many fields) is in need of being challenged by complex "real-life" problems. There is an ongoing process of connecting people and things in a societal scale ("Vergesellschaftung," "communalization", globalization) to which research activity and the university as an institution has something to contribute. So, the question when the researchers should leave is probably not pertinent. That projects will be continued without ending is not realistic, but would it be possible, as suggested by the two cases we have presented, to have some kind of low-intensive continuation between research and

practice as a base, followed by sporadic more intensive joint-ventures when there are need for them? It seems as if there exist research practices which are contradicting the official research agenda, and which are not analyzed and posed as a problem to overcome. [4]

Conclusion

The DWR approach makes some interesting points regarding R&D projects, points that we think many times are crucial.

First, the university-community coalitions that are necessary to establish in order to get innovation work done, are also necessary for research itself, provided that research is carried out as "interactive research" (or this kind of research under whatever name).

Second, learning conceptualised as "learning activity" is a core phenomenon closely related to development. Yrjö Engeström´s wonderful reconceptualization of learning - learning activity is an activity-producing or activity-transforming activity – means a shift in interest and focus from learning/development to development/learning. Learning the new by participating in the creation of the new, that is, in developmental activity, ought to be recognized as an important form of learning.

Third, the problem of accomplishing sustainability is a cry for overcoming the "local confinement" of the local joint venture projects in which DWR-researchers are engaged. It is signalling a need to engage higher-level agents in order to make the inter-institutional provisory coalitions less provisory. In this expansion from grass-root level R&D project, we have good reason to believe in the importance to take care of the energy generated in the local joint-venture endeavour..

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[4] Donald Schön deals with the issue in his epistemology of practice. "To the extent that such partnerships" – partnerships between researchers and practitioners – "grow in importance and begin to occupy an important place in the research enterprises of the professional schools, universities and practice institutions will enter into new relationships. University faculty will become interested in professional practice, not only as a source of problems for study or internships for students, but as a source of access to reflective practice. As a consequence, a new meaning will be given to activities usually considered peripheral to the conduct of the research university. Field work, consultation, and continuing education, often considered as second-class activities or as necessary evils, will rise to first-class status as vehicles for research, the main business of the university." (1983, p. 324)

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