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ABSTRACT The present paper examines how representations of prospective use became designed in a novel healthcare technology for elderly people. The case lends support to studies arguing that explicit investigations provide only a part of the representations of prospective use for technology design. It draws attention to a source of representations of use that is at once obvious and under-explored: the professional traditions of developers of technology. To examine this, the concept of practice-bound imaginary is introduced as an alternative to existing terms, such as technological frame. The concept enables better understanding of the interplay of multiple professional practices, the orientation of technology projects and the dynamics of how traditions affect the ideas about prospective use. These analytical possibilities were needed in the case-analysis, as the project was informed by several professional practices, each with their own sets of representations of use. Moreover, in many cases the representations of use were at once representations of viability, medical validity or manufacturability. They were often also inter-animated by adjoining representations from the same practice and compatible assumptions from other practices. Use was not only planned, configured or implicitly assumed, but also was inscribed by the models for conducting design, routine procedures and the messy interactions between people and materials. Designers themselves became aware of the implications of their solutions only after the artefact was reshaped by the resistance of the eventual users and refusers of the device.

Keywords elderly care, invention, practice-bound imaginary, technological frame, user-representation

Representations of Use and Practice-Bound Imaginaries in Automating the Safety of the Elderly

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Representations of Use in Designing New Technology

Social studies of technology production suggest that technologists are preoccupied with predicting and prefiguring the use of technology. A family of concepts, such as 'user-representations' (Akrich, 1995) 'configuring the user' (Grint & Woolgar, 1997), 'programmes for action' (Akrich & Latour, 1992) and 'representation' of use (Williams et al., 2005), have emerged for describing how the visions and assumptions of designers are connected to the affordances the technology demonstrates for its users.

Many of these studies have argued that explicit ways of obtaining information about use, such as market surveys and usability tests, are not

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the only or even the most important sources of representations of use in design (Akrich, 1995; Williams et al., 2005). Implicit practices of representation, such as relying on designers' personal experiences in users' practices (Kotro, 2005) or 'I-design' (using oneself as a reference user), have been shown to be profoundly important (Akrich, 1995; Oudshoorn et al., 2004). Woolgar (1991) examined how computer designers 'configured the user' by building their hardware to enforce the norms and desired actions they wanted the users to perform. While Woolgar described the designers' values and practices in configuring the user, his study opens further questions about how these norms and behaviours are linked to engineering and management traditions, and how these (and other professional practices) are involved in the construction of representations of use (cf. Williams et al., 2000: 134).

This paper explores how multiple professional traditions co-influence the configuration of the prospective use. Conceptually, I introduce the notion of 'practice-bound imaginary' (PBI) and illustrate it by analysing the early development of a new safety alarm system for elderly people and their caregivers.

Practice-Bound Imaginary: Conceptualizing Tradition and Practice in Technology Design

The ways by which the construction of technology is embedded in scientific and engineering practices is an established concern for science and technology studies. Since Fleck's seminal work on thought collectives (Fleck, 1979 [1935]) and Kuhn's notions of paradigm and disciplinary matrix (Kuhn, 1970), there have been a series of studies addressing the role of community, tradition and imagination in the construction of technology (for example, Constant, 1980; Bucciarelli, 1994; Bijker, 1995).

Building on this legacy, the concept of PBI orients to, in particular, examining user-representations located in the interplay of multiple practices involved in the construction of new technology. I shall first introduce the concept and then elaborate it further by comparing it with one of its key starting points, Wiebe Bijker's social construction of technology (SCOT) concept of 'technological frame' (TF).[1]

The term 'imaginary' has recently become more popular in, for instance, cultural studies (Marcus, 1995), feminist theory (Stoetzler & Yuval-Davis, 2002) and Science and Technology Studies (STS) (Gregory, 2000; Suchman & Bishop, 2000; Verran, 2001; Fujimura, 2003). Like imagination it evokes both vision and fantasy, while emphasizing the corporeality and specific cultural and historical resources present in imagining (Suchman & Bishop, 2000: 327; cf. Stoetzler & Yuval-Davis, 2002: 322–27). While 'imaginary' is easily misunderstood as variously referring to image, imagination, imagery or the colloquial meaning of imaginary as 'existing only in the mind', associated with 'free floating imagination' (Verran, 2001: 37; Gregory et al., 2003: 3), its appeal lies in the way it connects vision and fantasy to ways of perceiving and meaning-making. As Michael Carter phrases it: '[Imaginary] is not a "thing" of the mind but of an overarching relation . . . the imaginary is not something which the subject calls up at will, or . . . slips into when the reality principle is lifted' (Carter, cited in Verran, 2001: 37). Verran further defines imaginary in regard to land-right disputes in Australia, by saying that 'an imaginary [is that] through which the land is meaningful and by which the primary categories of that meaningfulness are given' (Verran, 1998: 252). She refers to earlier work of Castoriadis, who defines imaginary as 'the unceasing and essentially undetermined (social-historical and psychical) creation of figures/forms/images, on the basis of which alone there can ever be a question *of* "something". What we call "reality" and "rationality" are its works' (Castoriadis, 1987: 3; emphasis in original).

The notion of imaginary encompasses its embodiment in action and artefacts; practices that take place through an imaginary and by which the imaginary is being recreated. While being 'bound' in PBI underlines this connection between imaginary and practice, it also has more differentiating meanings.

'Bound' is used also to clarify that PBI denotes particular kinds of imaginaries, those *bound, in a sense of being restricted primarily to*, a specific practice. 'Practice' is here used as a proxy for a professional (or leisure) practice, a sustained way of engaging in action and attributing meaning in an area of life, typically taking place in multiple different communities. While resources for imagination (tools and concepts for imagining, envisioning, play) that motivate and prefigure action are seldom restricted to any one particular practice (Wartofsky, 1979: 209; Gregory, 2000), PBI also includes what Goodwin (1994) calls 'professional vision': practice-specific ways of perceiving and acting, such as particular usages of models, tools and conceptions for creating, maintaining and reproducing artefacts and action (Wartofsky, 1979: 201–10; Engeström, 1990; cf. Miettinen, 1998; Gregory, 2000).

The third sense of 'bound' is that in a PBI, sets of tools, ways of doing and imagining, desires, expectations, models, procedures and norms are *bound together* to form a relatively coherent whole. Such coupling is one of the prime sources from which practices gain their continuity and potency in accomplishing their practical and ideological concerns within a specific area of life. This facet of PBI will be discussed more thoroughly below in reference to how solutions and norms of information and communication technology (ICT) management reinforce one another.

The fourth sense of 'bound' emphasizes change and expectation. Professional practices are imaginaries that are *bound for* a prospective state of that practice. Like other collective expectations, such as 'guiding visions' (*leitbild*) (Dierkes et al., 1996), 'prospective structure' (von Lente & Rip, 1998; von Lente, 2000) and 'scenario' (Law, 1988), PBIs pre-adapt perceptions and evaluations, and act as functional equivalents for rules, discourses and imperatives that are not yet fully articulated within existing discourses. They mobilize people to think and act, and stabilize interpersonal interactions (Dierkes et al., 1996: 43–54).[2]

At the same time, practice and tradition form a springboard from which an imaginary *bounds* (leaps) *to* a prospected future. While the entire horizon of a practice is often unrealizable even in principle, the difference between fantastic imaginations and a PBI is that the latter appears partially realizable and desirable in the practical action of participants (Gregory, 2000). The motivational power of expectations depends on their material embodiments: success of the artefacts embodying them, articulation of visions, criteria for adequate solutions, prototypes, ways to organize work and so on (Dierkes et al., 1996: 44–45; von Lente & Rip, 1998; Gregory, 2000; von Lente, 2000). A potent PBI thus animates tradition and current practice as if they were not only bound for a prospected future state, but also that this state was also *bound to* be realized in one way or another, making the practice appear as durable and dependable continuation of change. Below, such a case is highlighted when I inquire into the development of safety phone designs to show how a novel product-concept won innovation prizes and other public recognition, during its early phases, even before its eventual functioning was established.

Thus PBI does not refer to imaginaries, expectations, *leitbilds*, scenarios or traditions in general, but to relatively integrated sets of visions, concepts, objects and relations that are regarded as desirable, relevant and potentially realizable in and for a practice, and as having cognitive and motivational power for organizing this practice.

Such an understanding of professional practice and tradition offers conceptual and methodological advantages, which can be further elaborated by comparing PBI with Bijker's notion of TF. TF is a good concept for comparison, because it has done important work in Bijker's and others' analyses, and it builds upon and refines previous conceptualizations of how practices foster design (Bijker, 1995: 126).[3]

The core idea in a 'frame with respect to technology', as Bijker clarifies his concept (Bijker, 1995: 126), is that humans relate to technologies through 'frames' that govern the way in which they perceive and act with them (Bijker, 1995: 193–97). The frames give structure and resources for action, but at the same time constrain the scope of possible ways to think and interact with technology (Bijker, 1995: 192). Bijker provides a sense of the heterogeneous but interconnected contextual elements at play in the practices of technology production, by noting that a TF tentatively includes: goals, key problems, problem-solving strategies, requirements to be met by problem solutions, current theories, tacit knowledge, testing procedures, design methods and criteria, (conceptions of) users' practices, perceived substitution functions and exemplary artefacts (Bijker, 1995: 125).

The above functions and tentative elements are indeed important aspects of PBI. The differences become visible with a closer examination of how we should understand what a 'professional practice', 'tradition' or 'TF' consists of. What I have in mind are four interrelated questions: Who holds a TF and how? How do people participate in, and by the same token, how do their actions depend on a TF? How does a TF change? How does it motivate and orient people acting within it?[4]

In SCOT, frames are held by 'relevant social groups' that attribute the same meaning to the artefact (or to a group of artefacts). The frames are seen to be located not in actors or in technology, but as a 'hinge' between actors and technology. Different relevant social groups give different meanings for artefacts through different TFs. New technologies can also create new social groups by re-aligning the meanings attributed to technologies, by creating new and changed TFs (Bijker, 1995: 195–97).

The way that SCOT uses the sameness of meaning in regard to the artefact as the defining criterion for 'relevant social groups' has been repeatedly criticized (see, for example, Klein & Kleinman, 2002). In the least generous reading, this kind of artefact-centrism (that is arguably not only SCOT's problem) runs a risk of (re)producing what I would call fake or marketing man's communities, for instance, social groups of shampoo-users (cf. Kotler, 1988). A technology (or the sameness of meaning for a technology) is seldom the prime reason why social formations such as companies, workplaces, families and disciplines exist, even though technology is indeed used and produced within them (cf. Strathern, 1992: vii, vi–xii; Klein & Kleinman, 2002; Suchman, 2002: 5, 8–9). Moreover, such communities do not require uniformity of meaning, but often exist because of complementary resources, different starting points and meanings (Blumer, 1969: 70–72; Star & Griesemer, 1989; Engeström, 2000).

The methodological implication of this criticism is that an alternative (or at least complementary) sensitivity to 'relevant social group' should be developed from examinating formations of joint action. There are also readily available STS concepts for this purpose, such as 'going concern' in symbolic interactionism (Hughes, 1971: 54–55; Clarke, 1990: 18) and 'activity system' in activity theory (Miettinen, 1998; Engeström, 2000; 1987: 78).[5]

The concern about the nature of communities that hold PBIs is related to the question of how PBIs are 'had': How are they present in action and imagination? While agreeing with Bijker's image of TF as a 'hinge' between people and objects, it should be further asked: How do different frames relate to one another? It is more a rule than an exception that technology projects are motivated by, and draw resources from, multiple practices and cultural sources (Law, 1988; Miettinen, 1998). Most modern design also takes place in teams and activities that are composed of representatives of different disciplines.

In contrast to, for instance, Kuhn's notion of paradigm, Bijker recognizes that individuals and institutions in technology production may be influenced by a number of different frames (Bijker, 1995, 2005). Bijker flags this by introducing the concept of 'degree of inclusion in a frame' to explain how much a particular frame enables and constrains an actor operating within it, as well as to explain differences between technologies influenced by one or more dominant frames (Bijker, 1995: 192, 139–43, 279, 282–86).

PBI sensitizes us to the possibility that there may be more to multiple participation than the degree of inclusion. In joint action, individuals, teams and activities interpret practices differently and combine them in novel ways with other practices. What follows is that instantiations of PBIs are often unique, both in terms of the combination of practices involved as well as in the way people and activities interpret and participate in those practices. PBIs, in turn, may instantiate a unique recombination of more pervasive 'incomplete utopian projects' (Gregory, 2000), ideographs (von Lente, 2000) and other cultural resources. Attention should therefore be paid to inter-animation, layeredness, and conflicts between different PBIs from which a design team or an activity draws (see Gregory, 2000: especially 153–61, 183–86, 544–48). This is hard to do with the way 'relevant social group' and 'TF' have been conceptualized to date.

This leads to the question about change. Bijker sees that '[a] TF is built up when interaction "around" an artefact begins. Existing practice guides future practice, though without logical determination' (Bijker, 1995: 123). He notes that 'The cyclical movement then becomes: artefact – TF – relevant social group – new artefact – new TF – new relevant social group' (Bijker, 2005). However, as Klein & Kleinman (2002) point out, frames are not likely to emerge de novo in the case of each new technology, but draw on existing practices and cultural resources. Parts within cultural formations typically change in different rhythms and have different durations (Braudel, 1995; Hyysalo, 2000). For instance, medical practices undergo frequent re-tooling, while the shared purposes for doing the work, social structures and even the ways of incorporating new tools in the practice remain remarkably stable from one technology to another (Blume, 1992; Hyysalo, 2000; Karasti, 2001). In contrast to TF, PBI emphasizes that change and continuity are intertwined, multifaceted and partial. It thus sensitizes the analyst to searching for patterns and stability in change.

Finally, conceptions of change are further related to the question about how PBIs orient and influence the construction of technology. It is not only that frames structure, enable and constrain action as retrospective structures as Bijker sees it (also see von Lente & Rip, 1998). Engineers and managers perceive the features of technology in relation to the changing collective expectations and 'prospective structures' (von Lente & Rip, 1998) that create significance for current as well as expected events and findings (Dierkes et al., 1996; von Lente & Rip, 1998; von Lente, 2000; Konrad, 2002). Such prospective structures orient and motivate participants. They align shared desires about the future that are necessary to launch and sustain complex and highly uncertain innovation processes (Dierkes et al., 1996; Gregory, 2000: 174).[6] PBI emphasizes analysing the dominant conceptions that guide a practice in addition to charting out the frame that enables and constrains action and thinking.

Wristcare: A Techno-Economic Invention from Heterogeneous Resources that Failed to Fit the Practices of Users

The relevance of PBI to studying user-representations can be illustrated by an analysis of the early development of Wristcare, a novel healthcare technology. The story is simultaneously one of success and partial failure. Designers invented a promising technology by combining several previously weakly related fields over a 5-year period, but spent another 5 years in redesigning the system to meet the requirements of its eventual users. As the initial user-representations became first questioned by users and later also by designers, they left many traces. Concepts such as PBI needed to be developed for (and through) the case analysis to help understand the complex dynamics through which multiple professional practices enabled and directed a technological project and how many good considerations led to an insufficient or 'bad' design.

The data presented in this paper result from a historical and ethnographic case study of design and use of Wristcare and its predecessors since the late 1970s to the year 2002, comprised of 77 interviews, one and half years of longitudinal observation, and analysis of archival documents. The primary focus here is on the early development (1992–96) of Wristcare and the company that designed it. The interviews and documents were cross-validated to reconstruct the course of events during the innovation. Particular emphasis was laid on tracking the resources that made the invention possible, and examining the user-representations that were visible in various documents, technical descriptions and statements by the people involved. The analysis of the PBIs relating to Wristcare used documents, interviews, and my own field observations about the encounters and relationships between the Wristcare project and the practices that gave rise to the invention.

The impetus for designing Wristcare was that, with the ageing of the European and North American populations, elderly people and elderly care were becoming an important market for producers of new technology. However, safety phones (safety alarm systems for the elderly and disabled) were (and still are) among the few examples in which producers' efforts have found profitable markets (Wild & Kirschner, 1994; Östlund, 1995). The main inventor of Wristcare estimated that if physiological monitoring could be introduced into a safety phone, it would not only replace the existing devices, but might also open up new market segments among younger users (Project Business Plan, 1995). He established a small start-up company International Security Technology Ltd (IST), in Helsinki, Finland.

The invention drew solutions from multiple practices and managed to combine these into a novel kind of approach to monitor the well-being of the user:

(1) The most important of these practices was safety phone development and marketing, with which designers had a long experience. This experience furnished the initial problem to be solved by Wristcare: to

create a better alternative for 'passivity sensors' distributed around the house to detect when a user had an accident, but was unable to sound a manual alarm. Safety phone development also helped focus the designers on what would be significant: for instance, the importance of an easy-to-wear wrist-held device; emphasis on a low price; and from the passivity monitoring, the idea that combining relatively crude and cheap instrumentation could provide sufficient information about the users.[7]

(2) The second source was the existing sensors and devices for physiological monitoring. By examining the existing devices, designers gradually found out that movement, acceleration, body temperature and the conductivity of skin might be possible to measure sufficiently with existing technology, even with sensors fitting a wrist-held device.[8]

(3) The founder's experience in industrial automation added to these ideas. It would be easier to detect disruptions of the user's condition by focusing on secondary signs, reactions and the overall state of the user than to detect the precise measuring of any one parameter, thus allowing for lighter instrumentation that could fit into a wearable size and remain within a reasonable price.[9]

(4) Discussions with first-aid personnel and a gerontologist suggested that the features to measure, principles for their measurement, and analogues for algorithms in Wristcare could simulate the diagnostic practice of front-line helpers.[10]

(5) Designers' experience in the technology business provided a means for achieving a viable design. Among the measures taken were concentrating the company effort only on research and development (R&D), while outsourcing as much as possible of everything else; adopting strict secrecy over key features to fend off competition; and defining the product as system-independent, minimal, mass-produced and fully automated to keep manufacturing, sales and maintenance costs low.[11]

(6) Finally, designers had acquired information about elderly care over the years from designing safety phones. This information convinced them of the desirability of extra security and possible pro-active detection of a user's declining state, and could enable cost reductions by allowing elderly people to live longer in their own homes.[12]

During the early years, the inventors regarded their innovation mostly as a technical and economic challenge. The device was launched in 1998, and won further recognition in innovation awards, received positive press coverage and began to seek international markets (Wristcare Business Plan, 1997, 1998, 2000). This was an achievement for a start-up that was founded in the midst of a deep recession and suffered from lack of funding throughout its early development.

At this point Wristcare was an integrated, fully automated device (with the alarm button as the only manual feature) that had only one additional transmitter unit to accompany it. It was intended primarily for the still active 60+ year-old population living at home. For care-givers, the design provided 32 notices and degrees of alarm, which the care-givers could not disable or modify (Wristcare Users' Manual, 1997).

Even though the concept was commercially appealing and technically ambitious, its pilot-use revealed problems in how reliably it monitored the health of some users, and in how the device fitted the habits of its end-users, as well as the work practices of implicated users such as care-givers and alarm centres receiving the calls. While aiming to be foolproof and easy to maintain, the device came to have a seven-page detailed manual about its optimal use, which quickly grew to 25 pages after the pilot trials.

What was initially planned to be a black-boxed and mass-produced artefact remained interpretatively flexible: its reliability, actual functioning and sufficient configuration remained subject to debate both within the company and in the various organizations using, recommending and evaluating it. In addition, the material make-up of the product gained only partial stabilization as extensive redesigns followed the initial launch.

By the year 2003, the device was used during the very last years of a client's life (just as had been the case for previous safety phones) and its biggest market was in sheltered housing. The most ambitious alarms in the system were removed, and the included software allowed for customizing alarms for each individual site and user. In addition, the company became active in incorporating accessories for specialized groups and further developing the device in contact with major user-organizations. Overall, the initial representations of use incorporated in the device during its first round of development in 1992–97 were thoroughly questioned and re-defined before the device started to win market share and trust from purchasers, implicated users, end-users and healthcare regulators in 2001–03. Fig. 1 sums up the early development of Wristcare.

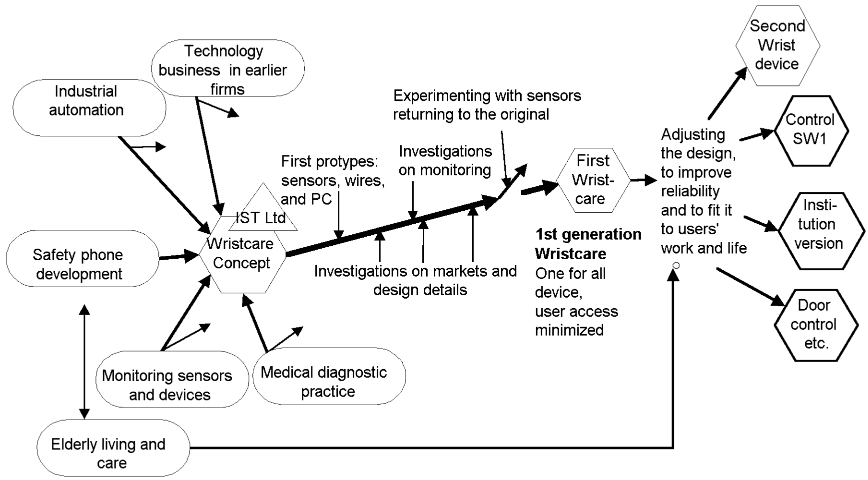
Against this background, I shall examine the representations of use that designers relied upon during the first phase of the product development in 1993–97. I have elsewhere analysed in detail (Hyysalo, 2003) how the explicit investigations commissioned by the designers – user-interviews, two market studies and a design study – proceeded only after the initial visions were articulated and did not significantly alter them. I shall thus focus on the sources of the initial visions; in this case, the six professional practices from which designers drew the resources for their design.

Illustrating the Facets of Practice-Bound Imaginaries that Gave Rise to the Invention and its User-Representations

This section illustrates in more depth the practices that gave rise to Wristcare. In doing so, it elaborates further the conceptual discussion of how PBI contributes to examining professional practices for studies of user-representations. Due to the limits of space I resort to illustrating each of the practices related to Wristcare only in regard to particular facets of PBIs. These are, that PBIs:

(1) are *bound for* and *bound to* future practice (illustrated with safety phone development);

FIGURE 1
The development of Wristcare from the inception in 1992–93 to post-market launch period in 1998–2000. The invention was made possible by complementary ideas from multiple fields. While gaining technical and economic credibility after the market launch, the concept faced deep problems in the hands of its users leading to long and costly redesigns.



(2) are *layered* and *inter-animated* with other PBIs and cultural resources (illustrated with safety phone development);
(3) are *bound together* from norms, solutions, projections and so on (illustrated with ICT management);
(4) are *restricted primarily to a specific practice* (illustrated with medical monitoring practices);
(5) have varying memberships and are interpreted in communities of joint action (illustrated with elderly care).

Safety Phone Development

Wristcare designers had their strongest professional commitments in safety phone development. The field resembles the case of burglar alarms in that designers have advocated increasingly complex systems, marketing both the threat and the need for sophisticated remedies.[13] The ancestors of safety phones were the various paging and nurse-call systems in hospitals, such as bedside bells, pull cords and alarm buttons. The first generation of safety alarm systems consisted basically of a phone with an alarm button and a pre-programmed alarm path to a service provider. They started to proliferate in the 1970s, both in sheltered housing and in home use (Ihonen, 1986). Gradually, a greater number of alarm buttons and cords were added (for instance in the lavatory and kitchen) to complement the phone that was usually located at the bedside. Some devices came to have an intercom system that could establish a speech connection between the alarm centre and user, even if the user was lying on the floor unable to pick up the handset of the phone (Ihonen, 1987; Wild & Kirschner, 1994).

The 1980s saw the coming of wireless, wearable alarm buttons that made the 'security' omnipresent inside the house. At the same time, there were attempts to use 'passive alarms' to detect the instances when the person was not able to sound an alarm manually. The solutions relied on finding indicators that would send an alarm if something had gone wrong with the person. Technologists reasoned that even 'demented' humans normally do certain vital things, such as sleep, eat and go to the toilet (cf. Björneby, 1994: 206, 209). Sensors in doors, refrigerators and beds were accompanied by wearable tags to which induction loops in the doors reacted. These accessories, however, had their own sets of constraints. Following the argumentation of the designers of Wristcare, they were prone to false alarms, were too slow to react to problems and required heavy wiring that was expensive and possibly intrusive (Wristcare Functional Description, 1993).

In the 30 years of safety phone development, technical change has involved increasing complexity and changes in transmission media. Changes in the artefacts seem to have been guided by a conception that it would be desirable to be able to transmit help in all harmful incidents that a user might face. This appears to be an unending pursuit of introducing more thorough and total monitoring within the limits set by unobtrusiveness and price, moving the devices away from the bedside and to encompass spaces occupied by more mobile and healthy users. This conception of desirable and feasible change is central to the PBI of safety phone production, accompanied by exemplary artefacts (robot phones, push buttons, radio-frequency receiver units), skills and ways of working (mechanical and electrical engineering in signal transmission, sales strategies, ways of organizing alarm centres, adopting solutions and people from other branches of telecommunications), instruments (changing tools to render circuit boards, manipulate plastics, changing software programming languages) and so on.

Wristcare proposes an ever-more sophisticated solution to this central concern in the safety phone PBI and, not surprisingly, it has received plenty of attention from competitors, distributors and healthcare professionals. At the same time, but from the point of view of the practices of elderly care, critical problems in the operation of safety phones appear somewhat different. These include: false alarms; the clumsy design of the devices; the conduct of the often overburdened but still hardly profitable alarm centres; mistrust; and the unreliable logistics of alarm response. Yet, these problems have received producers' attention only when demanded by the State (Ihonen, 1986, 1987; Kokko & Ekberg, 1993).

Seen from this perspective, the key issue in launching and (initially) sustaining a technically and commercially ambitious project such as Wristcare is not so much how well it caters to the needs of its users, but how it – and its facets like inscriptions of use – fit into imaginaries in technical development and business. Part of this fit lies in how the project relates to desires about and perceptions of the future in the dominant PBIs. At that, even a failed artefact can add to the power and continuity of an imaginary

(Gregory, 2000; cf. Suchman, 1987: 27–49). As a designer maintained with Wristcare:

> We shall see how well we manage to hold on, but it is certain that this won't fail as a concept. It might be that it has to be done with a different technology and in a different way ... but even in the worst case [this company going out of business], some of us might be able to continue with this ... [by now] it is certain that this kind of device will be made.[14]

The safety phone PBI also can be used for illustrating the boundaries between a PBI and its neighbouring practices, showing how such connections may add to the argumentative force behind a technology project. Not many, if any, wholly new component technologies have been invented for safety phones, but most solutions used in them have been first developed in other branches of telecommunications. By the same token, there are few people who have a career solely in safety phone business and engineering. Nonetheless, safety phone development differs from the other telecommunication practices because of its mix of instruments, markets, future prospects and a sense of development from past to future, both in technology and in terms of change in users' actions.

This relationship to neighbouring practices is visible (and highly relevant for Wristcare) in the way that safety phone development has followed advances in signal and voice transmission technology as part of the general development of telecommunications through the introductions of intercoms, wireless alarm buttons and various sensors in passive alarms. More recently, the development of the global system for mobile communications (GSM) and the global positioning system (GPS) has led to attempts to create devices with safety phone-like functions for outdoor use, which are likely to be incorporated more fully into safety phones in the future. Likewise these alignments with advances in other telecommunications, the idea of integrating safety phones with more thorough surveillance was 'in the air' when Wristcare was invented. Technical visions included radar, infrared detectors and new kinds of distributed sensors around the house to extend the coverage to cases in which the user could no longer call for help herself (von Berlo et al., 1994: 75; Björneby, 1994: 206–09; Zoche, 1994: 64).

Even though safety phone producers have positioned their business within the alarm and security sector, they have been well informed about the development of medical instruments such as pagers, nurse-call buttons and monitoring devices. This proximity made medical technologies a desired source of new solutions, thus adding argumentative power to the Wristcare project.

The inter-animation and persistence of ideas and concepts are not restricted to well-articulated PBIs alone, but reach out to more long-standing and pervasive cultural desires as well (Gregory, 2000). For instance, safety phones and similar devices instantiate the long-standing desires in healthcare and technology production to rationalize the living and care of 'problem groups', such as the disabled and elderly, by computer and communications technology, such as the 'smart home' (Pantzar, 2000: 28). As aids, safety phones are part of an increasing permeation of healthcare into the lives of the elderly in the form of home help, home care, frequent visits to doctors and an increased amount of medication, also promoted by the long-standing pursuit of technical solutions that enable variously disabled people to compensate for their lost abilities.

At the same time, particular projects do change and re-align parts of PBIs and their mutual relations. By managing to introduce direct monitoring of the body to safety phones, Wristcare added to the desirability and realizability of aligning safety phones more with medical technologies (in contrast to their previous alignment with other forms of security telecommunications).

Management and Manufacturing

The third issue to which PBI orients us to is the extent to which solutions, ways of thinking and calculating and so on are *bound together* and mutually reinforcing in professional practices. I illustrate this point by examining how expectations and exemplary solutions were coupled in ICT management and manufacturing.

Business practices in the telecommunications industry provided several solutions for the design of Wristcare, such as maximal outsourcing and reliance on off-the-shelf components, strict secrecy, and aiming for a foolproof and stand-alone product. These concerned different aspects of the project, but were closely coupled together by their background reasoning: each of these principles allows the producer to capitalize on the work of other providers (such as providers of subcomponents or maintenance) and to concentrate its own actions on a niche in the value-chain of the product. In particular, producers emphasized that the crux of economies of scale was not having to deal with any context-specific configurations, installations, implementations, service or maintenance. As a Wristcare designer reflects on one of the company's previous products:

> A burglar-alarm . . . when delivered as a mass-good to customers, also has to stay there . . . because if you even have to talk to a customer too much, you are bound to lose your overhead.[15]

While these solutions project a powerful way for a firm to diminish costs, they share an increased fragility of control (Toikka, 2003). For foolproofing to succeed, the designers' pre-figuration of users' actions has to suit their practice or be forced upon them. As access to reconfigure the device is cut off from the users, errors or mismatches will easily render the technology unusable (cf. Akrich, 1992; Engeström & Escalante, 1996).

The power of such projections may be furthered or diminished by the extent to which various solutions are bound with one another. If the calculations of the projected future state hold, the foolproof interface and the stand-alone character of the device will help in defining each other. But if the configuring of users' actions fails, also the stand-alone nature of the product is easily compromised, and vice versa. Other linkages may add to this source of power/error. Reliance on purchased parts and expertise would further reduce the cost of production, and increase the resources and room that the company has for manoeuvring. High secrecy is essential for fending-off competitors as well as fending-off users' modification of the product-in-use, providing the company more control over its product and its price (Grint & Woolgar, 1997). But here again, reliance on purchased parts and expertise may make it harder to diagnose and redesign problematic aspects, while high secrecy restricts collaboration as well as effective evaluation of adopted solutions.

Whether for good or ill, such couplings may effectively be enforced upon a project. Investment-intensive high-tech companies must appeal to investors who want to see plausible solutions that seem profitable and have a calculable risk in investors' instruments. The appeal of Wristcare as a techno-economic concept was due to the fact that it adopted so many compatible solutions. Compromising any one of these would weaken the other projections in the economy of the project. This was one of the most crucial issues in the design of the device. The interlinked and over-arching nature of the projection made user-representations related to this reasoning hard to dismiss, even when projections of, for example, the benefits of a foolproof and stand-alone device may have appeared wishful and risky. In fact, after the market launch, when both foolproof and stand-alone ideas were eventually compromised, the company kept swinging back and forth from trying to design in more variety and configurability for different users to standardizing the product anew to make it more viable (Hyysalo, 2004).

Medical Monitoring Practices

Having tentatively illustrated what is meant by the *boundness for*, *layeredness* and *bounding together* of PBIs, I move to illustrating how PBIs are *primarily restricted to a particular practice*. I examine this through the tension that arose between the biomedical measurement tradition and the monitoring functions of Wristcare.[16]

While Wristcare seems an obvious step in safety phone development, attempts to design such a device had stopped short because it had been impossible to combine a low price and easy-to-wear size with the reliability and accuracy demanded for medical monitoring. The Wristcare project sought to overcome this by combining multiple sensors with principles derived from industrial automation and diagnostic practices of frontline helpers. In the words of the founder:

> When paramedics come to a person lying still on the ground, they want to know three things: does he react to external stimuli, breathe and have a pulse? . . . So [our] device acts like a human would: if the person does not respond, we check the pulse and breathing. If these seem to be OK, then we just keep on observing [other signs]. There is no need for any mumbo jumbo when you look at the person slightly more all-inclusively, [laughs]

> [even] with these kinds of rather crude measures ... [It was my experience in] process control ... [which] made the pieces fit together ... You can anticipate from small, secondary signs that now something is heading for the worse. Our system is primarily based on measuring the reactions and not the actual incidents, which is the case in basic medicine.[17]

This approach deviated, however, from established ways to monitor the human body in biomedicine and medical technology. The tension first became visible in the evaluation of Wristcare's early prototypes by their collaboration partner, the medical technology laboratory of the State Technical Research Centre of Finland (STRC) in 1994. The STRC study pointed out that to date the wrist had not been used for the measurement of bodily functions. There almost always seemed to be a better place for reliable and secure measurement of specific medical conditions or parameters. How should the results be interpreted even if the measurement worked well? STRC also doubted that sufficiently reliable and precise measurements could be achieved by Wristcare's prime sensors, or that the device could reliably cover all severe attacks of illness in different human physiologies, if it were to avoid excessive false alarms.[18] STRC suggested adding extra sensors distributed around the body, attached to for instance the belt-buckle, a chest-belt and a finger to secure individual measurements, all difficult options for Wristcare in terms of its wearability and feasibility.

In their evaluation, STRC (and in proceeding years, several other medical institutions) articulated the boundaries of acceptable medical technology by demonstrating what Goodwin (1994) calls 'professional vision' for examining Wristcare. In Goodwin's terms, the monitoring function of Wristcare was evaluated against the *coding schemes* of established medical measurements. Its deviance was then *highlighted* as sets of differences and shortcomings that were further *articulated* into evaluations and suggestions about compliant *material representations* – such as the extra measurement points.

PBI emphasizes how professional vision (or a TF) is not only a projection over a current domain of action, but also how it orients to shaping the future of such a professional domain.[19] In their evaluation of Wristcare, STRC seemed to disregard the practical value, commercial potential and other central concerns for safety phone design and technology management. This evaluation involved more than the selective perception of medical-technology professionals. The medical community had not shown any interest in passivity alarms in safety phones, but once the same function was attempted (perhaps even more reliably) for direct monitoring of the body, it was interpreted as being relevant to the medical profession. The norms, ways of working, standards and exemplary solutions central to a medical technology's PBI were instrumental in maintaining the plausibility and future prospects of medical monitoring devices. As the design of Wristcare potentially re-negotiated these criteria, STRC evaluation also became related to the continuity of an articulated and pervasive tradition – with its established institutions, education, thousands of practitioners and large companies – which in its entirety was vastly more important than a potentially valuable prototype. Part of this package was that representations of medically tested, reliable and medically appropriate uses were accentuated. I examine below how these criteria were also effectively enforced for Wristcare, even when the project sought to steer clear of being a medical technology.

Elderly Care

The final facet of PBIs around Wristcare is illustrated with designers' acquaintance with the practices and requirements of elderly care. This is a matter of *membership* and it illustrates the importance of *actual interactions in communities of joint action.*

Before the market launch of Wristcare, the designers were acquainted with elderly care through safety phone development, which provided them with various indirect contacts, such as reports, and contact with gerontologists and other people working with technologies for the elderly:

> Even during the [early 1980s] Nokia period, we didn't have any people with first-hand knowledge [about elderly care], and the knowledge came to us through intermediaries . . . [O]nly in Sostel [the late 1980s] did we have some contact with elderly care. So it is all learnt knowledge, learnt in the hard way, I would say, to grasp the processes and problems of that area.[20]

Designers were initially content that their product was appropriately suited for the requirements of elderly care. Survey results showed that elderly people preferred staying home as long as possible, and the concern for the cost of care was leading to a trend to substitute intra-mural care with cheaper extra-mural care, with the latter made still cheaper through technical appliances. Technology such as Wristcare could detect, prevent and mitigate the outcomes of accidents that would require immediate care in a more expensive setting (Vaarama, 1995; Mäkitalo, 2000).

These issues were mostly emphasized in what I call the managerial view of elder care, concerned with the cost of healthcare within acceptable moral standards (cf. Starr, 1982: 161, 229, 436). This view was strongly expressed in the newspapers, and in the reports and by the specialist people that Wristcare designers encountered. However, it was not uniformly shared by front-line care-givers, older people or their relatives. Care-givers' perspective or 'caring-rationality' (Östlund, 1994; Beck, 2002) emphasized that the recipient of care should not be allowed to sink into a vortex of worsening conditions before receiving care (Heikkinen et al., 1992). This view emphasized breaking the isolation and solitude and building new ways of re-organizing patients' lives as fundamental factors in enabling prolonged living at home (Beck, 2002). Cutting costs by offering technologically assisted security would need to be weighed against other solutions, such as enlisting volunteer groups or extra personnel who might assist elderly people to live more active lives, which would delay the point at which they required institutionalization (Östlund, 1994; Beck, 2002).

A caring rationality share the aspiration to reach out to elderly people as potential or actual patients in order to prevent their conditions from worsening. The pro-active warnings that Wristcare was designed to send about the worsening state of the end-user fit nicely with these images. However, they fit much more poorly with how elderly people often preferred to organize their lives, with their lack of exercise, smoking, gaining weight and so on.

The fact that Wristcare designers had only a peripheral membership in elderly care, and actual contacts mostly with people emphasizing a managerial view of it, effectively restricted their apprehension of the scope and variety of user-representations and requirements relevant for designing their product. This highlights the importance of not restricting the analysis solely to the frames of shared meaning, and of examining the actual communities in which design work is done. This is not meant to suggest that peripheral relationships are undesirable as such. Indeed, designers typically inhabit several communities of practice and almost by default remain peripheral to some of them. Moreover, as was the case with elderly care, many PBIs do not have one authoritative centre or are not uniformly held by different participants. Communities of joint action may be inter-animated by different sets of PBIs, and may have different degree of inclusion in those PBIs as well. While designers are accustomed to dealing with multiple constraints, it is often the work of making the underlying positioning behind the given constraints visible that is at the root of the problem and calls for its own sets of means (cf. Greenbaum & Kyng, 1991; Schuler & Namioka, 1993).

Practice-Bound Imaginaries as Sources for Representations and Inscriptions of Use

Being composed of integrated sets of visions, coding schemes, instrumentalities, compatibilities, norms, expectations, and so on, PBIs offer a powerful resource for perceiving, thinking and acting for people who enact them. This final section addresses the question of how PBIs influenced the way that the Wristcare project arrived at its key inscriptions of use. As a rule, most of these inscriptions were animated by several PBIs at once. The analysis moves from 'direct' representations towards more indirect ways that PBIs affected the project.[21]

As noted above, some user-representations were emphasized over others in the PBIs influencing the design of Wristcare. A first set of key representations of use were about *who the users will be*. For instance, the vision that the automatic monitoring should create a significant new market among still active '60+ year people under an increased risk of sudden fatal attacks of illness, such as strokes and heart attacks' was prominent in the imaginaries in safety phone development as well as the managerial view on elderly care.[22] But this vision was fairly vague, and did not include detailed considerations of how this new group of users would be related to the customer base for current safety phones, or how these users would be related to the work practices of the secondary users, such as home-care nurses, relatives and alarm centres.

These representations were intertwined with representations of *how the device will be used.* For instance, the managerial view of elderly care held that the major problems with the existing safety phones were the number (and price) of 'talk-calls' and other alarms set off without immediate danger. The appropriate uses were seen as setting off an alarm when in acute danger, and otherwise just wearing it. Some of the users might suffer from dementia and the ability of many other users to understand the new technology could be doubted.[23] While these assumptions could lead to various kinds of design approaches, the foolproofing suggested by technology management had desirable effects for cost and manufacturability. Foolproofing was further supported by the assumption that, to be really useful, the device must account for all the situations for which it could provide help, and thus should be worn 24 hours a day, which increased the range of situations the device had to withstand.[24] This assumption of the necessity of maximum utility becomes understandable when we remember that it is central in the imaginary of the safety phone development, backed up both by managerialist and preventive imaginaries in elderly care.[25]

These representations were further related to the representations of *what kind of functionality would be appreciated by the users and buyers.* The device was seen to 'surpass' 'the alarm on/off-logic' of safety phones and to provide accumulating data for care providers on the user's condition. If the user's condition began to grow worse, the device should first signal, for instance, 'increased passivity', then 'disruption in condition', and if the situation got out of hand, an 'acute disruption in condition' message. This way the care-providers could shift from reactive to proactive measures in ensuring the well-being of the end-user. This representation of use was inter-animated from multiple directions: safety phone development, biomedical monitoring and a managerial view to elderly care. In turn, these representations of the preferred functioning were accompanied by a set of representations of how the device was to be used: it should be worn on the weaker arm to keep the monitoring more reliable; the tightness of the connection to the wrist should be ensured; the device should be washed in the way instructed and at regular intervals; and test alarms should be performed regularly.[26]

The inexpensive price, relative to a safety phone was, an important characteristic. As noted, it lent support to one-for-all design that could then be mass-produced with a low unit cost.[27] The less the variation, the easier it is to automate and package. The remaining user actions could be seen as straightforward and simply definable, a question of training. These considerations further cross-fertilized the above-described proper use of the device, stemming from safety phone development, biomedical monitoring and managerial view to elderly care.

There were also more indirect ways that PBIs affected the inscriptions of use in Wristcare. The first of these was the way in which PBIs set out particular ways to define the nature of the tasks at hand, through, for instance, exemplary artefacts, key problems and problem-solving strategies pointed out by Bijker (1995). These definitions incorporate some representations of use, while others become non-compatible with 'the key features', and are gradually eroded or excluded. Again, the interplay of several practices is central in, for instance, how Wristcare was reduced to an engineering and monitoring problem. Safety phone development was clearly the dominant PBI in the actions of IST designers. It suggested a very technology-oriented way of conducting product design, and promoted the assumption that the new device would fit the existing infrastructure unproblematically. Second, nearly all the key PBIs affecting Wristcare-design suggested that Wristcare would meet genuine desires in an enormous market if it could be technically realized. Third, the dissonant voices did not reach the ears of the designers, as they did not have much actual contact with the practitioners of front-line elderly care, or the future end-users.

Another indirect way of influencing which representations of use prevail in design is that PBIs give direction to and guide actions in a local activity, setting preconditions for what kind of user-representations designers will encounter in the future. This includes seeking out and selecting collaboration partners, then preferring some ways of collaboration over others, and seeing some representations of use as more vital.

In the years following the initial 1992–94 phase of invention, IST not only worked internally with the technical development of Wristcare, but also launched some investigations with external consultants on the issues they found important for the device. I have already mentioned the collaborative investigations with STRC on physiological monitoring, prompted by the STRC's authoritative position in it. The business concerns led to two marketing studies in Europe (Strategy Analysis International, 1993; Leriche et al., 1995), later followed by more informal efforts to map out market dynamics in the targeted countries. The idea of establishing the 60+ market segment led to a year-long design study (Soosalu, 1996).

The investigations that ensued matched the imaginaries of medical monitoring (modelling physiology) and business management (marketing studies and the design wrapping of the device). These investigations had a steady following in similar investigations during the second round of development in 1999–2003, which further strengthened the viewpoints of these PBIs in designing Wristcare. It is also noteworthy that the way that collaborations were organized did not bind the designers to any findings or decisions. Pre-existing assumptions governed what was relevant knowledge in these investigations: while each of the studies identified some potentially critical representations of use, each one was, by and large, dismissed or not acted upon. A good example is that the results from the design study were used in 2000, for the second-generation Wristcare, only after they had proved impossible to dismiss by difficulties faced in actual use. Even then, only design details were adopted, even though the study also revealed much broader implications for re-design (Hyysalo, 2003).

PBIs are also involved in formation of criteria for acceptable solutions and ways of conduct. Attributions of quality and approval may influence ways of defining a technology, even when a project aims to participate only peripherally in a PBI, as Wristcare designers did in medical monitoring. Until 1999, IST systematically emphasized that Wristcare was a security device, which was not intended to perform any medical functions.[28] There was a tangible commercial reason for this choice:

> It is a strategic choice, because if you go to the medical side you have to tell them everything, you are bound to be thoroughly tested. And we have made a decision that no matter how promising a market, we will leave aside any country that requires complete clinical tests . . . until we are big enough [to protect ourselves against copy-cat products]. (Interview with the IST Export Manager 25 November 1999)

However, it soon became evident that, even in Finland, the healthcare officials and their technical advisors did not only have the regulative power in medical technologies. They also had considerable informal influence on opinions about any new technology used in care-giving. By introducing the physiological monitoring, IST had imposed on the medical officials' domain. In the clashes that followed, the company gradually realized that it had to generate biomedical evidence of the effectiveness of the device. As a result, the company had a constant preoccupation with how Wristcare really monitored human physiology. With regard to user-representations, this affected how the engineers inscribed normative user-scripts in the Wristcare system to ensure the adequacy and reliability of monitoring. Just as important, this preoccupation defined the most important aspects of the device's application:

> One of the best things in this [year 2000 redesign] process is that all the problems that have come up have been in one way or another connected to this non-simulated border with users, whatever then [had been the particular reason for problems]: habits of use, attitudes, problems in communication. (Interview with company founder, 9 May 2001)

The 'best' thing referred to here was that the initial design was 'correct': it measured the signals that physiological monitoring should monitor, according to the biomedical criteria. The not-so-harmful side effect was that the initial design did not fit very well into the life and work of the users. In this way, PBIs can establish themselves as passage points that enforce compliance with their norms and interpretive schemes and, as a side effect, define the subject matter in such a way that other practices are considered less significant.

Finally, PBIs are a source of legitimization for the representations of use. As noted, a central characteristic of PBI is that it includes projected future states and visions, which tend to make the assumptions and considerations appear as a necessary part of a likely development. An expert participant in a PBI easily regards him/herself as positioned to see 'the change' more clearly than others. In the case of Wristcare, there was a continuing emphasis that designers were 'ahead' of the 'development'. This was not restricted to the practices of elderly care (younger users, new ways to organize work). It also included physiological monitoring (bringing it to everyday life), the development of electrical appliances (into smart-home technology) and the performance of high-risk business moves. None of these projected states of affairs were only whimsical or hubristic expressions of a small start-up company, but well in line with the PBIs in which designers participated. The outcome of this legitimization was the emphasis on training and communication instead of redesign when faced with users' resistance:

> About the problems, the first is that they [care-givers] have not understood the device right, but have thought of it as if it were a traditional safety phone . . . so when they get an alarm, they respond to it as if it were acute and send in an ambulance. Our alarm might have been for instance caused by not taking medicine, and should be understood as an initiation of conversation. So, obviously, these people have not been trained or have been poorly trained. (IST Customer manager, 9 November 1999)

Conclusions

This paper has examined where the representations of use for the Wristcare-device came from and why they proved mistaken when the device was placed in the hands of users. The Wristcare invention was achieved from bringing together multiple practices, which provided the insights, knowledge, skill and tools for conceiving and furthering the technological concept. The designers' deepest professional experience was in safety phone development, but the limitations of this expertise were superseded by drawing solutions from other practices, including diagnostic practices of first-aid personnel, methods for monitoring physiological conditions, technology business and management practices, industrial automation, as well as elderly care. Instead of simply complementing one another, these PBIs were composed of different norms, tools, expectations, skills and knowledge-bases that needed to be aligned for a successful technology to emerge.

These PBIs complemented and cross-fertilized 'direct' representations of use, such as who the users would be (for instance, healthy persons between 60 and 70 years of age), how the device would be used (worn only to trigger acute alarms) and what kind of functionality would be preferred (the most extensive coverage of physical injuries possible). PBIs also emphasized other preoccupations. Some matters appeared urgent (maximal coverage of monitoring), and these held implications about use and users (for example, that users must be willing to wear the device firmly on their wrists 24 hours a day). These more indirect implications helped provide a basis for defining key problems and solutions (for instance, that the challenge with Wristcare was first and foremost a matter of technical problem-solving), and means to seek and assess future collaborations (the end-users did not meet the criteria for providers of relevant information). They also included attributions of quality and approval (medical practitioners could act as gatekeepers for distributing such devices, but elderly-care-workers could not), and provided a privileged and self-legitimizing perspective on the future development of the practices at stake (the developers saw themselves ahead at the cutting edge of developments in elderly care, home electronics and physiological monitoring). Such implicated representations of use remained difficult to challenge, as they were connected to other priorities in design, and entered into the design process in many different ways.

These results complement earlier findings on the importance of implicit representations of use (Akrich, 1992, 1995; Oudshoorn et al., 2004). In particular, the case suggests that PBIs offer user-representations that were implicit, in the sense that they did not result from an explicit investigation and their origins were not openly scrutinized. Nor were they always explicated as representations of use, but answered to other, seemingly more technical or economic, considerations, leaving designers unaware of the user-representations that they followed in their work. The design of Wristcare may not have been particularly 'richly informed of use' in a sense of being conscious of it (Stewart & Williams, 2005), but it took place in an environment that was rich with representations of use, even though many of these representations were primarily representations about something else and represented prospective use only secondarily. Studies of user-representation should thus recognize that use is not only planned, configured or implicitly assumed, but also gets inscribed by the models of conducting design, routinized procedures, and the messy interactions between people and materials (cf. Woolgar, 1991; Akrich, 1992, 1995). The case underscores the fact that the power of a design depends on difficult trade-offs between conflicting rationalities and the extent that these are designed into an artefact. Perhaps Wristcare was also a case when a design with implicit and under-specified representations of use ended up producing an artefact that had a relatively strong programme for action, which was, in turn, effectively reshaped by the resistance by the eventual users and refusers of the device (cf. Williams et al., 2000: 131–32).

The notion of PBI was pursued here to refine the analytical possibilities offered by the concept of TF. First, PBI oriented analysing the continuities and conceptions of change in practices. Second, it directed attention to the effects that multiple, sometimes peripheral, involvements in different practices had for the emerging artefact. Finally, it offered a way to conceptualize how PBIs are mediated through communities of joint action, in which social mediation and inter-animation of practices take place.

Overall, the analysis illustrated the empirical significance of (and difficulty designers face in dealing with) implicit representations of use. After the implementation, the final Wristcare concept had to be redesigned because of the demands and daily care needs of elderly users, as well as the requirements of biomedical monitoring. The practices that forced the developers to re-evaluate their original concepts were the ones with which they had the least direct contact to begin with. It could be argued that they did not recognize or were unable to assess the requirements set by these practices among all the other practice-bound projections, predictions and sanctions crucial for the success of the project.

Notes

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1. The conceptual development in PBI also draws significantly from literatures on imaginaries (Gregory, 2000; Verran, 2001), activity theory (for example, Engeström, 1987; Miettinen, 1998), expectations in technology production (for example, Law, 1988; Dierkes et al., 1996; von Lente & Rip, 1998) and cultural history (for example, Braudel, 1995). Particularly crucial has been Judith Gregory's work in bridging between the notion of imaginary used by Verran (1998, 2001) and notion of 'objectivity of the ideal' and object of activity used in activity theoretical studies (Ilyenkow, 1977; Leont'ev, 1978; Engeström, 2001). Also the structure of my analysis owes to her analysis of how culturally prevalent resources of imagination became embedded in a prototype of a large-scale electronic health record (Gregory, 2000).
2. Much of this discussion of the functions of collective expectations has been paralleled in the activity theoretical discussion about the functions of objects of activity (Leontjev, 1978; Engeström, 1987; Engeström & Escalante, 1996; Kaptelinin, 2005).
3. The SCOT framework was originally developed by Bijker and Trevor Pinch (Pinch & Bijker, 1984; Bijker et al., 1987). Since then, Bijker has taken the theory considerably further, and therefore I rely mainly on his book, *Of Bicycles, Bakelite and Bulbs* (1995), and some of his later papers.
4. It should be noted that the following criticism of SCOT and TF is appreciative of SCOT's program. The points of criticism raised here are intended as constructive in articulating and developing the approach further, and not as an external attack towards the framework (cf. Bijker & Pinch, 2002).
5. Going concerns – families, workplaces, organizations, institutions – are formations of joint action in which people do things in relation to one another, have situated social and material relations that persist at least long enough to be identifiable, and have primary commitments that keep them going (instead of potentially rather arbitrary relationship to a particular artefact) (Hughes, 1971: 54–55; Clarke, 1990: 18). An activity system is a historically formed unit of relatively durable collective conduct that is woven together out of a community of people, shared rules, division of labour, an array of artefacts and signs that mediate the actions of its participants, as well as a partially shared collective motive – a social sense for acting – which is instantiated in objects that people in that activity are engaged in transforming (Engeström, 1987, 78–80; 2000).
6. In fact, the characteristics of a particular artefact or a frame in regard to it may be superseded by more long-standing aspirations. Gregory has elaborated how technology production is animated by pervasive practical and intellectual projects, 'incomplete utopian projects', such as Taylorism in management and evidence-based medicine. The scope of such a project is utopian, and its completeness is:

    > not fully realizable as a practical achievement but whose partial realization – whether as instantiations of an idea or materialized as iteratively developed tools and forms of activity – engage actors in collaborative activities that produce and reproduce its instantiations over time . . . They outlive any particular attempt at realization, nor is any particular failure sufficient to spell the end of a Utopian quest. (Gregory, 2000: 176–77)

7. Wristcare Functional Description, 1993; interviews with the company founder, 15 October 1999, 22 October 1999.
8. Wristcare Functional Description, 1993; interviews with the company founder, 15 October 1999, 22 October 1999.
9. Interview with the company founder, 9 May 2001.
10. Interview with the company founder, 15 October; software designer, 25 January 2000.
11. IST Business Plan, 1995; electronics designer, 25 November 1999; founder, 9 May 2001.
12. Wristcare Functional Description, 1993; IST Business Plan, 1995.
13. Interview with a manager of safety phone service in the Finnish Red Cross, 11 June 2001.
14. Interview with IST R&D manager, 14 May 2001.
15. IST electronics designer, 25 November 1999.
16. Medical practices and biomedical research are not discussed at length here, because they are well recognized in the STS literature (see, for examples: Berg, 1997; Berg & Mol, 1998; Gregory, 2000: 233–57).
17. Interviews with the company founder, 15 October 1999 and 9 May 2001.
18. STRC Baseline Research Report, 1994.
19. The concept of professional vision allows us to examine in detail the unfolding of the ways in which events are scrutinized and shaped into phenomenal objects in a domain (Goodwin, 1994: especially 626). PBI seems quite compatible with this concept, as both draw from practice-based theories (such as activity theory and stress), that vision is specific to particular practices and domains of action (Goodwin, 1994: 606, 629).
20. Interview with the company founder, 9 May 2001.
21. Direct in a sense that they visibly implied certain aspects of use and users.
22. Functional Description, 1993; Business Plan, 1995.
23. Functional Description, 1993; Business Plan, 1995.
24. Functional Description, 1993.
25. This user-representation and of the corresponding design decisions were so durable that it was considered an inconceivable design option to drop the demanding 24-hour use from every user even in the design of second generation device. But that time there had been three years of evidence from actual use strongly suggesting this.
26. Wristcare Users' Manual, 1997.
27. Functional Description, 1993; Business Plan, 1995.
28. Company Business Plans, 1995, 1997, 1998.

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