

Location in Work Practices: The Social Shaping of a Personal Digital Assistant

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ABSTRACT

In this paper, we describe the design process involved in the production of a Personal Digital Assistant (henceforth PDA) for an Intensive Care Unit in a Swedish hospital. We argue that the functionalities of such a device require much more than a simply geographical concept of location. It requires, we suggest that location should be understood as a feature of the social distribution of expertise. In other words, the design of this wireless technology has to do with understanding the various knowledges of people involved in the shaping of the product. Obtaining this understanding in turn, we suggest, brings to bear a differentiated set of professional knowledges (for example, software developers, IT facilitators, hospital personnel, nurses). Thinking in terms of the social distribution of expertise and knowledge allows us to recover a complex variety of possible uses for such a device (for example, the PDA as an instrumental reminder, or as a tool for continuous training and knowledge updating, or as a tool related to the actual work of medical intervention on bodies, etc.). To illustrate the point, we will review some cases where socially distributed knowledges and expertises raise different but relevant issues around different phases of PDA design for the Intensive Care Unit. We will draw some conclusions from this focus on sociological rather than spatial issues around the nature of

communities of practice and use, and in particular on the need to retain an interest in the meaning and nature of work practice whilst at the same time recognising how these practices vary as a result of professional commitments, expertises and knowledges.

Keywords

Location, Interdisciplinary IT Design Process, PDA Software Development, Intensive Care Unit Work Practices.

INTRODUCTION

In the field of design studies, there is a common view that ‘location’ is essentially a matter of geographical mapping, as with the use of spatial metaphors in, for instance, the field of office automation. In this view, mobile devices, personal information managers and PDAs are conceptualised in opposition to the desktop computer. That is, it is simply supposed that the appropriate frame of reference is the distinction between the mobile and the fixed (Hinkley and al. 2000: 91). From this simplistic distinction, and especially in the context of mobile devices, derives an equally simplistic view of social action which consists mainly of ergonomic, ecological or ‘human factors’ relationships, with a focus on such matters as light, sound, conversation, proximity between people and between people and machine. In the domain of ubiquitous

computing a second but related model can be discerned where for example, hand held devices are seen as operating as a tour guide - selecting relevant information as we proceed through a given landscape. Within this framework, the problem of location has been viewed mainly as a problem of tracking other people down and the possibility of extending peoples' awareness of each other (Salber et al. 1999: 434). A third approach to location has been elaborated by Spreitzer & Theimer, (1993: 27) where the relevant matters (the context being public administration) include access, accuracy, privacy and user identification. The important questions in such a view have to do with secure communication when a user is accessing his personal information from different locations.

This brief review suggests two things to us: (1) we need a deeper understanding of the professional domain we are involved with, such that our sense of 'context' comes to include the location from within which actions make sense. (2) Locations will be differentiated according to what is being done and who is doing it. The possible functions of the new PDA will depend on this fundamentally sociological conception. This approach is not designed to remove geography from our purview but to suggest that some marriage of geographical location and purposive behaviour is more appropriate. This way, and to paraphrase Garfinkel, we remove a set of geographical presuppositions from our eyes 'to bring investigation' (Garfinkel, 1967: 11). In other words, a specifically sociological enquiry which does not take the nature of location for granted may reveal what has previously been unnoticed.

For this purpose, we will look at (a) the software community and its extended network as a location in which developers discover IT solutions, (b) the ward as a location for the continuous professional training of hospital personnel, and (c) the ward as the location of caring practices. Taken together, these sites provide us with a resource for doing design work. That it, the implementation of a successful PDA

device which can be used in the Intensive Care unit requires some understanding of the need for an integrated approach to the work environment, one which recognises each of these sites.

1 - KLIV PROJECT: INTERDISCIPLINARY COLLABORATION

The design project emerges from a project called 'Continuous Learning Within Clinical Nursing' (Henceforth KLIV - the Swedish acronym). It is an interdisciplinary collaboration between Malmö's hospital school and Malmö's Interactive Institute (Teknik & Vetenskap, 2002).

The original idea was to support the use of educational/training tools in the daily work of clinical nurses. KLIV's approach was founded on the idea of using PDAs as a medium for instruction using videos that had in turn been produced by clinical practitioners. This, it was hoped, would replace a prior oral culture which relied on local expertise (akin to the 'Mavis' phenomenon, see Randall et al. 1996) and in particular 'knowing who knows'. As a result of this interdisciplinary endeavour, IT designers/developers, ethnographers and film producers worked in close association with the intensive care employees. In this environment, design solutions clearly involve interdisciplinary collaboration, and emerge at different phases of the project as the multiple dimensions of design we allude to above become salient.

The design of the PDA in question came from ethnographic observation of the conditions under which work is carried in the Intensive Care Unit (Björgvinsson & Hillgren, 2002, Strauss 1975: 230-1). The general requirements for the device came specifically from a number of insights which observation provided:

- Space for each patient is a constant issue. Increasing space for any single patient implies the reduction of availability of beds for other patients.
- Sophisticated medical technology abounds (fig. 1). Nurses are in command of more medical machinery in those units than anywhere else in the hospital.

- New recruits in the ICU are exposed to stresses linked to the management of complicated machineries.
- Swedish law requires nurses in the Intensive Care Unit to be updated on the last technology in use.



Figure 1: A nurse caring for a patient in an Intensive Care Unit

All those features of nurses' work make the introduction of the PDA an interesting issue to work with. Above all, the likelihood of adoption and the relevance of this device for the work of nurses in the Intensive Care Unit has to do with the fulfilment of several criteria that we encountered as we undertook studies of the materials used and typical practices of the nurses in their daily work. In our design process, several skills are at work in different dimensions of the project:

- The design process has to do with fixing a PDA such that it works. This PDA, with movie-playing capability, requires that nurses and others know who and how to fix such a device such that it works.
- Once the technology works reliably, it must fit with work practices in the hospital context. The design process involves nurses' professional knowledge itself. It is a centrepiece for making relevant choices in terms of filmmaking such as which machine to select, which medical intervention to shoot, and how explanation should be sequenced. It also involves organisational work, i.e. where to stock the movie bank, how many PDAs should be available, who will use those PDA, etc.
- Issues of status in the hospital, including 'who knows best' and 'who is allowed to know', are part of the process. These issues will not be taken up in this paper.

3 – LOCATION: A CONCEPT FOR ETHNOGRAPHY AND DESIGN?

The idea of this paper is to appropriate the concept of location to make it fundamentally sociological rather than merely geographical. This, we argue, allows us to recognise a series of complexities in the design process itself. As such, it requires approaching the link between ethnography and design in a very careful manner. We envisage that location as a design concept may have a lot to do with social distribution of knowledge. The importance of this can be gleaned from the work of ethnomethodologists such as Button (2000: 330). Button explains the implication as follows:

I am offering the suggestion that ethnography can be trailed into the world of design in a harder fashion than our enthusiasm currently permits. It is not classical ethnography that is the remedy here: indeed I am sceptical of classical ethnography in and of itself. Much more relevant is the use of fieldwork, but even here I believe we need to be more rigorous, demanding not merely scenic depictions of settings and doings, but

analytic explications of how activities are done and ordered. Analytic explications must reference what Garfinkel terms member's knowledge: what people have to know, and how that knowledge is deployed in the ordering and organisation of their work.

If we import Button's reflections into our argument about location, it suggests that a rigorous ethnographic awareness should enable us to see the ordering of work activities as situated in place. That is, context includes ecological matters but is not exhausted by them. The complexity of work practices necessitates a deep understanding of who is involved in the process of work, when and where. Where location conceived geographically leaves the user as a 'scenic feature' of design (Sharrock & Anderson 1994: 11), an ethnographic attitude re-locates attention in such a way that the deployment of user knowledges and expertise becomes central. In our case, given the interdisciplinary context of the design, location refers to the differentiated, yet related, domains of work practice of participants to the KLIV project. It means that we will deal with location by taking into account what has to be located, by whom, for whom, for which expected results. In other words, one of the results of bringing the new concept of location to bear is to take the design process out of the rhetoric of one-man-creativity into a descriptive one. Then it is possible to take the social complexities of iterative design seriously and utilise these in an interdisciplinary process focusing on collaborative inquiry and design (Brandt, 2001). Then collaboration in design implies knowing each other's boundaries of competences such that management of resources are distributed adequately.

We will now see how the design of the PDA for hospital personnel in the intensive care unit involves understanding the location of different expert knowledges. In the design process of PDA for the intensive care unit, it appears that:

- Design of a PDA for the intensive care unit engages developers in understanding

the initial hospital need. The initial impulse comes from the Swedish legal policies in intensive care unit. It stipulates the need for continuous knowledge of technical machinery by personnel working in those units.

- From the user's point of view, i.e. the hospital personnel, it means that PDA's content, its relevance and application are dependent upon their expert knowledge of the hospital's functioning.
- From the IT developer's point of view, it means investigating software tools that will permit hospital personnel's expertise to be available in a PDA.

The following three parts will deal successively with location as a sociological concept as it applies to different communities of use. The first part (section 4) deals with technical design solution. It consists in locating a community of expertise within which technological solutions may be discovered. The second part (section 5) deals with the ward as a location where learning is a central part of the work of personnel. The third part (section 6) is dealing with the ward as a location where the use of technology and teaching orients to emergency care and nursing practices.

4 – THE MAKING OF THE PERSONAL DIGITAL ASSISTANT: LOCATING TECHNICAL SOLUTION

The designers' team produced a technological solution specifically dedicated to making the PDA work. One of the central issues was the location of relevant technical knowledge. We will see how the problem of the location of IT professional knowledge came down to a problem of translating requirements expressed in ordinary language into relevant technological terms. In other words, the traditional design issue of finding the right resources to make the PDA suitable for running the relevant movies without crashing. The developers worked with some basic requirements such as:

- Finding out a software application for playing movie that could be modified.

- Creating an application that would start a specific file or movie.
- Connecting the barcode scanner to the PDA by developing the application.

The design process is basically a process of concretisation- turning a set of varied social and institutional purposes into consistent and complete requirements. Despite the fact that these different purposes may be unrelated, they nevertheless impact on the design of the PDA. This can be captured in one sentence: the developer needs to provide a PDA such that nurses consult it to document their practices (use of machinery or medical intervention in the intensive care unit). It turns out that finding the appropriate movie technology for the PDA was exactly the factor that made the design decision concrete. Users as well as technologists had a shared experience of technological inconveniences with the pre-existing PDA version. For example, in the earlier version of the PDA, the film ‘froze’ when second or new films were loaded. From this initial issue, technological solutions have to be worked out. In this case, technological expert knowledge consists of locating and applying relevant IT tools. The technologists started by:

- An initial familiarisation with the PDA hardware (iPaq) and its functions.
- Knowing the software platform basic requirement (pocket pc 2002).
- Choosing a movie application (Media Player) compatible with pocket pc 2002.
- Familiarising themselves with the programming language (Visual Basic).
- Getting the software tool (SDK: Software Development Kit) that captures the expected movie and starts the player.

Here, the understanding of location has to do with the identification of relevant technical solutions (see figure 2. below).

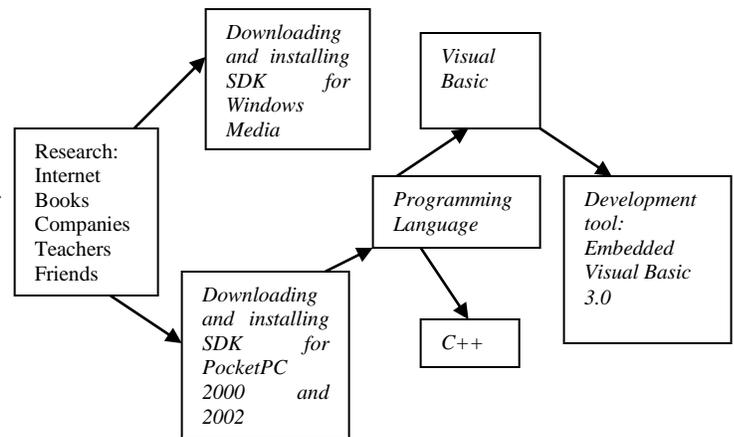


Figure 2.: Development process by Bergqvist & Emilson (2002: 14)

Notice that without the location of relevant domains of knowledge (the first frame on the left), the tool development is made impossible. What the concept of location allows us to do, here, is to dig into what turns developers into de facto researchers of their own putative solutions (not as ontological experts but as active and ongoing participants in their own expertise).

A - TECHNICAL KNOWLEDGE

For example, the development work consists in programming in Visual Basic in order (1) to connect the movie player with a specific movie, (2) to draw, select and fix graphical user interface details such as buttons, text labels for movie identification, and provide recognition of text fields for the interface application as well as the infrared device.

The software development goes through phases. One of them consists of developing the PDA functions using an emulator tool. The emulator (which belonging to the system development kit) simulates on computer what will be done within the PDA itself. Developers have simulated an operating system environment (pocket pc 2002). Of course, the choice of Pocket PC 2002 is the result of testing other versions and verification of best compatibility with the PDA hardware (iPaq).

B- TECHNICAL KNOWLEDGE WITHIN A COMMUNITY

Developers have used external resources for their development such as an Internet support group,

mailing list and open source developer. The work of location of technical knowledge is an emergent feature of work. As the extract from the project report shows (Bergqvist & Emilson, 2002: 16):

We started to examine different environments. Internet supports and search for information was probably the most effective way for getting the most updated information. We also noticed when working with forefront technology, how hard it is to find information about how things works and which tools are available. When we spoke to one specialist at BTH (the school) he gave us one kind of information. When talking to companies they gave us another kind of information. One important thing we learned during this process was that it's hard to find information if you don't know exactly what you are looking for. At first, we couldn't ask the right questions. You can't ask the right questions if you don't suppose to have an answer of that question. Even if the answer is wrong, at least you have a ground to stand for revising your previous knowledge. We started our search on Internet thanks to a search engine. We looked at websites with forum identifying the topic most relevant to our own search issue. After overcoming the first messy impression as first user of those forums, we identified useful domains. For example, different discussion forums and mailing lists revealed to be useful.

The emergent features of work and its relevant details are negotiated from within the community of experts. In our case, the technical expert needs to know what kind of movie application and operating system are available in the market. The issue also has to do with how to get them, if these are available for free etc. (a) The support group on the net helps to do this preliminary investigative work. The mailing list allows answering the same kind of quest. More importantly it allows developers to find out answer to issue their have experienced with the movie application or the operating system. (b) The mailing list permits the posting of specific requests to other specialists that may have similar experiences and thus can proffer candidate solutions and relevant warnings. The mailing list

provides access to 'tricks of the trade' in the software community as they relate to specific products. It allows the developers to locate and identify unusual issues (bugs) as well as locate other relevant developers in relation to the problem at hand. (c) As a result of this knowledge work, the open source community was identified as an ultimate resource. Code was available from it that constituted an adequate (and free) solution to the problem of running the movie player. This facilitated the developers' work on the application EVB. As a result, they succeeded in playing film with the selected media player. They also managed to implement further devices such as the barcode scanner (allowing the customisation of the EVB with the dedicated scanner application SocketsScan). As a result, the developers have made a prototype available to the nurses in the intensive care unit.

The issue of finding adequate knowledge turns out to be an issue of the professional knowledge available within the software developer community. Location, in this sense, invites two remarks:

- A rigid framework of positivistic engineering specifications could not provide the relevant software solutions. Solutions could only be found out through locating the relevant community of people to talk to.
- Location understood as identification of resources (community, books, trials and error, testing) is the fruit of design development phases. The location of expert knowledge within the community is not given. It develops sequentially with and is co-constructed with, the successive phase reached by the actual implementation of the PDA itself.

In summary, location in this context is the location of a community of experts. Location, in this specific instance, is understood as the social arena within which the embodiment of expert knowledge may be discovered and applied. As

seen before, this social arena is not a clear-cut identification of persons, nor a place where knowledge is stocked and accessible on shelves but involves a social process of searching and identifying relevance and adequacy. The location of expert knowledge is the result of the search by developers using reflexive interpretive methods using what they know at one point in time and what other developers have told them. These exchanges are relevant because they answer the issue at hand with the specific technical constraints of the PDA in mind. The software solutions, in themselves, are the result of this research. This research is constitutive of what defines the area of expert knowledge.

5 – THE WARD AS LOCATION

One of the domains where KLIV ideas have been applied is the creation of movies by nurses themselves. These are about the functioning of machines and about medical interventions. In the ward, the use of PDA technology takes its meaning, i.e. its function, from the work practices in the intensive care unit. It must be clear that the PDA (with its tutoring movies for nurses and others) becomes a useful tool only if its meshes with the pre-existing professional practices of medical care, machine maintenance and the needs of others in the ward. In the intensive care unit in Malmö, a feature of the work practice is the existence of dedicated nurses identified by speciality. In the professional jargon, they are referred to as ‘specialist nurses’ (Benner, 1984). One nurse is in charge of the medical technology as well as responsible for the education of the staff. She adopted the PDA and taught herself the art of moviemaking (see fig. 3, recording a ventilator). In this specific instance, the use of the PDA and the working practices of personnel find their common meeting point within the educational responsibilities of this person. At this point, the concept of location takes its meaning from the way the PDA technology is applied in and through the social practices of an individual with a clear role and professional responsibilities within the institutional structure of the intensive care unit. It is important because, in this instance, the introduction of a new technology is

dependent upon the institutional structure of educational responsibility and its relation to technology in the Swedish hospital.

A – LOCATION AND INSTITUTIONAL STRUCTURE

In the Swedish system, the requirement of continuous education of the staff in intensive care units is a legal requirement (http://www.sos.se/sosfs/2001_12/2001_12.htm). It is a fact that Swedish hospitals have organised the responsibilities of the clinical nurses around a set of identified specialities defined by work in the intensive care unit (Benner, 1996). For example, we found: (a) a nurse responsible for wounds, (b) a nurse responsible for continuous learning in the ward, (c) a nurse who specialises in IT and hardware maintenance, and (d) a nurse responsible for medical technology. We will deal, in this part (section 5) with the specialist-nurse responsible for medical technology, as she is the pivotal point between the ward as a location and the PDA as a piece of new technology in this environment. This person is also responsible for the educational program which deals with the relevant technology. Her workload is 50% consecrated to nursing and 50% to her specialty, i.e. machine maintenance, technological issues and related education in the ward. The responsibilities of this specialist-nurse include being in charge of (a) relations with the technology salesman and also (b) the administration of purchase. All relevant personnel motivate their need of new machinery or instrumentation to this specialist-nurse. (c) She is a full manager of the technical office with control over budget and planning. (d) When new machinery comes in, such as devices like the PDA, she is responsible for the education of the all staff (including 140 nurses and doctors). All relevant staff have to go through the training as it is assumed that not having done it will impact on the safety of patients.

One of the main implications of the institutional requirement for education in the ward is tutoring *all* the personnel. It is clear that the person in charge of the education of over 140 staff members faces an obvious managerial issue: how

to make sure that the whole staff is trained in a relative short period of time without disrupting the normal functioning of the intensive care unit? One of the solutions that the use of the PDA invites is to allow the hospital personnel to select educationally relevant features to record themselves. In the same way, the tutoring procedures of different members of staff through the movie medium has invited cooperation, exchange of information about best practices, tricks about filming etc. among the staff. The location of these practices, and hence for filming them, is no single place in particular on the ward, but is normally wherever on the ward the technology is located for the medical practices in question are typically associated with specific technology. In other words, the location of tutorials is the result of co-construction and collaboration among the personnel themselves.

B- TUTORING: WHERE TECHNOLOGY PLAYS ITS ROLE

Our example deals essentially with the ward as a location for work practice in relation to the use of the PDA. The use of the PDA and its relation to the ward as a location is primarily associated with the educational aspects of the device. Its primary function in the ward is as a tutoring device. Figure 3 shows one of these filming sessions. We see how the clinical nurse in charge of the medical technology is teaching herself to film a piece of a transportable ventilator. Ultimately, the ward is a location for caring work, and one of the obvious dimensions that the ward possesses in the context of using PDA movies is the role that updated education plays in enhancing nursing work in the intensive care unit.

In figure 3., we see the specialised nurse in charge of the technical equipment filming another nurse providing an explanation for the use of transport ventilator. This kind of ventilator is used to help patient breathing during their transportation. It is also used when patients are transferred from one clinic to the other. The PDA allows the performance of tutorial work within the context of the work itself rather than from a decontextualised classroom. In this perspective,

locating the machinery's functions and pointing them out is done for the sake of didactic clarity. The idea is to find out for themselves the appropriate way to use the movie technology (and potentially the PDA at the end of the chain) in order to transmit their 'tips and tricks' to other nurses who can, in their turn, makes movies as well.



Figure 3: Recording an old transportable ventilator

When personnel consult the PDA, this is the tutorial they get:

I will show the transportable ventilator we use in the ICU. This is the ventilator (pointing it out), this is the oxygen tube (holding it), and this is the ventilator tube. There is a connection to the patient, a PEP safety valve and an oxygen tank used for the transport. If you look at the ventilator it has one manometer where you can measure air pressure (pointing it out), the breathing frequency (pointing it out) and the minute volume. It is also possible to adjust if it should be 50% oxygen or 100% oxygen. There is also an on/off button.

The systematic location of function on the machinery itself (by pointing to and simultaneously speaking of) performs three main purposes: (1) the development of well-organised tutorial for others to watch and follow as easily as possible. (2) provision of a visual and public display of nurses' professional knowledge in the

ward. (3) making availability materials in tutorial form for all personal to consult. The PDA makes available and recognisable the things that nursing staff themselves previously considered to be invisible properties of their professional knowledge. Making the nurses' professional knowledge public removes the superficial understanding of knowledge as idiosyncratic properties of particular individuals. This fact may play another role in the politics of the organisation itself. Rather than having one person relying on another for their access to tutorials (which may work perfectly well but also may potentially conceal, voluntarily or involuntarily, know-how and other precious tricks of the trade), the PDA makes the distribution of tutorials more accessible because they are less dependent on personal relationships. Although the PDA does not remove the fact that some nurses may be regarded as local experts-known in the ward for their knowledge and skills- it helps the task of distributing expertise more generally. The PDA further supports the use of tutorials according to the real world constraints of workload, fatigue, availability of personal, night shift and obviates the organisational constraints involved in more formal arrangements.

C- THE WARD AS A TRAINING FIELD

With the introduction of the PDA and the concomitant need for making movies, the ward as a location became a place for the investigation of professional practice itself as well as a training field for nurses. Nurses, that is, exercise their skills in order to film in the right way, with the right angle (fig. 4).



Figure 4: Getting a proper view for tutorials

This work of tutoring and the display of embodied knowledge points to two issues:

- Nurses' training.
- The orientation of the profession toward patient care in emergency situation.

(1) For medical staff such as doctors and nurses, the training has often to do with interpreting the results obtained from certain machinery (such as X ray films and electrocardiograms printouts). The teaching programme at the local university involves some workshops for nurses which relate to the machinery in question, but it is hardly a major focus of formal teaching. Basically, student nurses learn the facets of machine work during the time they spend in wards working as assistants of senior nurses. Of course, the medical world is full of extramural workshops, training conferences and continuing education programmes. The KLIV program, however, is predicated on the 'community of practice' view that emphasises learning on the job. The movie captures the knowledge which emanates directly from the work experience of nurses. The capture of this experience by nurses for nurses makes explicit much of what had previously been tacit, or local. It appears that the introduction of the PDA has allowed a space for nurses to check and complement their own knowledge of machine functioning.

(2) The function of precise tutoring and, therefore, qualitative location of machine function has to do with the general orientation of nurses and staff toward safety work (Strauss & al. 1997: 69-98). If we concentrate on the 'life maintaining' machinery (such as the transportable ventilator above), in contrast to diagnosis and therapy machinery, it is because these machines are the closest one gets to life-critical functions. Their bad use or functioning may prove to be lethal to the patient. The other point is that machinery (such as breathing pumps) needs to be calibrated (check of oxygen rate, air pressure and air circulation). Of course, those machines are checked but nurses have to know when this has to be done, when a machine is going wrong, or is likely to go wrong in the future. The role of the specialist-nurse responsible for technology is to maintain a high level of maintenance to avoid that. Although mechanisms exist for contacting suppliers, even where no specific maintenance exists, the specialist nurse still needs to know enough about the machinery to formulate the right questions and adequately describe problems, as well as being able to recognise them in the first place. The efficiency, durability and safety of pumps are dependent on the knowledges that the responsible nurse deploys. She has to carry knowledge about the real-world work of nurses and the technical functioning and capacity of the machinery in practice. This may explain the difference in attitude difference between physicians with a rather 'gee whizz' attitude to new machinery, and that of the specialist-nurse who has to have an eye on practical constraints and problems as they arise, and who will expect them as a normal part of her duties.

In summary, it is clear that specialist-nurses' production of tutorial material on film is done with a practiced eye for the use of technical materials, the proper use of the PDA, the didactic quality of the movie, the systematic checking of pieces of equipment as well as the clear location of those pieces in the overall functioning of the machine. This points to the complexities of the ward-as-a-location. It incorporates a set of work practices about nursing in the Intensive Care

Unit. Location has to be understood not simply as a meeting point of different professions but as a place where the whole organisation is oriented toward the caring for, life support and recovery of patients in emergency situations. To understand the relevance of location we need to unravel the social complexity of nurses' work environment. The role of location of machinery pieces relates to the distribution of knowledge within the ward, between junior and senior staff as well as the circulation of up-dated information in the form of advices and remarks, tricks of trade for machine maintenance and so on. We will now see how attention to the ward as a location brings to prominence the nurses' work in relationship to patients real bodily degradation.

6 – THE PATIENT'S BODY: THE LOCATION OF CARE

We have seen that the organization of the hospital itself recognizes a specialist division of labour in the form of specialist-nurses with specific expert knowledges. The developers in this project recognized these institutional facts and designed accordingly. Specifically, it was decided that nurses and physicians themselves, as possessors of professional expertise, would produce movies themselves. In this way, technological designers worked mainly as technological facilitators in the last phase of the project. It makes clear two things:

- The production and relevance of the movies is a direct product of the recognisable professional expertise of those who produce the movies, as they go about their ordinary business.
- The PDA function is a repository of locally relevant knowledge for nurses and physicians in the intensive care unit. The PDA's quality serves the staff in the working context. Basically, it makes officially available in a repository the otherwise unofficial 'tricks of the trade'.

We would like to show, in this final part, how the ward as a location exhibits both these dimensions. We will use the example of a wound

as the kind of work that intensive care unit personnel are used to dealing with. (see fig. 5)



Figure 5. Dressing changes on a fasciotomy wound demonstrated by the clinical wound specialist-nurse.

The clinical wound specialist-nurse performs the demonstration of the fasciotomy. It is a surgical procedure that consists to make an incision of the connective tissue (muscles and other organs) to relieve pain and tension (in the leg in our case). The movie provides the following comments and advices:

Here you have a fasciotomy (pointing out with one hand). It is important to keep everything as sterile as possible. It is difficult because it is a big open wound. First, we start by putting a sterile green cloth underneath the leg (nurse assistant helps to hold up the leg). Then, (taking a bottle of acetic acid and NaCl (sodium chloride) in front of the camera) acetic acid and NaCl is what to use for wounds like this. All liquids have to be warm otherwise it's very painful for the patient. You warm it in a special cupboard on the ward. (Putting on sterile gloves) I use sterile gloves. Before starting, it is important to give the patient enough drugs. So you are sure that he doesn't feel any pain at all. (He now takes a sterile bowl (cup shaped) and pours in the NaCl, squishes compresses in it. And he proceeds to wash the wounds very carefully.)

In this extract, viewers focus their attention on the patient wounds as a matter of professional concern. Here, the patient body is the main focus of attention, the location captured on camera for good professional reasons. The movie provides the details of a well-informed and documented procedure. This is crucial for transfer of knowledge. Here, the patient body as a place of professional intervention is central to the functioning of the intensive care unit. The patient body is the place where intervention takes place. It means that it encapsulates an important series of related set of practices and that other, less experienced, practitioners need to know. The case of the wound is a good example of the concentration of expertise displayed as a work practice. (a) This movie already implies precision and knowledge on the part of the specialist-nurse holding the demonstration. (b) The movie also implies a suitable reference point recognisable as to-be-consulted by other nurses and physicians. The patient body as a professional location for intervention demonstrates the role that documentation plays in the Intensive Care Unit.

(a) The patient body is a domain of professional intervention. In this sense, the location of attention in the movie is a reflection of the nurse's practices. From the nurse's point of view, what is at stake is how to proceed with such delicate body surfaces as wounds. In this extract, information is sequenced and orientated toward the same goal, i.e. the success of the patient operation. First, let us notice that the patient body is a place of medical intervention. The place, the instruments must be as sterile as possible. Second, there is a work of isolation of the patient body from any physical reaction such as pain. The nurse indicates how to isolate the leg as a place of intervention (with the green cloth) and dispose of pain symptoms (with the warming of antiseptic as well as with drugs). Third, there is the intervention (in this case and at this stage) which consists of the sterilisation of the wound.

(b) It is clear that the movies produced for the PDA have to maintain the degree of detail and information suitable this kind of intervention. It is

clear from this example that the patient body as a location of professional intervention is the domain of reference. The PDA technology is a platform to make the details of work available to the other staff members at the Intensive Care Unit. It also provides a reference point from which nurses can assess their own practices relative to that of the expert in respect of all the different dimensions of the nurses' craft. For example, they may assess their own attitude during the medical intervention, their own organisation of the overall process of intervention, but also their bodily movements, their rhythm, their own precision, etc. The filmmaking technology embedded in the PDA essentially brings of documentation of the work to the practitioners who accomplish that work. It is this document that may be used as a tool of reflection concerning their own practices. It may also bring detailed information concerning how to proceed. The capture of the location of specific work practices as described above uncovers elements of professional practice that otherwise remain unnoticed by the practitioners themselves. The PDA has given birth to an area of real time documentation that has never been produced before. Nurses learn their job by doing it and, for practical reasons, do not bother with the grey area of unspecified action. They fill in the practical details of skills as the need arises. It is clear that the PDA as a re-enactment of localised set of professional knowledge has shed light on important details concerning skill. This was previously overlooked because unavailable for scrutiny by the practitioner. The PDA provides a documentary record of the different locations of professional expertise. The PDA has made lay tutorials of technical practices by practitioners available for practitioners.

CONCLUSION: LOCATION AS A PERSPICUOUS POINTER OF WORK PRACTICES

The case of the PDA re-design for the accomplishment of task in the intensive care unit is a good example of how the technology cannot dictate the conditions under which it will be of applied. The PDA remains a tool which will be used contextually, and the context in question

cannot be described with any single approach to 'location'. All of the different meanings of the term, under the diverse range of conditions under which it is used, need to be explored, especially as they are all at different times important in the course of a single design project. We have seen that the tool was shaped at various stages in accordance with these different assumptions. Thus, location for the designer was a matter of placing it in a context mutually elaborated within a community of software experts. This proved essential to the project in identifying known problems and prospective solutions. Location, then, in the first instance related to the shaping of the technological tool itself. Secondly, we have seen that location of work practices, the institution in which they take place, and the people who play a role in them dictate the role the PDA can play. Considering the intensive care unit as a working location, we have seen how the use of the PDA was shaped. The ward was another kind of location, one in which professional expertise and interest became the locus for enquiry. Location here referred to (a) continuous learning on machinery as well as (b) care and intervention on the patient body. The very idea of working out software solutions for the PDA through movie-playing incorporated the professional interest in its own topics. These consist in the related subjects of professional intervention and know-how.

What the concept of location has allows to do is to point out the perspicuous domain of inquiry (Lynch, 1995: 226), i.e. where the action occurs. The locations reported in this paper are:

- Developers' search for locating relevant IT solutions: discovering communities of IT practitioners as *ad hoc* resources for a problem.
- The ward as location of continuous learning. Recording machine functions on movies in the PDA exemplifies a professional concern for continuous training about machine maintenance.
- The patient body as a location for intervention. The wound and its techniques locate a domain of nurses' and

physicians' practices of care and treatment.

The paper reports on the way in which introducing a new technology in a professional domain is done necessarily through interdisciplinary development. Ranging over the relevance of location enforces attention on the social constellation of professional issues and knowledge. These shape the whole PDA as a technical object. The object itself makes sense when incorporated within the details of the work practices it helps to support. We have seen that the PDA is shaped as a technical tool within the location of a social community of software developers as well as a useful tool within the location of the hospital community (concerned with continuous training and care delivery, in our examples). The location concept helps us return to the details of work procedure that give sense to the PDA as a working tool in the real world.

To conclude, let us make a final remark on the PDA and its meaning in relationship to its location in work practice. Originally, the naming of the PDA (Personal Digital Assistant) was a reference to a portable assistant for time organisation and management (aiming at the white-collar population). The diversification of the domain of application made the generic term of 'hand held device' seem more appropriate. Perhaps the time has come to reclaim the notion of the PDA as Professional Digital Assistant. The notion of the 'hand held device' as a description of technology says nothing about what the technology does until we specify the social context of its use. The concept of Professional Digital Assistant at least points us towards the kind of assistance that can be embedded in professional practices, and puts the location of a domain of practices under the spotlight. If location is to be a useful organising principle for the Professional Digital Assistant then it will require a nuanced view of how the social practices of work are embedded in a framework of ecology and purpose. Such a framework will ultimately specify its usefulness.

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