Promises, Premises and Risks: Sharing Responsibilities, Working Up Trust and Sustaining Commitment in Participatory Design Projects

Monika Büscher, Dan Shapiro
Department of Sociology
University of Lancaster,
Lancaster LA1 4YL, UK
m.buscher|d.shapiro@lancs.ac.uk

Mark Hartswood, Rob Procter, Roger Slack, Alex Voß
Division of Informatics
University of Edinburgh
Edinburgh EH8 9LW, Scotland
mjh|rnp|rslack|av@cogsci.ed.ac.uk

Preben Mogensen
Computer Science Department
Aarhus University
DK-8000 Aarhus C, Denmark
preben@daimi.au.dk

ABSTRACT
While participatory design crosses the boundaries between technology production and use, it does not erase them. In accounts of participatory projects, the work of negotiating and changing these boundaries often recedes into the background, yet it is crucial in shaping the very nature and scope of what is achievable. In this paper, we report on our various experiences of 'boundary crossing' in four very different participatory design contexts. We argue that in each setting a key task consists of enlisting the effort, imagination, trust and commitment of users, and the sharing of risks and responsibilities. We compare and discuss the different strategies, methods we have devised to achieve this within the local politics of each setting.

Keywords: Participatory design, co-realisation, risk, trust, commitment, system biographies

INTRODUCTION
Participatory design (PD) is about drawing the real end users of IT systems into processes of design and development, and eliding the boundaries between production and use. To do this involves commitment and creativity from the different participants – in our cases, users, designers and work analysts – and a sharing of responsibility for the inevitable risks. It involves mutual respect, consideration and trust. This underlies what remains of PD as a political programme, in that in contrast to conventional design practice it may be claimed that the network of respect, consideration and trust connects different parties, and invokes different principles, with use-value predominating over exchange-value.

Participatory design invokes a harmonious relationship between the participants that is in part genuine – pursuing a PD agenda increases the pool of design ideas, reduces the risk of delivering unworkable systems and may resolve many issues in a mutually satisfactory way. But it is also in part ideological - while the PD process may ameliorate the differing interests of the parties, they do not disappear. Such differences include: PD projects, as much as other projects, may not be allowed to 'fail' because designers must report to funders and protect their reputation and access to future projects; users may wish the ends but may not wish the means in terms of time, resources and disruption; designers and users may have divergent and unstable agendas about what is interesting and useful; and not least, the parties may have market or quasi-market relations in which one's gain is the other's loss. Hence, there is in PD a *practical* politics relating to the sharing of responsibilities, the working up of trust and the sustaining of commitment, and these must be achieved in a situated manner within a constantly changing context.

A project team can only very patchily control the context within which it must operate. Technological innovations arise from, and are embedded in, a socio-technical 'system' of human practices, other technologies, and materials. The implementation of new technologies or, rather, the creation of stable and productive states within a socio-technical system that includes new technologies is fraught with struggle and uncertainties. Closely examined, it involves continuous bricolage: the often ad-hoc and creative combination of materials at hand for a particular purpose [1].

Recent years have seen the growth of closer and more intensive forms of collaboration between users and designers. For ourselves, ideas about designing 'technologies in use' [8,9,10,15], of using off-the-shelf components for quick results [10,14], of extrapolating from bricolage as a description of human-technology relations to bricolage as a design approach [6,12] have encouraged us to explicitly cross the boundaries between technology production and use, thereby bringing together system design, work analysis and user experience as three different fields of expertise. We see this as moving beyond PD as typically practised, to the 'co-realisation' of technologies [2,10]. For co-realisation, bricolage is both central and a challenge. It is a means of realising work affording ensembles of technologies, practices and procedures that

In *PDC 02 Proceedings of the Participatory Design Conference,* T.Binder, J.Gregory, I.Wagner (Eds.) Malmö, Sweden, 23-25 June 2002. CPSR, P.O. Box 717, Palo Alto, CA 94302 cpsr@cpsr.org
ISBN 0-9667818-2-1.

challenge. It is a means of realising work affording ensembles of technologies, practices and procedures that are neither solely the province of 'IT professionals', nor too chaotic to be stable. For co-realisation, the work of bricolage is democratising and instantiates the need for interventions at a number of levels, not simply on the technological: the selection of component technologies and design choices; the embedding of the new system within the workplace; and the activities of making it 'work-affording', i.e., usable and relevant over time.

Premised on situated, immersive and sustained notions of participation, we find that co-realisation helps to deliver the promises of work-affording technologies while offsetting the attendant risks for both users and designers [10]. Critical to co-realisation is what, following Garfinkel [7] we call 'membership', i.e., being 'vulgarly' competent in the work practices of the setting. Becoming a member is the only way that IT professionals will be able to acquire the competencies as well as the rights and responsibilities that enable them to work with fellow members in the work setting. Membership takes time; hence co-realisation advocates a longitudinal engagement within the workplace. In co-realisation, the role of IT professionals is to establish a set of competencies on which to build rights and responsibilities. Thus while IT professionals deploy their technical skills, they also have the responsibility to become a member in the setting and to *facilitate*[1] the work of co-realisation. In part, this is about breaking down boundaries between 'them' and 'us'; it is also about knowing where those boundaries are and how they impact on the work of co-realisation. In this way, co-realisation takes on the politics of and in design as a thoroughgoingly practical matter, with the aim not necessarily to emancipate but to afford work practice (although these aims might well be linked).

This does not mean that we regard co-realisation as a panacea for conflict: to be sure the projects below encountered some very real conflicts and part of the work must perforce be to engage with these conflicts over time and space. Yet, we find that the types of co-operation engendered in and through co-realisation offset some conflicts by meeting them head on as a part of work: conflict and its resolution are practical matters that must be addressed within the framework of the co-realisation, as a normal, natural part of work, not as something to be avoided (we might also say that conflict can be creative).

Against this background, in this paper we explore two main questions. First, how the located politics of commitment, creativity, effort, respect, consideration and trust is 'worked into' the bricolage of design and development that characterises co-realisation. Second, whether co-realisation can only really succeed in relatively small-scale and short-term projects, or whether it can also cope with long-term, highly innovative projects.

In the following sections, we briefly summarise the biographies of different project settings and the natural histories of participation within them. By using the term 'natural histories' we wish to highlight the complex, dynamic, yet locally logical unfolding of co-realisation in particular settings. Thus it makes sense to treat of co-realisation as a situated enterprise itself realised with regard to the extant local skills mix, timescales for change and the scale of the projects. The notion of natural history draws our attention to these. We delineate instances of negotiating boundaries in projects with distinct (though nested) horizons of change: the immediacy of co-realisation projects in a healthcare setting and a practice of landscape architects; a co-realisation project looking towards the intermediate future of a manufacturing unit; and a co-realisation for a future that is 5-10 years away. We argue that in each of these cases establishing mutual trust and sustaining commitment of all team members are core issues. We discuss how trust is practically worked up in the face of specific risks and gains that surround processes of co-realisation. Our experience shows that just how those involved in co-realisation are willing, able, and allowed to participate in creating future technologies and working cultures shapes the very nature and scope of what is achievable.

DESIGNING FOR THE 'HERE AND NOW'

As part of a three year project to explore co-realisation within a busy toxicology ward in a UK hospital, we explored the use of an off-the-shelf speech recognition system to assist members of the ward psychiatric assessment team produce discharge and transfer letters. The aim was to address bottlenecks in current procedures that rely on dictation and subsequent transcription by secretaries [9,10].

It is a commonplace that technology has pitfalls as well as potentialities and in our study we found that the 'opportunity cost' in terms of training time, operating time and other related issues were 'bracketed off' at the outset: *inter alia* the time and effort of learning to use it, the risks of upsetting established routines, and the risk of finding that the system might not work in this context. Use in practice did occasion risks for those who made use of it: e.g., time was lost when trying to produce a letter using speech recognition, work was lost if there are problems with the system itself and the delivery of patient letters was made error prone in specific sorts of ways. Thus members had to sit down and grapple with the system during what are often busy working days, to undergo the periods of training required to become familiar with the system and to enable the system to recognise their individual voices. These difficulties and commitments were set against the risk that the 'experiment' itself may come to nothing; using the system may in the end not turn out to be a viable means of producing letters in the hoped for fashion.

[1] Hence, we shall refer to these members as IT facilitators.

assisted in use and participated in the evaluation of the system in use. The facilitator's sustained, daily presence over the whole period of the project meant that whatever the problems encountered, the users would not have to cope with the system 'on their own' as a 'finished' entity. That the system was not subject to the 'closure' inherent in other design methods was important as it enabled users to identify problems and then to work around these in cooperation with the facilitator. The bricolage approach enables a modicum of reconfigurations of the technologies used – this prevents premature closure and its attendant lock in – and provokes imagination through a dynamic assemblage of possibilities instantiated in and through work-affording technologies.

There is a need to establish some framework of commitment at the outset in order to build the technology and the social relations that are central to the work of co-realisation. In this case this was predicated on an invitation from one of the assessment team members. Such relationships presume relations of reciprocity and partially constitute a space of willing engagement wherein co-realisation can take place. As noted above, this manifested as an initial willingness to focus on the potential of speech recognition as good reason for its adoption over and above the potential difficulties (which the facilitator took pains to draw to members' attention) as reason for not doing so. Of course, this is only an initial commitment and there is a need to move on to a firmer footing in order to sustain the work over time – this is in part why we stress the need to become a member wherein the facilitator acquires competencies and establishes themselves as a sustained presence in the setting.

What one might call the 'compulsions of proximity' are central to this process in that the facilitator is there when troubles arise and is accountable for these: offering advice, a temporal sense within the project and possible remedies in that time-span as well as being able to offer fixes and workarounds offsetting the risks of working with the technology. Such practical actions can be read as tokens of commitment and are central to the endeavour as well as to the reciprocity of co-realisation's work. Obversely, the facilitator's presence is a tacit reminder to the participants of their undertaking to take part in the work of co-realisation. Thus, not using the technology becomes an accountable matter – the obligation is to use the system or to explain why this cannot be done at present (e.g., "you can't do that, the facilitator is here")[2]. Yet obliging through presence alone is not a sufficient predicate for the work – members have to find the system work affording in and as a part of that use to continue using the system. Members also have to trust that the system is approaching work affording and that progress to this goal will take some time – in other words, time and commitment are required to make co-realisation work.

After roughly a year of use, it was jointly decided that speech recognition was not going to be a viable means of producing letters. This was done without rancour; there was neither feeling that time had been wasted nor that the attempt had not been worthwhile. Rather, it was decided to pursue the goals that speech recognition aimed for by different means – through the production of a discharge summary from an electronic medical record that had been under development as part of the same project.

The process of co-realisation enabled the putative users of technologies to become aware of the ways in which technologies could be configured and reconfigured to afford their work. The facilitator's role included the co-realisation of an evolving solution in and as a part of work-affording technology. A central tenet of this is that it is vital that users can say what it is they do not want as well as what they do. In co-realisation, users can experiment in a relatively risk free environment and explore the technologies without feeling that they are being 'sold' or 'manoeuvred' into a solution too early. Yet, to give new technologies a 'real chance', there has to be commitment and we would point to the role of co-realisation in actuating it: that is to say, users and 'facilitator' as a team become committed to an experimental process of change that allows new technologies to 'settle' into an evolving working culture.

Making the system available to the user involves the crossing of what have traditionally been conceptualised as boundaries between the technical and non-technical: it is our contention that this boundary is a problematic construction and that when we speak of co-realisation we have to treat these boundaries as being produced as a retrospective rationalisation. In practice, while boundaries between technology production and use are continuously crossed, users usually receive very little support for their bricolage work of making 'the system' work. In contrast, co-realisation foregrounds the work of bricolage and distributes the responsibilities more evenly. The system becomes everyone's concern, the point being to use it to afford work practice as opposed to demarcating were one stands in the organisation of technology production and use. New technologies are not 'slotted' into a dynamic and complex socio-technical system, but 'grafted' into its substrate, becoming a part of its dynamic – in positive, but also potentially negative ways. Co-realisation is a way of acknowledging the risks and costs of this process. The process of realisation is two-way: the facilitator is able to show how to use the system while the members, having this support, are able to envisage more fully ways to integrate it into their everyday work tasks.

The opportunity to play with technologies and to examine their potentialities is at the heart of co-realisation. Co-realisation invokes the imagination of all participants whilst

[2] While this was said humorously, its sense does play off the obligations engendered in co-realisation.

tying the technology to its workplace use. When one examines the ways that members engage with the technology, one finds that they look at it in terms of how it affords their work and how it might be used in the work setting in a contexted manner – such situated experiments are the result of co-realisation making a space for them and it is important that co-realisation is able to make such a space.

MAKING IT HAPPEN

The next example is drawn from a co-realisation project that involved a small research group (ethnographers and computer scientists) and a practice of landscape architects, one of eight branches in a larger company, based in the northwest of England. We will focus on the 'bare bones' of the natural history of participation here to illustrate further points within our argument. More detail can be found in [11].

When the project started in October 1995, almost all the production of 'output' – to clients but also to professional partners and contractors -- was paper based. Coloured maps, photomontages, sketches, master plans, and construction drawings were all drawn on paper and photocopied. Exceptions to this were text processing and intermediate steps in creating the drawings and maps: contour maps and wirelines were both created in AutoCAD and plotted on transparent sheets for use as layers in the construction of maps and drawings. This was our starting point for a collectively organised process of change.

Less than a year later, all workplaces were equipped with PCs that were networked internally and had access to the Internet through a gateway. A substantial part of graphical work (photomontages, drawings, master plans, etc.) was produced digitally (some of it using pressure sensitive tablets and pens), and communication internally as well as to external partners was increasingly facilitated through email and attached files. While this project also mainly used off-the-shelf components at relatively modest cost, the relatively small scale and bounded nature of the practice as an independent unit allowed us to carry through a significant transformation into an integrated system of technical support.

The way of working in the project was one that involved a meeting between different competencies: ethnography, technical computer science, PD and various competencies within landscape architecture. The mode of cooperation was therefore not so much concentrated around established PD techniques such as prototyping sessions, workshops, organisational games and the like. Rather, it was characterised by a continuing presence (on average, something like one day a week in the case of the IT facilitator, and more variable periods for the workplace analysts) in which the effort shifted fairly smoothly between implementing or adjusting previously decided possibilities, picking up on the host of small problems that arise during work, coping with the unanticipated consequences of previous actions, talking to individuals, and occasionally setting up larger meetings for important decisions.

As with the healthcare project, this project was an explicit attempt to engage in a process of co-realisation and judged on this basis it was successful. Even though the landscape architecture practice in question was facing major financial difficulties [12], due to a successful build up of trust and commitment, radical changes in the work practices were successfully accomplished.

There were several factors contributing to this. Probably the most important one was the readiness of all parties to take on (or to be urged into) various roles. So far, we have described the members of the co-realisation team as IT facilitators, practitioners, work analysts and ethnographers. However, on closer inspection, a more diverse set of roles emerges – for all members of the team. The development process can metaphorically be regarded as a journey, with the domain expert 'standing in front' proposing which way to go, the facilitator 'standing beside' assisting in the exploration of current conditions and possibilities; and others urging people onward. Within PD, the role of the facilitator is often considered to be the ideal one, among other reasons due to its (apparent) neutrality, and because the other roles introduce the risk of 'knowing better', 'taking sides', etc. However, it is very often the other two roles that facilitate trust and commitment (assuming the 'expert' turns out to be correct and the 'goad' is willing to facilitate). These are the moments where people 'stick their necks out', take on responsibility, and run some risks. In the landscape architecture project, all parties were willing to take on (or to be urged into) the various roles and to shift between them readily, thereby creating an environment in which everyone took on responsibilities and risks, and contributed to the overall project.

As with the healthcare project, a related factor was the willingness among the participants to cross boundaries between research and doing landscape architecture; between designing new solutions and understanding current practices; between technology as an object of study and technology used for a purpose; etc. For an outside observer, it would have been difficult, for example, to judge whether the researchers were participating in the analysis and re-design of work practices in the branch, or if it was the landscape architects participating in a research project. In effect, it meant that most participants, although to varying degrees, felt committed to all the various objectives and agendas within the project.

A third factor is the acceptance by the two main parties (researchers and landscape architects) that they had diverse objectives and agendas, and that those were, for the most part, explicitly formulated. As it turned out, this resulted in the requirement for almost all the activities that were taken on that they should fulfil both long-term objectives and short-term gains. It was, for example, not enough to buy a printer and produce drawings digitally. Because the long-

term research interest lay with the creation of a new working culture that integrated new technologies, electronic communication (email and internet) was also required, even though there was (in 1995) no immediate need for it from the landscape architects' point of view. Although, at the time, this was sometimes seen as a constraint, there is no doubt that it helped considerably in maintaining commitment among the participants.

In both the healthcare and landscape projects, the participants could be said to be accepting the compulsions of proximity. The aim of co-realising a work affording new state of the socio-technical system requires something close to genuine consensus from members of very different communities. Practitioners, work analysts, and IT facilitators come together and agree to engage with each other as equal partners with different areas of expertise that need to be woven together, not just 'patched'. This often brings intense, at times uncomfortable, proximity. Each member needs to commit to trying to explain their perspective, defend it when necessary (i.e., not be shy of conflict), and show a genuine willingness to engage with the problem from the others' perspectives even if there is disagreement. This makes collaboration very rewarding, but at times also very demanding and difficult. The continuing engagement can not simply dissolve differences of interest and perspective, but means that they must be faced and acknowledged, and that accommodations need to be negotiated – there is nowhere to hide.

PARTICIPATION AS A DAY-TO-DAY ACHIEVEMENT

The next example is from a project set in a manufacturing plant producing mass-customised diesel engines (EngineCo). The setting is interesting in that there are IT staff located at the site of use of the system they built and now maintain, the central assembly control host that controls the overall operation of the plant [1]. Ongoing development of products, the plant, related IT systems and working practices is very much part of the daily working life of various kinds of IT staff and production worker. While these practices are not explicitly informed by the PD tradition, users are still involved in systems development at a number of levels and the boundaries between design, development and use are, to a certain extent, permeable. This illustrates how doing participation is not simply to be treated as a bounded matter, but as a way of working that is predominantly a practical engagement with the workplace and its design issues. Co-realisation is, then, situated in and as part of ordinary, naturally occurring work: doing whatever the organisation is concerned with. There is no time out from co-realisation, and this study shows how 'naturally occurring' participation in such activities can occur even in the absence of an explicit participatory agenda. We show how risk, responsibility and trust cut across boundaries in the 'doing' of IT.

Material Flow and Its Troubles

Material is supplied to the plant by roll-on/roll-off trucks that deliver material directly to conveyor belts in the goods entrance part of the plant. Infrared-guided autonomous carriers transport boxes of material to their destinations. Most parts are delivered to shelves distributed throughout the plant but there is a certain class of parts (especially crankcases) which are delivered to a small number of material storage towers (MSTs) that have recently been installed as part of an ongoing effort to improve the material flow.

One of the MSTs is located close to the goods entrance, so all carriers have to pass through the area in front of it. The combined traffic of carriers supplying crankcases to the MST and of carriers moving to other locations makes the area a 'hot-spot' where problems quickly accumulate. There is an ongoing discussion of this problematic situation that is itself part of the larger discourse on the ongoing evolution of the plant that people engage in, in and as part of their everyday working practices.

In the past, conveyor belts in the goods entrance were emptied one by one so that if a truckload of crankcases were delivered, all subsequent transports would be between the goods entrance and the material storage tower in question. This would cause too much traffic in front of this MST with a significant number of carriers being idle waiting for other carriers to unload and get out of the way. This led to the idea to mix different kinds of parts that have different destinations so that only some part of the transports would go to the MST, relieving the 'traffic situation' in front of it. This would improve the utilisation of carriers since fewer carriers would sit idle awaiting access to the tower. A side effect, however, is that the average time before a conveyor belt is completely emptied (and thus made accessible again for further deliveries) is increased.

The basic idea of mixing material is a very simple one and it was implemented by on-site IT staff in a relatively straightforward way by modifying the programming of the computer controlling the goods entrance. However, this has a number of implications that are far-reaching and in order for it to be effective, a number of factors have to come together so that the desired effect is achieved in practice. This involves the work of a number of plant workers, not least those in the control room. So, quite naturally, they are involved in bringing about the desired effects, turning the idea, the candidate solution into a working solution in context. We find that they also participate in a number of ways in the discussion of this change and that their participation is taken for granted by some, anticipated, and even demanded by others. The question of participation in this context is not so much 'if', but 'how'.

It is important to note that a change is not seen as necessarily being final and finished, but rather as a trial. It is difficult in such complex contexts to establish *a-priori* what the effects will be and even after the change is implemented, judgments of effectiveness and efficiency are contested. Control room workers take part in the

discussions about changes in the plant, they are aware of the context in which these discussions take place and can refer to the history of previous interactions, to what we might call the *biography* of the plant. Participation is not unproblematic and is subject to many contingencies as illustrated below.

Demonstrating Competence

Control room workers regularly formulate alternative solutions and thus contribute directly to the shaping of their work context. In this example, workers suggested that the desired effect of relieving the traffic situation in the problem area could be achieved with means that were readily available and under control room workers' control, namely assigning different priorities. They intended to demonstrate the effectiveness of this alternative strategy but were unable to do so because that state of production in the plant didn't allow them to. Demonstrating that a candidate solution works in practice, of course, is the strongest argument in an engineering culture but the demonstration has to be made in terms of 'hard data', i.e., a change in performance has to be recorded in terms of some accepted measurement. This measurement then has to be defended against possible criticism. Clearly, a truck waiting outside the plant is more expensive than a couple of autonomous carriers waiting inside, but it has to be demonstrated that there was a need to order the delivery in the first place.

Participation is thus subject to challenges and one has to be seen as a member in order to be successful. Being a member is an achievement that is established through repeated interactions and also one which has to be actively defended. Control room workers have at their disposal various means that help them to maintain their position as knowledgeable members; they have the widest range of data available to support their arguments. On the other hand, they do not normally have the time to perform thorough investigations and to work up convincing presentations. It is sometimes quite easy for them to make their point in the control room where they have immediate access to the systems, while making the same point in meetings is much more difficult. Members improvise by, e.g., printing off screenshots of production control systems to strengthen their position in discussions taking place outside the control room. Repeated screenshots enable them to refer to a history of events in the plant. This history, of course, is only a partial representation of the events in the plant and other parties may challenge the conclusions drawn from this representation.

Since the effectiveness of a change like the mixing of material is contested and because there are bound to be situations when the measures are actually counter-productive, ways have to be established to influence the way the control system works. At present, the only way to do this is to change the control system program, which is both costly and risky to do. So control room workers are trying to influence the design of the next version to have a selection mechanism built into the system.

From the 'Meckerbuch'

Control room workers use a Word document to trace issues with the assembly control host system. This document is referred to as the 'Meckerbuch' (complaint book) as it records the issues that control room workers have raised in their interactions with IT staff. It is also a means for tracing these issues and to control the process of them being discussed and resolved in some way. We might say that it provides a natural history of the interactions that go on in and around the project and that its 'traces' are the history of co-realisation within the system.

1. Engines are "red" even when only loose material is missing.
2. Engines are downloaded "green" and then turn "red".
3. Engines do not turn "green" if there's first an FA-part [flowing assembly] and an LM [loose material] missing but later there's only the LM missing.

Mr Peters + KO # occurred again on 09.04.
Mr McLean # no explanation
27.07. can't be reconstructed

In this example, the problem statement leads to a sequence of efforts aimed at specifying and resolving the problem. There is no established way of doing this, so people have to live with its consequences. Since the nature of the underlying problem is not known, a number of actors engage in activities such as tracing and recording occurrences of the problem and referring to the system structure to unveil the causes of this problem. The problem is not resolved, however, but since occurrences are infrequent and consequences low, the case is nevertheless closed for the moment. It might, of course, be reopened, should the problem reoccur and be more severe or should new information become available. The entry serves as a record to refer back to the previous occurrences of the problem and to identify the workers who were involved in trying to resolve it.

Reason for blocking A-boxes is not accepted.
30.01 Mr Peters # today not IO # expected 27.02.
done 27.02.

The second example shows how the Meckerbuch is used as a means for tracing the work of IT staff. There are not normally formal meetings between IT staff and control room workers as the latter work on shifts and do not normally leave the control room for long periods of time. Instead, interactions take place as opportunities arise. Some IT staff regularly visit the control room and control room workers often ask IT staff to come around to look at or discuss problems. It is difficult to draw any clear distinction between what might be called 'design' or 'use'. As both IT staff and production workers grapple with a complex ensemble of technologies, co-realisation is achieved in, and as part of, their naturally occurring interactions.

Risks are perceived and commitments made in relation to what the organisation normally does. The risk of losing data, for example, is evaluated in terms of the risk of not being able to do one's job properly rather than in terms of some abstract principle of "keeping data safe". Recently, an

electronic shiftbook application was installed in the control room and workers initially agreed to cut-and-paste entries into a backup system while the stability of the new system was tested. They also printed off entries at the end of every shift. After two weeks of problem-free operation of the new system, however, they decided to no longer use the backup system. As one worker put it: "The worst that can happen is that we lose one shift worth of entries and that is easily re-established." Some weeks later one worker even suggested that there was no longer a need to routinely print the entries but the IT facilitator strongly objected, not trusting his system completely and unwilling to take the blame for potential future loss of data.

It is evident from this example that participation in the sense envisaged in classical PD is taking place in this setting, regardless that it is unlikely that many of the participants have ever heard the term. This is because there are no clear boundaries between design and use and the system is subject to near-continuous evolution. Users and IT facilitators participate as members and this membership is mutually acknowledged, but it has to be earned. It takes place sometimes through tensions, conflicts and contestations, not through avoiding them. We have shown some of the different, though not necessarily unequal, ways in which participants are resourced for these local 'struggles'. While it takes place in a commercial context, this is the internal market of the firm and so at some distance from the discipline of undiluted exchange-value.

What is more, it is far from clear that this is 'second best' to 'classical' PD. Specifically classic PD projects are obviously an exception to the standard routine of work, which generate their own excitements, energies and commitments, but which are likely to be demarcated in time, specialised in scope, and isolated from wider, everyday practice. In EngineCo, by contrast, the engagement is much more 'authentically' grounded and longitudinal. The tentacles of its co-realisation will penetrate far wider and deeper within the organisation and they will be sedimented in time. By comparison with the concentrated trust and commitment worked up in the context of a specialised project, it may be less intense and more exposed to the routine politics of the organisation, but it is 'steadier' and can also draw on the larger context of commitment to the larger undertaking of the organisation. It is, one might say, *participation in the wild.*

DESIGNS ON THE FUTURE

Our fourth example is a project that brings together IT facilitators, industrial designers, architects, landscape architects, and work analysts. As part of exploratory, long-term research, the team develops technologies aimed to become viable in 5-10 years. The work is grounded in ethnographic observations and collaboration with landscape architects, but is unusual in a PD context because its time horizon stretches out far into the future. The design approach has important continuities with the more immediate and hands-on landscape architecture bricolage project outlined above, and the co-realisation team seeks to remain true to those. However, given the 'futuristic' orientation in this project, how can one retain a bricolage element? We show below how, even in this context, carefully negotiated practical politics helps to find ways of 'grafting' new technologies into a future working culture, greatly improving the design and the 'fit' between them.

Designing Spaces

As part of the EU programme on the 'Disappearing Computer', the WorkSPACE project aims to design new kinds of (work)spaces by exploring and realising ways in which computation could be used differently. Spatial and embodied aspects of collaborative work inform a particularly important avenue of design. A collaborative virtual environment where configurations of electronic work materials can be created as part of ongoing work is a first step in this direction [5]. It is an important element of the overall design rationale but it can be greatly enhanced by creating a more ambitious hybrid mixed reality environment that exploits: advances in display technology – e.g., large screens, stereo projection, portable, and transparent displays; Indoor/outdoor sensing, tracking and tagging technologies; new forms of interaction – e.g., touch screens, pen or gesture based interaction, 3D sound and force feedback; enhanced inter-connectivity between devices; miniaturisation of devices, making them portable; and computationally augmented paper and materials increases in bandwidth and network infrastructures.

Through these technologies, mixed configurations of work materials and new ways of working with them become possible, such that computation becomes increasingly ready-to-hand and thus 'invisible' [3,4] within a hybrid digital-physical environment. These ideas have been worked up in the context of PD cooperation with different groups of landscape architects and are now being further refined and realised in a new round of continuous and close collaboration with these professionals.

Snapshots

At the start of the project, a group of landscape architects who had had no involvement in the initial formulation of the design rationale became part of the team. Their immediate and enthusiastic grasp of the ideas is evidence of the relevance and appropriateness of the project's aims and marks an important point within the 'natural history' of participation in a 'futuristic' PD project.

As the architects are being introduced to the Topos virtual workspace, they see how one might gauge information about activities in remote collaborators' workspaces. They like it:

> "... there's huge amounts of functional applications ... what's interesting is where using it [Topos] would take us in projects that we want to bid for ... in terms of the commerciality and competitiveness of what we do ..."

Two aspects of the landscape architects' motivations and

expectations are particularly striking here: (1) They expect to be able to use the software immediately in the context of real work. (2) They expect commercial and competitive advantages. The statement above refers to the possibility of mentioning Topos in bids for projects - a cutting edge technology that can double up as a signifier for competence in information management. Their enthusiasm is very welcome. It suggests that it might be possible to observe the emergence of a new working culture *in vivo*. Using a technology that is still under development and unlikely to become completely viable within the space of the project under real work conditions would be an invaluable design resource for the creation of a more ambitious hybrid mixed reality space. However, the realities of working life soon catch up with these hopes and put them on a more realistic footing. In the light of daily deadline pressures, the unfinished nature of 'futuristic' prototypes can be an obstacle that is hard to overcome, as the following observations from after a design workshop illustrate.

Mike (M), a visualisation specialist responsible for photomontages and GIS visualisations tries to use Topos to organise his work. He inserts an Adobe Illustrator version of a map created using a Geographical Information System (GIS) into a Topos workspace and some further files. The latter show as empty boxes and, on double-click, which usually opens the document, nothing happens. The IT facilitator (P) comments on the problem:

P: it's just an empty box.

M: it doesn't have the filename? It won't do anything with it at all?

P: no because what should we do? There's nothing to display - we can link to it but we can't do anything with it.

Mike is trying to organise source files that feed into GIS visualisations, but have no independent existence. Normally Topos displays work materials and - on request - displays them in their respective application. However, this does not make sense here, because the source files cannot be opened independently. Initially this experiment comes to be seen as indicating unsuitable design avenues. Mike suggests that "maybe it's not the point, maybe it's just not what Topos is about". But the work analyst and the facilitator persevere and try to determine in more detail how the work is done. It turns out that often several versions of a map have to be constructed, with different source files. This requires Mike to maintain an overview over which source files have been used when, in case he needs to go back to an earlier version of a map. If these relationships were intelligible from the organisation of files within Topos workspaces, it would help greatly. Eventually, the discussion sparks a design idea – to allow access from within Topos to the 'containing folder' within the Windows Explorer file manager. Mike decides to postpone his day-to-day use of Topos until this is implemented. However, it takes several weeks to do so and by the time the change is announced Mike's workload does not allow for a focused engagement with the prototype.

These two examples illustrate promises, premises, and risks inherent in new technologies, and show how they call for trust, commitment and creativity. We see both an enthusiastic endorsement of technological potential and the practical difficulties in bringing it about. Mike's engagement with the prototype generates important design insights. But it also makes its incompleteness visible. This is one amongst several factors that tighten the rope for the balancing act of PD in 'futuristic', exploratory design.

Against the odds

We have encountered many difficulties like these in maintaining trust, commitment and creative enthusiasm for the technologies and new ways of working we are designing, First, incompleteness does not only refer to individual prototypes. These are components within a hybrid mixed reality environment that will only reveal their full potential if considered/experienced in relation to a whole set of as yet 'missing links'. More intuitive ways of interacting with electronic work materials, for example, rely upon currently expensive and fragile technologies. This makes it difficult to approximate authentic use to provide indispensable inspiration and evaluation of design ideas. 'Futuristic' PD requires not just a willingness to invest time and money, a critical and creative eye, and a good level of tolerance and patience for sub-optimalities, but also imagination – an ability to fill in the blanks. Of course, all PD requires imagination, but in the context of far-future oriented design the opportunities to learn by doing through hands-on bricolage that usually provide a guiding line for the imagination, are severely limited. This inability to experiment realistically with new ways of working calls for quite radical imagination.

What it boils down to is that, unlike a bricolage approach based around the use of off-the-shelf technologies, bricolage as a design approach for exploratory research cannot rely upon the ability to fit new technologies into (changing) work practices easily. Imagination and a huge amount of work is required to even approximate suitable conditions. Who is to carry out this work? Whilst it is possible for IT facilitators to take on a large part of the work required to fit off-the-shelf technologies into work settings, the demands on IT facilitators in a more design-oriented context make this difficult. Still, to us a bricolage approach that aims to insert new technologies into work practice to explore and play with possibilities is desirable because it alone allows us to learn what we need to know about emerging new work practices to take the design further. So, how do we respond to these challenges? Some answers can be found in the composition of the team, others lie in the activities we undertake.

The co-realisation team builds upon the competencies within the user organisation more strongly than traditional PD. There are several people, including a landscape architect with IT management training and a computer scientist, who can act as technically-oriented bricoleurs. We consciously introduce a compulsion of proximity through regular online meetings that utilise some of the technologies

we have realised. In addition, we simulate a future new working culture in laboratory-based workshops. The lab provides a prototype hybrid mixed reality environment where our own prototypes mix with versions of 'missing links' that are too experimental and expensive to introduce into the landscape architects' studio. The workshops combine the functions of testing prototypes and scenarios, and of driving, maintaining and illustrating the larger vision and its enthusiasms. These activities foster membership that goes both ways – from IT design to work practice and from work practice to IT design. It helps greatly, too, that our collaborators are themselves designers who are used to the drawn out and hesitant ways in which aesthetic and practical visions are realised over time.

In this setting, a 'complete' bricolage of new prototypes and newly evolving work practices is unattainable. We are creating future forms of technology that will not become completely viable within the scope of the project. The gap between existing conditions and our vision can only be closed through imagination and improvisation. However, this introduces fertile friction rather than simply a hurdle that must be overcome. Imagination-led bricolage is not second best. The fact that it is not possible to create wholly authentic experience forces us, but also allows us, to transcend the present.

Despite these potential advantages, however, it remains the case that several of the success and sustainability factors identified in the earlier examples are absent here and, metaphorically, the 'values in the cells of the pay-off matrix' systematically favour the long-term perspective of the researcher rather than the shorter-term perspective of the practitioner. It is not at all that the architects are hostile to an ambitious experiment, quite the contrary: rather, that the dull compulsions of everyday work are corrosive for commitment. Inevitably, then, this imposes a greater strain on the local politics of commitment, trust and the sharing of risk. This produces a corresponding shift in the 'mechanisms' of trust, with less reliance on achieved and embedded work programmes, and more reliance on the users' willingness to become involved in co-realisation projects, mixed with tokens, enactments and signals of the IT facilitators' membership in work practice that have an element of 'staging'.

CONCLUSIONS

The promise of participatory design is the delivery of work-affording artifacts: we have shown some of its premises and some of the sites in which we have attempted to use co-realisation methods, as well as their attendant risks and the results. Our studies, each using its own situationally grounded version of co-realisation, have shown how risk, trust and commitment might be respectively offset, worked up and sustained. We have demonstrated how, despite these projects having different temporal horizons, all find distinctive solutions in co-realisation.

A number of common threads connect the projects we have discussed. The first of these is the concern with membership – in each of the projects, what it is to do design in that setting turns on the notion of membership and its accompanying competencies. By attending to membership, the project team is able to work across boundaries of production and use [13]. It does not see crossing boundaries as inevitably signalling problems, but as offering the opportunity to create work-affording artifacts. Membership involves a common set of concerns and competencies that can be embodied in the artefact, thereby securing at least a minimal commitment to make that artifact work. Membership allows one to make competent interventions in the natural history of an artifact; through mobilising what one knows and uses, it allows one to build systems that can support the work for which they have been designed. We would argue that only through membership could one appreciate what needs to be built and appreciate what is built. In other words, membership sensitises one to the workplace and the artifacts that are designed to be used in it. The participants become, to a limited but adequate extent, members of each other's communities of practice; and all become members of a 'third space', which is a conjoined community of practice of the design project itself.

Hence the second thread is that of making a space for co-realisation: the projects' timescales vary from the 'here and now' to the future, yet there is a common concern to make a space for imagining what candidate solutions to a problem or work setting might be or over how long they might be delivered. Such spaces for imagination are important because, while one might have a number of potentially contrary imaginations, the friction therein is productive and is, as we have demonstrated, generative of work-affording artifacts. While participants accept the compulsions of proximity of this space, they are confronted with each other's perspectives and pressed to negotiate an accommodation with them. This means being led not by some process-oriented or top down change agenda, but by the ways that those doing the work want to design that work and artifacts that afford it. In this sense there is a planful vagueness in the design situation – what comes out may not be what was envisaged; what will happen is that people will be given a site in which to imagine. The conceptual 'elbow room' of co-realisation affords reflection and reflection informs design. Co-realisation opens up this space. When we take on the work of co-realisation, we take on a commitment – especially in that we take on this commitment over time – and it is this that leads us to trust those involved, and to be trusted in turn. Of course it should be kept in mind that this project space is often fragile and subject to a universe of competing commitments both within and after the project itself. Part of the work of co-realisation is to keep this space open and to keep communication and commitment flowing therein.

A third thread, then, is the willingness to make the project work – this involves the 'bracketing off' of problems in the

purely technical sphere and the willingness to engage with the technology in context. All of the projects discussed above show how members are both able and willing to do this, thereby evincing a commitment to what an evolving technology might amount to, not just now – when it does not work – but later, as it becomes something that will afford work. This includes notions such as improvisation and, perhaps most important of all, patience. Finally, in all the above, there is an apparent willingness to share the risk of technical innovations and to engage with what is available, not as a provider of 'bells and whistles' but as something that will afford work, either now or in the future.

As well as these common threads, however, there are also divergences. PD can claim a head start over other methods in engendering commitment, creativity, effort, trust and the sharing of risks and responsibilities, but the settings in which it seeks to do so vary, and some are more propitious than others. For example, we saw that short timescale, off-the-shelf components, limited cost, and the presence of the facilitators made it *relatively* straightforward for the parties to exercise reciprocity in the work and to perform the various tokens, enactments and signals of respect and consideration needed to keep co-realisation moving along. This could be sustained both for a relatively isolated technology (healthcare) and for an integrated small-scale work environment (landscape architecture).

In the EngineCo example, however, we saw that these achievements can be realised very effectively in a setting which does not conceive of itself as a PD project (or, indeed, as any kind of project) at all. This was despite the high complexity of the work, technology, hardware and software setting. While it is surely helpful to set one's actions in a participatory frame, it is probably nothing like as helpful as this kind of 'natural' and sedimented evolution of commitment and creativity, and the naturally-occurring local politics of trust.

In the WorkSPACE example, we saw that the long term and experimental character of the developments creates opportunities and rewards but also hazards for a PD approach. An important characteristic here are the demands placed on the users to become members in a design team, to imagine a new working culture 'through' an incomplete ensemble of working prototypes, fragile and expensive new technologies, and still missing links. This produced a shift in the local politics of trust and commitment and in the mechanisms brought into play to cope with them towards laboratory based activities, imagination and somewhat formalised and periodical rather than continuous engagement of facilitator's in work programmes 'on the ground' at the workplace.

In the course of all the projects, the promises, premises and risks of designing new technologies became re-defined, as did the boundaries between technology production and use. All the examples presented in this paper provide insight into different ways of breaking down the boundaries that otherwise impact upon sharing responsibilities, working up trust and sustaining commitment.

ACKNOWLEDGEMENTS

We are very grateful for the contributions made by our practitioner partners in all the projects described here. We would also like to thank the UK EPSRC and ESRC, the Dependability Inter-disciplinary Research Collaboration, the European HCM Programme and the EU, Disappearing Computer Programme for funding the work.

REFERENCES

1. Blomberg, J., Suchman, L. and R. Trigg (1995). Back to work: Renewing old agendas for cooperative design. In *Proceedings of Computers in Context,* Aarhus, August, p. 1-9.
2. Büscher, M. and Mogensen, P. (1997). Mediating change: translation and mediation in the context of bricolage. In McMaster, et al. (eds). Facilitating Technology Transfer through Partnership: Learning from Practice and Research. IFIP TC8 WG8.6 International Working Conference on Diffusion, Adoption and Implementation of Information Technology. London: Chapman & Hall. p. 76-91.
3. Büscher, M., Krogh, P., Mogensen, P., Shapiro, D. (in preparation). Designing (work)spaces.
4. Büscher, M., Krogh, P., Mogensen, P. and D. Shapiro (2001). Vision on the move: Technologies for the footloose. *Appliance Design.* Issue 1, vol. 1.
5. Büscher, M., P. Mogensen and D. Shapiro (2001). Spaces of Practice. In *Proceedings of ECSCW'2001,* Bonn, September, Kluwer Academic Press, p. 139-158.
6. Ciborra, C. (1996). Improvisation and Information Technology in Organizations. In *Proceedings of. ICIS 96*, Cleveland, Ohio, USA.
7. Garfinkel, H. (1967). Studies in Ethnomethodology. Englewood Cliffs, New Jersey. Prentice Hall.
8. Grønbæk, K., Kyng, M., and P. Mogensen (1995). Cooperative experimental system development. In *Proceedings of Computers in Context,* Aarhus, August, p. 20-29.
9. Hartswood, M., Procter, R., Rouncefield, M. and Sharpe, M. (2000). Being There and Doing IT: A Case Study of a Co-Development Approach in Healthcare. In *Proceedings of PDC'2000*, New York, November, p. 96-105.
10. Hartswood, M., Procter, R., Rouchy, P., Rouncefield, M., Slack, R. and Voss, A. Working IT Out in Medical Practice: IT Systems Design and Development as Co-Realisation. To be published in *Methods of Information in Medicine*, 2002.
11. Mogensen, P. and Shapiro, D. (1998). When survival is an issue. In *Proceedings of PDC'98*, Seattle, November.
12. Shapiro, D., Mogensen, P. and M. Büscher. (1996). Bricolage as software culture and practice. In *Proceedings of the COSTA4 Workshop on Software Cultures*, December, Technical University of Vienna.
13. Suchman, L. (1994). Working relations of technology production and use. *Computer Supported Cooperative Work (CSCW)* Vol. 2, p. 21-39.
14. Sumner, T. and Stolze, M. (1995). Evolution Not Revolution: PD in the Toolbelt Era. In *Proceedings of Computers in Context*, Aarhus, August, p. 30-39.

Voss, A. Procter, R. and Williams, R. (2000). Innovation in Use: Interleaving day-to-day operation and systems development. In *Proceedings of PDC'2000*, New York, November, p. 192-201