5. Virtually Connected, Practically Mobile: Mobile Technology and Mobile Work

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5.1 Chapter outline

This chapter addresses a central issue in studies of mobile work and mobile technology – what is the work of mobile workers, and how do they use the resources that they have to undertake this work (i.e. the work they have to do in order to do their work)? In contrast to many of the other papers in this collection, the objective of this chapter is to examine individual mobile work, and not teamwork and co-operation other than where it impacts on the work of individuals. We present data from a study of mobile workers, examining a range of mobile workers to produce a rich picture of their work. Our analysis reveals insights into how mobile workers mix their mobility with their work, home and social lives, their use of mobile technology, the problems – technological and otherwise – inherent in being mobile, and the strategies that they use to manage their work, time, other resources and availability. Our findings demonstrate important issues in understanding mobile work, including the maintenance of communities of practice, the role and management of interpersonal awareness and co-ordination, how environmental resources affect activity, the impact of mobility on family/social relationships and the crossover between the mobile workers' private and working lives, how preplanning is employed prior to travel, and how mobile workers perform activity multitasking, for example through making use of 'dead time'. Finally, we turn to the implications of this data for the design and deployment of mobile virtual work (MVW) technologies for individuals and a broader organisational context.

5.2 Designing mobile technology to 'fit' the work

One of the most important things that we can say about mobile technology is that it has the potential to support and even change the way we work – the very topic of this collection of papers on mobile virtual work being based on this notion. However, whilst it is a commonplace observation to say that mobile technology can improve and transform work, there is very little evidence to support how this might happen, or the real benefits that mobile technology will bring to its users. Moreover, we know very little about the way that mobility itself is used to support the performance of work. There is an interesting parallel to be made here with studies of collaborative work arrangements – academic theorists often talk about the work needed to make collaboration happen: the additional work on top of the task needed to manage collaboration, known as 'articulation work'. As yet there is no parallel term in the area of mobility, but clearly, when people are mobile, they need to do additional 'mobile' work to be able to accomplish their work when they are mobile. Perhaps there is no simple differentiation between the two forms of work, as people are often mobile because the work itself requires this, but there are clearly areas where some form of alignment is required to marshal and co-ordinate the resources and work around the constraints posed by the mobile settings with the mobile individual's ongoing work activities.

This then, is the area that we have chosen to explore in this chapter – making the point that whilst users of the so-called 'Martini' solution technologies (enabling "anytime anywhere" connectivity) may be connected to a communications network, they have very practical constraints that arise from the nature of the technology, the sorts of work that they are doing, the environment that they are working in, and the broader context of the work (including temporal, social and political contexts). This then, is the 'practical' aspect of mobility, and as such may greatly affect the 'virtual' world of work that is promised by the marketing rhetoric of mobile solution providers. This practical set of considerations is crucially important in improving existing technology and in motivating new mobile technology designs – only by understanding users' needs and wants, and the problems and importance of mobility to users, can we set about doing this in a principled way. There are really only two ways to examine the role and potential value that mobile technology could play in supporting its users, and these are i) to examine user activities (part of which may involve mobile activity or may be constrained by users *not* being able to be mobile) and ii) to give users technology with new capabilities that allows them to explore

new ways of going about their activities. We address both in the chapter, reporting and reflecting on our own research.

Certainly, it would be hard to imagine a world without the mobile telephone, and increasingly, laptops and handheld computing applications, and a multitude of hybrid information technology and communications devices are visibly proliferating within certain market segments. Go to any international airport and see a hinterworld of hunted and exhausted executives tapping into their mobile devices, trying to maintain a connection with their offices in the outside world and keeping up with their ever-increasing workload. Yet we must ask ourselves how much of this activity is bound into mobility and where the mobile devices fit into this work – and whether they actually support it (and if so, how?).

The goal, therefore, of this chapter is to work through the conceptions of mobile virtual work, and then to present a 'vision of the future', developing this to generate design guidelines for effective and sustainable MVW systems (which we see as synonymous with mobile information and communications technology and mobile information systems). The next section examines the nature of mobility and the various literatures contributing to our understanding of mobile virtual work.

5.3 On Being Mobile

5.3.1 Addressing Mobile Virtual Work

The title of this paper "Virtually connected, practically mobile" comes from the central problem of the mobile worker, that is, whilst technology now gives them the potential to make some kind of a connection, this opportunity is constrained by the very practical concerns and constraints that they face when they are being mobile. There is a play on the term 'virtually' here, in its double meanings of supporting a remote presence, but also meaning 'almost succeeding, but not quite'. Its dual connotation is that whilst allowing a remote and connected presence, that this presence may be inadequate or failing in some way. This is very much the reported evidence from the mobile workers that we have studied and in the academic literature.

There is currently no truly effective 'anytime, anywhere' solution that allows its users to work as effectively as they could when they were not mobile. There is, of course, a corollary here, in that workers obviously find a value in mobile work and could not work as effectively when they are

static[1]. This is an important point to make – we should not think of mobile work as a constrained form of static work, but as a type of work that has different values for people, opportunities for action, and methods of performing that work. This clearly has implications for technology design, although what these implications actually are is not so obvious – all that we are immediately able to say is that designers should *not* attempt to simply reproduce the work resources from an office into mobile technology, as the practical and occasioned requirements of the mobile workers are likely to be different to those of office-based workers. The much-lauded 'mobile office' should not just duplicate the desktop office (see also Laurier 2000). However, a cursory examination of many current, commercially available mobile technologies does not appear to demonstrate that this has been fully taken on board, so, for example, we have mobile devices that duplicate many of the functionalities of the desktop computer (e.g. running Microsoft Office's Word and Excel) that are simple ports (admittedly with some concessions to the device's form factor) of their desktop counterparts. Perhaps the mobile office is an inappropriate metaphor.

Of course, users may be demanding this advanced functionality from their mobile devices (known as 'creeping featuritis' in the trade), but this point only serves to illustrate that the conceptual models of the mobile technology that many designers are presenting users with are themselves inadequate – is it a computer? a personal assistant? a telephone book? or even a camera/address book/telephone/mini-computer/videoconferencing suite/media station? Fieldwork has shown that users generally have suites of technology that they select from to take with them which is dependant on their plans and expectations of the demands that they will have made on them. Each of these technologies has particular strengths for particular activities, and compression of the whole set of office resources (some of which may not be even currently computer-based) into a miniaturised computer workstation is to misunderstand and misrepresent their users' needs and capabilities.[2]

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[1] The term 'static' may not be ideal, but we are using it as the antithesis of 'mobile'. In reality, both terms are descriptively limited, in that they do not allow us to convey the full richness of the work and the inherent crossovers between them. However, for pragmatic reasons, whilst recognising this limitation, the two terms suit the purposes of this discussion.

[2] A growing literature in *appliance design* (Norman 1998; Sharpe and Stenton 2002; Bergman 2000) examines this, offering solutions to the problems of usability posed by the general-purpose PC. However, this is not solely concerned with the nature and problems of mobility.

5.3.2 'Mobility' in the research literature

Whilst it is a frequently used term in the research literature, the term 'mobility' has been used in a number of different and occasionally conflicting ways. Typically, mobility denotes some form of movement in space and time. However, within the corpus of research material addressing mobility in work, this description has ranged from Luff and Health's (1998) discussion of 'micro-mobility' (shifting the orientation of resources, such as paper, between people) to notions of mobility that embrace spatial, social, temporal and contextual elements (Kakihara and Sorensen 2002). More typically, the focus of research into mobility is centred on the notion of travelling (local or remote), and can involve working *'at multiple (but stationary) locations, walking around a central location, travelling between locations, working in hotel rooms, on moving vehicles and in remote meeting rooms'* (Perry et al 2001). However, each of these environments have their own challenges in terms of resources for/and constraints on communication unique to their own circumstances. Within this chapter, we again take this broad view of mobility.

Generally, mobile technology and research into mobile technology has developed at an increasing pace as mobile technology components have improved, getting smaller, faster, more energy efficient, networked and making effective use of protocols for technology 'convergence'. Yet hindering the design and take-up of these technologies has been a largely insufficient understanding of the social and or organisational backdrop against which these technologies are deployed, and how it has the potential to change them. Much of the recent research that has attempted to address this has largely arisen from the fields of CSCW (computer supported cooperative work) and information systems. This research has, unsurprisingly, tended to focus on that most pervasive and visible mobile technology, the mobile telephone. Social interaction around the telephone, using voice and text (SMS) messaging has formed a body of evidence demonstrating the role that mobile technology has taken on in the lives of a variety of user groups and in a range of settings: novices users (Palen et al. 2000), teenagers (Grinter and Eldridge 2001), mobile knowledge workers (Perry et al. 2001), and in restaurants (Ling 1999), waiting at bus stops (Tamminen et al 2004), on public transport (Weilenmann and Larsson 2002) and in cars (Laurier 2000), amongst others.

This research focus on the particularities of specific user groups and settings, whilst important in understating mobility and mobile technology, has often resulted in the design of prototype mobile technologies that support particular workers, work types or settings, for example, supporting the efficient handling of electronic documents in large-scale mobile knowledge

work (Flynn et al. 2000), or the work of mobile service engineers (Kristof-fersen and Ljungberg 1999). Moreover, the commercial focus on what is seen as the 'early adopters' and high value customer segments have also skewed the development of technology towards white-collar knowledge workers in favour of what we have called a document-centric perspective (O'Hara et al. 2001). Unfortunately, these digital tools can be ineffective or inappropriate for other types of mobile work. What we require for the design of more generic mobile technologies is to understand the impact of these technologies on a broader section of society in a more widely scoped study of users, with more abstract generalisations on use practices and user needs that can be applied back into the design process.

Of the more generalised findings that have come out of the literature, the core issues on mobility that face users and which form the backdrop of why they employ mobile technologies include awareness (e.g. Laurier 2000), general work maintenance when mobile (e.g. Perry et al. 2001), and a need to make use of lightweight (e.g. Churchill and Bly 1999) and inter-actionally appropriate technologies (e.g. Luff and Heath 1998). We revisit these issues and examine other issues arising from the incorporation of technology in the performance of mobile work.

5.3.3 Articulating mobile work: 'mobilisation work'

Mobile work, as with other forms of work, requires resources (most visi-bly, information, technologies and social networks) to be brought to bear on the tasks being undertaken. Work that involves the co-ordination and meshing of task activities (above and beyond the core work itself) is known as 'articulation work' (Strauss 1995). Articulation work allows people to manage contingencies that arise out of the performance of work, and is contrasted against predefined work processes. Articulation work goes beyond the everyday conception of what one of our reviewers has called 'co-ordination work' by explicitly delimiting the boundaries of co-ordination activity, as well as placing it within a theoretical and analytic context. As an analytic tool, articulation work is commonly used in the analysis of the divisions of labour in work that involves multiple individu-als. Schmidt and Bannon describe that when workers are *interdependent* on one another in their collective work, this cooperation:

> …involves a number of secondary activities of mediating and con-trolling these cooperative relationships. Tasks have to be allocated to different members of the cooperative work arrangement: which worker is to do what, where, when? […] Furthermore, the cooperat-

ing workers have to articulate (divide, allocate, coordinate, schedule, mesh, interrelate, etc.) their distributed individual activities [….] Thus, by entering into cooperative work relations, the participants must engage in activities that are, in a sense, extraneous to the activities that contribute directly to fashioning the product or service and meeting requirements. That is, compared with individual work, cooperative work implies an overhead cost in terms of labour, resources, time, etc. (1992:14)

As noted above, the majority of the research on articulation work within the area of computing has been in the analysis of multi-person activity, and not so much in the arrangement of individual tasks. Yet, the nature of articulation work is not limited to collective activity performed by ensembles of people. Strauss is clear about this: the division of labour (which involves articulation work) may be carried out over a unit of any size.

How can this research on articulation work be of relevance to mobile work? Well, there is a considerable co-ordination overhead to being mobile: mobile workers are often impoverished in terms of their social, informational and technological resources. They need to perform additional work be able to achieve their goals when they are mobile. This is a form of articulation work, but is sufficiently unique to warrant a unique term for itself, one that we will call 'mobilisation work', from the work required to mobilise resources that are not in themselves necessarily suitable for use outside of a resource-rich, static and unique work location.[3] Mobilisation work underlies many of the challenges and opportunities for mobile technology design, in supporting the secondary co-ordination efforts that users have to perform in order to complete their primary work objectives and goals. This focus on mobilising work cannot be the only factor in the design and choice of mobile technologies (for example, aesthetics and entertainment value may figure as important issues), but it is a crucially important one that will help determine the work-related utility of the mobile technology for users.

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[3] Mobilisation work has a counterpart in the work that is being mobilised. In articulation work, this counterpart has been called 'co-ordinated work' (see for example Simone et al. 1999). Rather than calling our parallel term 'co-ordinated mobile work', we have opted to differentiate it simply as the primary mobile work objective/s. This lack of formal nomenclature is mainly for reasons of confusion, 'mobile work' being the term used in common parlance for the totality of all mobile activities, but also as the mobilisation work can itself shift levels to become a primary objective, and may itself require further mobilisation work to resolve contingencies arising from local circumstances (c.f. Gerson and Star 1986).

There is an interesting point to note here in the choices that people make about going mobile: being mobile may be a less efficient way of fulfilling the work tasks than working at a fixed workplace. The required degree of mobilisation work may make their work so inefficient that the costs of being mobile exceed its benefits. This is not a choice that some of mobile workers are able to make (due to the nature of their jobs), but it explains why many workers have a work*place*. Rather than thinking of the static workplace as the norm for a working environment, perhaps we need to think about it as being a necessary workaround for the failures of the mobile work environment.

In this chapter, we do not simply attempt to understand mobility for some abstract reason; we examine mobility – specifically mobilisation work – to better support it through the design of appropriate technologies. The bulk of the rest of this chapter therefore undertakes to examine the mechanisms of interaction that are used by mobile workers in order to perform this mobilisation work, concentrating on the practices and strategies used by mobile workers. However, first, we document the methods used in collecting data for the study.

5.4.4 Examining mobility

5.4.1 Data collection methods

We employed two main techniques to collect data on mobility, supported by additional research methods allowing us to triangulate our analysis. These methods were entirely qualitative, as we were interested in the rich picture, or the 'thick' descriptions of our informants' mobile activities to look at the detail and lived experiences of those people. The first of these methods was based on an interview-based examination of the day-to-day activities of mobile workers. The second used a 'technology probe' approach. Hutchinson et al. (2003) describe technology probes as simple and adaptable technologies that are assessed by users with three primary goals:

> 'the social science goal of understanding the needs and desires of users in a real world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and researchers to think about new technologies.' [p.18]

A technological probe is assumed to influence the behaviour of the user and allow designers to gather use-data related to this. A probe is not a prototype in the traditional sense: its purpose goes beyond design and allows

further data to be gathered about users, their needs, social contexts, and the 'fit' of the technology (and its transformative qualities) with their work practices. In support of these two techniques, a range of other methods was also used, including observational fieldwork, scenario-based design, paper prototyping, and breakdown analysis. However, for the purposes of this chapter, we concentrate on the interview and probe data, as these lie at the core of the arguments that we make.

5.4.2 Primary data collection

Our initial research focused on the underlying patterns of mobile communication activities. Fifteen users of digital mobile technology were interviewed for between 1 to 2 hours, where possible, in their usual working environments, surrounded by their everyday work tools. We sought to get a broad mix of participants: all came from different organisations, with different jobs; there were 11 men and 4 women; they varied by employment type, both employed and self employed; by the distance travelled, international, national, regional and local; by mode of transport (various); frequency of travel; destination (same, different); and the extent of collaboration in their work. These individuals fall across the categories noted in this volume (on-site movers, yo-yos, pendulums, nomads and carriers), although many of them could be described as working across more than one of these categorisations, simultaneously, or changing over time. We recognise that there are different types of mobile worker by sector, work type, position in the value chain, communication style, etc., and that mobile workers themselves may (or may not) be 'structurally' different to non-mobile workers. However, the set of participants used in this study was intended to reflect a broad range of mobile work types and to examine work practices in detail, not as a large set for statistical sampling.

We focused the interviews on the communicative activities of mobile workers when they were mobile (including both local, distributed and global mobility). We also examined the way workers used space and supporting artefacts when they were mobile, and any collaboration in their work. Beyond the mobile event itself, we examined the activities undertaken before and after travel. In order to encourage users to present us with real, and not idealised accounts of their activities, we used a diary technique in which participants recorded a typical working day in detail, including the resources used and information collected over their whole day, and not just the work they did, thus emphasising sequential activities and interrelated activities.

In addition to examining the communicative requirements that users have and the contexts that they work in, we also wanted to see how users make use of the communicative tools that they currently use to see how any new device would fit within an existing web of technology. As might be expected, most of the workers studied only had access to mobile phones and not other mobile technologies (e.g. laptop computers and PDAs), and consequently the findings reflect this. This is not to say that the only mobile technology that we were interested in is the mobile telephone, and we have tried to emphasise the nature of the need for mobile information and communication by those interviewed rather than simply focusing on their use and application of the mobile telephone in their work.

5.4.3. Technology probes and user evaluation

The probes were trialled with six users in the autumn of 2003. Two of the participants had been interviewed in the original study and had offered some interesting insights into mobile work in their particular professions so it was felt useful to return to them to gauge their opinion on the effectiveness or otherwise of the probe technologies (the hairdresser and electric meter installer). The others included a telecommunications engineer, an electrician, a plastic sales specialist and a chiropodist. All were highly mobile (in a variety of different ways), and their work covered a range of different forms of activities.

Each of the interviews lasted between one and a half to two hours. Each of the participants was interviewed, wherever possible, in their typical working surroundings, and the interviews were taped and later transcribed. Following initial background information being collected on the users, the probes were shown to users. Taking each probe in turn, the participants were presented with three 'future use' scenarios. Following on from each scenario, they were shown the technology probes running on a mobile device. For the purposes of collecting data, the probes were 'chauffeur' driven by the second author during this initial interview stage. After a detailed run-through of each of the probes, questions were asked regarding the probe and its potential role in the participants' working lives.

5.5 Analysis

The analysis of our initial interview study is loosely grouped into two main categories, although, as keen readers will note, many of these issues are interdependent. Moreover, we recognise that the boundaries between cogni-

tive and social behaviour are not absolute, and different schools of philosophical thought have differing views on this. However, these analytic segmentations of the data serve to detail something simpler than a fundamental point about human thought; they separate the solutions that individuals have created to manage their own work (cognitive activity and planning behaviour) from the methods that the participants used to manage and co-ordinate their social interactions (social interaction and home/work relationships). In using the term 'social' here, we are using it in the broad sense of living within a community of some form, and not as a synonym for leisure. Within these two categories, we have broken down some of the behaviours that constitute them, and examine the mechanisms of interaction used in resolving problems arising from mobility and the social practices that enable mobile work to be conducted.

5.5.1 Cognitive activity and planning behaviour

5.5.1.1 Environmental resources and mobile activity

This issue covers the interplay between the primary work objectives, the resources (or lack of them) in the mobile work environment, and the mobilising work required to repair this. With respect to mobile technology use and design, it demonstrates the changes that may result in the nature of mobile work as users employ more, or different, mobile communication technologies.

Communications technology often necessitated environmental rearrangements. Individuals working on the move needed to take account of the resource deprivation they experienced because the majority of the informational resources available in static environments are missing. Mobile workers frequently sought out flat surfaces to work on in the venues observed, e.g. tables in restaurants and bars in airports. The requirement for a flat surface to colonise with their array of tools (including notepads, notebooks, laptops, PDAs or mobile phones) stemmed from the problem that mobile work often requires users to employ several different information artefacts simultaneously, and they need therefore need these immediately available at hand. Ironically, the configuration of this communication space actually hindered movement through physical space, tying mobile users to the table-top.

An inappropriate 'form factor' for existing mobile technologies often led to 'breakdowns', with users unable to work effectively just anywhere. Fellow passengers were observed on trains having to balance their paper work on their knees to accommodate the considerable table space demanded by the simultaneous use of several mobile communication devices (e.g.

PDAs and laptops by themselves and others). Another reason that a flat surface was sought out was the form factor of some mobile communications artefacts. These mobile devices often tried to replicate the PC by having, for example, keyboard input, which meant that to use them effectively, during the inputting of data, two-handed input was needed, which required the device to be placed on a flat surface during these interactions.

Beyond the devices themselves, companies often did not take into consideration that their employees may need to be mobile in different locations. For the communications manager, this meant that when he spent a few days a week in Bristol he was unable to access the network in that location because the firewall prevented him from logging on from more than one location (in his case London), but this meant problems printing in Bristol, which he had devised a workaround for:

> *"Because it is a network printer and because I am not on that server I can't connect and I am only on a phone line. So I plug-in and what I do is I end up emailing people in the same room as me with a document which they then open and print. And that has been going on for a year because there isn't a technical way around it; as our infrastructure has not caught up with the fact that loads and loads of people work semi-location independent."*

In another example, the plumber had tried to take his phone into some extreme conditions, and he had lost his mobile several times in attics and lofts. He now preferred just to leave it in a 'safe place' rather than carry it about in extreme conditions. He also opted to switch it off when working on a roof or somewhere else where answering it may be dangerous. For the traditional knowledge workers interviewed, their locations also sometimes limited their communication choices, such as when they were driving. Socialisation effects also played a part in this: the communications manager noted that he did not like to make work-related phone calls in public places, such as on trains, because he felt it was disruptive to others around him.

What we see here are the frequent effects of environmental constraints and resources impinging on mobile work and their activities having to be developed to accommodate to these conditions in either temporary workarounds or in reorganising their practices so that these problematic conditions did not occur. Environmental conditions have a strong impact on the potential use of MVW technologies, so that whilst there is a theoretical possibility of always on connectivity, this is highly limited in practice.

5.5.1.2 Preplanning for mobility

Although in situ flexibility is important for mobile workers, planning prior to travel was also an important work strategy (c.f. Perry et al. 2001). Part of the planning those mobile workers engaged in involved determining which artefacts and information they *might* need. For example, when going from London to Bristol for a few days, the communications manager would take his car to accommodate all his work artefacts. However, if he were only staying overnight, he would travel by train and just take his laptop and briefcase. For the blue-collar workers interviewed, daily planning was crucial. Often work would be issued by control rooms in the order that the jobs were requested by customers. This meant, for example, the telecommunications engineer and the electric meter installer having to sit down and re-organise the order of their jobs around their location (ensuring that jobs near each other were dealt with after each other), the job difficulty, and whether other people would be involved. Both thus needed an A to Z map to hand and notebooks to write their new working day structure in.

A very important issue emerged in our observations, that whilst mobile workers are mobile, and particularly when they are travelling, they are not easily able to carry on with their day-to-day work, keeping their 'heads above water', and there was a constant danger of their being swamped with work on their return to their offices or when reporting to a client or supervisor. Many of them tried to make best use of 'dead' time (Perry et al. 2001) or 'wasted' time when on trains and planes to keep up with their workloads (e.g. carrying on with email communications on laptops and PDAs), and even planned for this ahead of time. Unfortunately, given the poor access to resources that they had when mobile, and the unpredictability of their circumstances, this was not always possible to do as effectively as when at their static workplace. Clearly the mobile telephone was an important tool in making use of this dead time (largely because of its minimal interaction requirements during travel), and several mobile workers reported delaying and lining up several telephone calls for precisely these times.

The data emphasises that mobile work is at least partially predicable, allowing mobile workers to determine which resources that they may require to take with them. Even when work is not predictable, mobile workers can at least plan for that unpredictability, taking task-relevant paperwork 'just in case' it is required. Paradoxically, mobilisation work may therefore take place whilst at a static workplace location. This extends mobilisation work beyond the mobile event itself – something that is not typically considered in the research on mobile work.

5.5.2 Social interaction and home/work relationships

5.5.2.1 Communities of practice

From the interview transcripts, it is evident that much mobile work revolves around the idea of social 'contacts', which formed communities of practice (of varying intensity) that they could call on. These communities of practice were also important in the performance of ongoing mobile work, perhaps even more so in blue collar work (although not exclusively). Often the blue-collar workers would help out other tradesmen working in their vicinity if they requested help, even if they were personally unknown to them. As examples of this, the builder gave a surplus barrel of sand to other builders who had run out, the mobile hairdresser did a hairstyle for a fellow hairdressing colleague and the painter helped a plasterer move furniture. As the gas boiler installer noted, the relationships with others on a building site may become mutually beneficial:

> "...the builder might say ... I need some hot water here or cold water and I can't be bothered to walk back upstairs where the bathroom is any chance in running me an outside tap, and so you say to them 'Yeah, right when I finish the boiler instead of me getting on the ladder, if you are a builder with all the equipment,' he might even have the scaffolding up, 'instead of me getting on the ladder to get up with my sand and cement will you do it for me?'"

Overall then, in the data, there is as general sense of mobile workers possessing a sense of shared identify and community with others in their own profession, or other mobile workers they often come into close contact with, even if these people are not know to them personally. This sense of community did not just surface among the blue-collar workers, but was also evident in the interviews of the art director, arts workshop coordinator, and the academic. We see here how mobile workers make use of others when mobilising their work. Although this is often *ad hoc* and unplanned, communities of practice form an important resource in mobilising work, usually (though not always) through reciprocal arrangements.

5.5.2.2 Colleague awareness when mobile

Mobile workers rarely did their jobs in isolation from others, even if they were often alone whilst mobile. As we have seen, mobile workers often had to organise and coordinate their work activities around each other as part of a community of practice. This led to a need for others to know what the particular mobile worker's schedule was and for the mobile workers in

turn to know other peoples' schedules so that collaborative activities were carried out effectively. This was often resolved by *ad hoc* agreements being made over the telephone and using paper diaries. However, the extra effort of using a long-term diary – even a paper one – is clearly evident in an extract from a self-employed informant:

> *"I am really crap at diaries and like, for instance, you having to phone me today and remind me. You see my diary is basically empty. I just don't bother! ... Basically, everything goes in the daybook or scraps of bits of papers."* [Art director]

Similarly, the communications manager noted that although current groupware calendaring technology like Lotus Notes fitted into desk-bound work well and had a high value for co-ordination with co-workers, it required too much maintenance and effort for dynamic work on the move.

For the most part, the people interviewed were heavy mobile phone users (when this was not the case, it was because their firms refused to pay their mobile phone bills). The majority of the calls made on the move were for logistical coordination with other co-workers, or to give others an awareness of their activities and updates on their current work situation. The data suggest that current digital technology often fails to support the need for constant communication between co-workers who may just be in the next building or room but who need steady progress updates from each other to manage their own workloads.

Often, the mobile workers described how they would often waste time phoning colleagues about something urgent, but their colleagues' mobile phones would be engaged or switched off. The painter also pointed out another problem, relating to other people's awareness of a mobile worker's activities. He noted that since his working schedule had to be highly dynamic (he would paint one coat then go onto the next job, often returning the following day to finish the job off), the companies he went to visit had limited awareness of his planned activities, so his working schedule had to be very flexible. This meant that he often found when he arrived at a company, their staff was not prepared for his visit and he was requested to return the following day to do the job because the staff had to arrange to sit somewhere else for their lunch or meetings when he was painting.

Mobile workers would often record the planned activities of others that they worked with ahead of time, even if they were not directly involved in those future activities themselves. This would remind them of the availability or lack of availability of close colleagues and help them coordinate their activities at a later time/date. Even on a day-to-day basis, mobile workers often described keeping their "eyes and ears open" to background

information when talking to colleagues to find out what was happening to them:

"You ask each other where you are working and what you are doing...that is mostly the topic of the conversation in the morning where have you been working and who have you been working with. How do you get there 'cause usually they are quite far away… in case… during the day the boss could phone and say 'nip up to wherever' and if you have been speaking to someone you have a rough idea how to get there because they have been there." [Painter]

Such a need to know what others were doing in case they had to help out was common. Similarly, mobile workers frequently had to make their own job activities known to their managers and others over the mobile phone in case they needed help themselves. Awareness information from colleagues therefore has a high value in reducing the effort required to mobilise the resources available to mobile workers, and a large part of the mobilisation work observed fell into monitoring this awareness information, both actively and passively, and before and during travel.

5.5.3 Strategies for mobility: mechanisms of interaction in mobilising work

What the data show are a number of strategies through which mobile workers make use of the resources available to them and how they are able to work around their actual or expected constraints that arise through mobility. In performing these activities, they are *mobilising* their resources in order to be able to conduct their primary work objectives: by developing workarounds to environmental conditions and preplanning for their expected constraints, and by enabling awareness information and communities of practice, mobile workers are able to build an infrastructure around which they are able to conduct their primary work activities. An interesting point to note here is the granular basis of this mobilisation work, ranging from the broad appropriation of social contacts into the co-ordination of work, to the opposite end of the scale, in the highly localised reorganisations of artefacts in space to better manage available resources.

5.5.6 Technology Probes: design and functionality

5.6.1 Design of the probes

Following a review of the data, a list of initial core functions was drawn-up for three probes. For each function of the probes, the function was named (e.g. opportunistic communication) and a description of the support that this will provide for the users' work was given (e.g. facilitate the arrangement of opportunistic meetings between co-workers). We do not go into the design processes for each of the probe technologies as this is not of concern here (see Brodie 2004); our concern is demonstrating the functionality of the technology and the opportunities that they offer their mobile users in supporting mobilisation work. In the rest of this section we describe the prototypes.

5.6.2 VMail

The effective management of incoming communications and the use of information received while on the move presents a challenging design problem if we accept that mobile workers will not always be available to communicate synchronously. One of the main sources of this incoming communication is the mobile phone. However, even when mobile workers made an effort to respond to voice messages on a regularly basis, they often found that they could not work '*anytime, anywhere',* and mobile voice calls were left unmanaged for several hours. When eventually picking up their voicemails, mobile workers may have to deal with a lot of information sequentially, unaware of the importance or trivial nature of each message in advance.

In the first probe technology, V-mail, we established that it would be valuable to support two important functions: *awareness* (being aware of coming information while using the system, for e.g., how many messages a user has received while unavailable in a meeting)*,* and *managing coming information* (ordering and archival of coming information based on user preferences, to allow effective use of that information). V-mail supported the management of incoming verbal communications through a voicemail application. The ability to search previous voicemail messages was also seen as important if a mobile worker

Fig. 5.1. A V-mail entry

wanted to access all calls from a particular caller in sequence or to re-find a particular call but were unsure of the time the call was made.

As fig. 1 shows, a V-mail entry shows the phone number of caller, the caller's name (if in the mobile phone's address book), the subject header, the time/date and length of the call and the option to listen to it. After a caller has received a V-mail notification, they can select to 'read' the message and this will take them to a list of all unread V-mail notifications. By scrolling down they can highlight and then select the call they would prefer to listen to first. In its simple mode, see figure 2,

Fig. 5.2. V-mail listing (simple mode)

calls are presented by recency, but in a more advanced mode, users can opt, for example, to have calls ordered in terms of other personalised prioritising criteria, such as who the voice call is from, regardless of the time of arrival of the notification, or they can chose to have notifications with topic headers such as '*urgent*' listed first.

5.6.3 Dynamic-List

We have seen that mobile workers organise and coordinate their activities in conjunction with one another as part of their wider communities of practice. However, the need for an ongoing and up-to-date awareness of other people's activities and location was not always possible when mobile workers were mobile and so the possibility of re-organising their own work more effectively in real-time would often be lost.

For Dynamic-List, we identified several issues that were important in supporting *ad hoc* mobile co-ordination: *awareness* (information available to users of the system about other users, from being aware that someone is in the same area as the user, or that they free to collaborate); *lightweight interaction* (without the interactional and logistical overheads of the computer); and *opportunistic communication* (a 'constant' communication channel should allow users to communicate with one another quickly and receive responses). The Dynamic-List prototype was built around a shared dynamic time and activity to-do-list schedule. It provides its users and their colleagues with real-time information on schedule changes to help them re-organise their own work around each other. Individual privacy

needs are supported, with mechanisms such as restricted viewing of to-do-list entries marked 'private'. It allows information awareness through visual 'notification' of incoming verification requests or automatic updates of lists, and allowed limited read/write capacity for a user's colleagues. Finally, it provides an easily accessible archive of past and future to-do-list schedules.
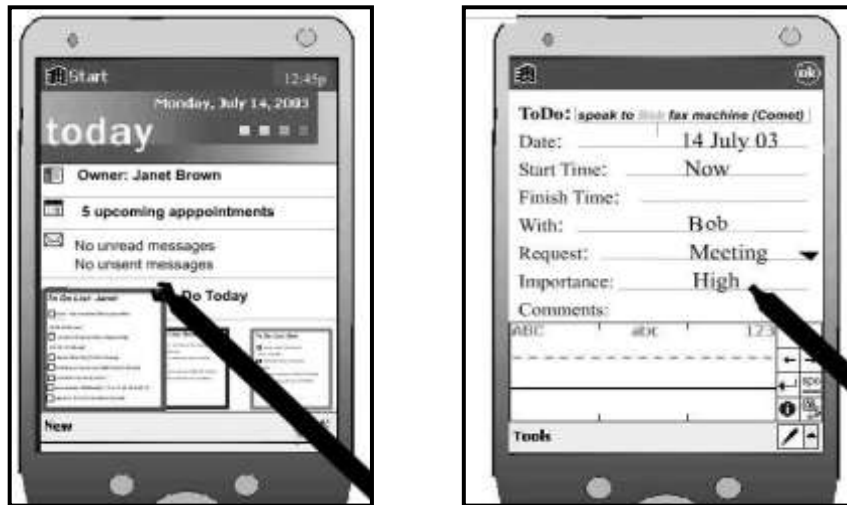

Fig. 5.3a. Dynamic-List (awareness screen)   **b** Adding a to-do-list entry

The 'desktop' view of Dynamic-List (figure 3a) shows activities that the user has listed to do that day. The application has its own small 'peripheral awareness' screens on the PDA home screen. These show a miniature version of the user's to-do-list and also two of their chosen colleagues' to-do-lists. These miniature screens can be extended, by dragging the top right corner with the stylus to present a larger 'awareness' screen for quick viewing of a user's or their colleagues' schedules. Using a combination of drop-down lists and stylus writing, users can also enter requests to meet up with other users (figure 3b).

In a Dynamic-List page (figure 4a), a user's activities are listed in time order. Users can choose which day or start time they wish to view by selecting the arrows on the date and time toolbar. Users can access each other's to-do-lists for viewing, and edited if permission has been granted. The application allows users to choose who they want to view their lists as well as choosing 'special' others who have read/write access (see Figure 4b).
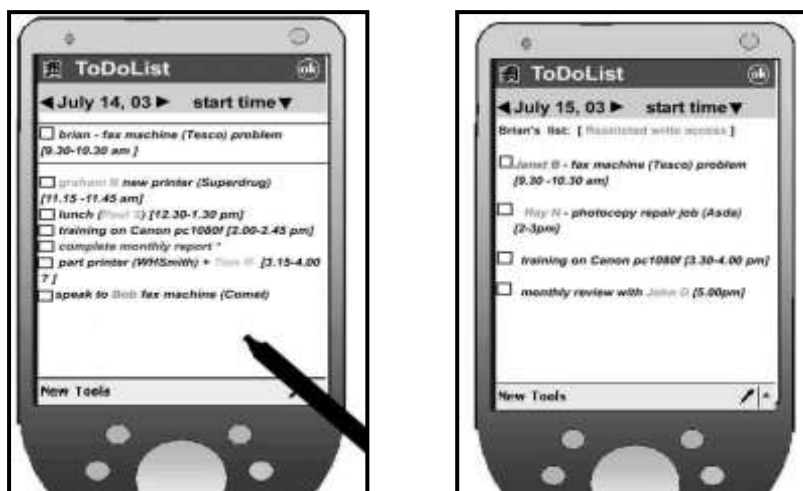
Fig. 5.4a. To-do-list page   **b** Viewing another user's to-do-list page

Dynamic-List therefore supports opportunistic face-to-face meetings by providing notification about local potential colleagues to interact with. The user can either choose whom to be alerted about in advance, when in a particular location, or allow the system to 'react' to any of their colleagues when they are close to the user's current location. Alerting users to colleagues nearby is achieved through an audio alert (or vibration) accompanied by a flashing of the display and an accompanying text notification indicating who the other user is.

5.6.4 Connect-Talk

Mobile workers frequently collaborate with other mobile people. However, current mobile technologies often fail to support the need for communication and awareness among mobile co-workers. Connect-Talk was primarily intended to investigate the interactional potential of a mobile device to support work and relationships within mobile communities of practice. Criteria guiding the development of the talk-mode operations of Connect-Talk included the facilitation of *ad hoc* coordination between mobile workers and their co-workers by providing a constant audio communication channel. This would provide a community of practice with passive awareness of each other's activities and communications while mobile. It was intended to support opportunistic face-to-face meetings by showing

colleagues in the user's environment that they could interact with through the location positioning technologies.

Connect-Talk's core functions were *awareness, lightweight interaction and communication, coordination* and *presence*. The final function, presence, refers to information about the user being made available to other users. The system provides mechanisms to share a user's status (e.g. 'online', 'offline', etc.) with others, and allows a user's on-line presence to switch between different 'buddy' groups (similar to instant messaging technology).

Connect-Talk was designed as an 'always-on' awareness device, utilising a radio/walkie-talkie metaphor of use. As noted in the analysis, mobile workers of-

Fig. 6.5. Connect-Talk concept device

ten found themselves asking their colleagues on their mobile phones their exact whereabouts to aid smooth coordination. We therefore sought to make use of location-based services for Connect-Talk so that users could easily locate each other when in the same local area should they wish to arrange an opportunistic meeting to carry out face to face conversations.

When a user is present in a given location, and the device is in 'talk' mode, the interface shows iconic representations of co-workers using Connect-Talk in the area (see fig 5). Users of the Connect-Talk device are alerted to the status of co-workers by colour coding (availability), audio/vibration (new buddies' devices detected nearby), and concentric circles showing the approximate location of colleagues (in relation to the user), so that buddy proximity can be established at a glance. Switching between different 'buddy' networks (e.g. different communities of practice) that a user may wish to view or to allow adjustment of a user's status (e.g. when they are no longer available or engaged in hazardous activities) is possible. A change of icon colour, from blue to green, informs users who is talking on the system.
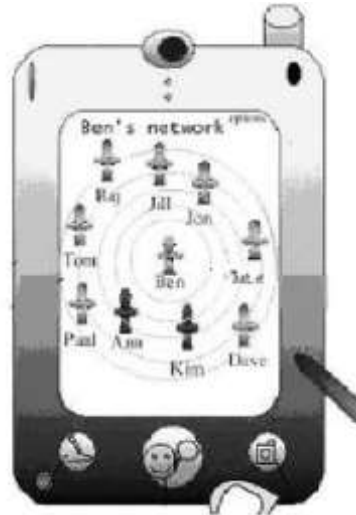
5.7. Probe Evaluation and implications for Design

In this section, we document the use of the probes from the user evaluations, describing our users' expectations and the problems that they described. We present the findings for the probe interviews collectively, rather than separating out individual probes, as the findings for each of the probes overlap and inform each other, allowing a richer picture about technologically mediated mobile work to be offered than would be possible if each set of findings for the technologies were presented alone. Following this, we develop these into implications for the design of future mobile technologies.

5.7.1 Supporting awareness

One of the main themes that emerged from the user evaluations was that the probes could support a heightened sense of awareness of other colleagues when a mobile worker was out on a job. For example, the electrician noted that one of the key benefits of the Dynamic-List system was being able to know exactly where his colleagues were. Similarly, the plastic sales specialist noted that it was advantageous to know when a colleague or client was close by:

> *"If you could spare 15 minutes you could quickly go and see the person. I appreciate that. That is good. Whereas with a mobile phone you wouldn't know that unless you call the number."*

However, there was a negative aspect to this greater awareness: while the technology allowed them to know the precise whereabouts of their remote colleagues it also allowed colleagues and family to know their own exact location. Indeed, the hairdresser noted that by supporting greater awareness of a user's activities and location, the technology could actually lead to restrictions on her activities because, for example, if asked for help through the Dynamic-List system:

> *"there was no way you could lie and kid on that you were at the other end of the city!"*

While the three probe technologies were deemed successful at supporting effective awareness for mobile workers and their communities, this 'heightened' awareness did not always 'mesh' well with the users' current work practices. Mobile technology adoption would be improved if mobile

technologies that include support for greater awareness of a user's activities also offer users mechanisms to restrict colleagues' awareness of their activities when deemed necessary.

5.7.2 Supporting effective communication

Over-hearing of conversations through the Connect-Talk device was considered to be mutually beneficial:

> *"It has advantages too if other people hear your conversation. If it is work related. If the two of us don't know, someone else may be able to give some knowledge on that." [Telecommunications engineer]*

The electric meter installer echoed this, noting that Connect-Talk could overcome the need for fruitless rounds of phone calls. One of the potential benefits that the participants could envision with V-mail was that it would help them maintain awareness of their contacts, even when they were unavailable to receive phone calls. Instead of having a barrage of voice messages to listen to, the header part of V-mail would allow users to respond quickly to important messages.

The plastic sales specialist was also appreciative of the way V-mail could allow busy salespeople to cope with the demands of communicating whilst driving. However, despite the participants expressing optimism about the benefits of V-mail, the telecommunications engineer noted that he would be reluctant to activate it – in some organisations there is an *expectation* of 'anytime, anywhere' accountability for mobile workers:

> *"Sometimes the manager wants to get hold of you because you have done something wrong or something. Or maybe he wants some explanation because someone is screaming his head off or something. So these things, they can't wait. If you don't answer they come looking for you and I would be in more trouble because maybe I am not in the place I am meant to be."*

Another problem identified with Dynamic-List was the need to focus attention on the device to the detriment of the other ongoing activities. As we already know, mobile work can be cognitively demanding. Tools that make heavy demands are likely to be left in vans and cars (like the laptop) in favour of other technologies that facilitate more fluid and flexible communications when mobile.

In summary, while the mobile workers saw some of the technologies as potentially supportive of more effective communication, those that were more cognitively demanding may not be as effective at supporting communications in very dynamic mobile work environments because of the need to actively monitor the device and manually update it.

5.7.3 Transforming work relationships

Evaluators noted that the probes could potentially affect their relationships with colleagues. In current work practice, those interviewed admitted that they would contact the colleagues that they get on best with if they needed physical help, rather than the colleagues who may be physically nearer. However, by explicitly showing who was physically nearest, Connect-Talk allowed users to choose to ask for help from their nearest co-worker. Other criteria for asking for help, in addition to proximity, could also be potentially established through Connect-Talk:

> *"I would maybe state, and sort of ask, who is the closer to me and who hasn't got as many calls left for the day. Maybe to help me out for the rest of the afternoon or whatever...Tom may be further away, but he might only have one call left and, such and such, may have two or three more left." [Electric meter installer]*

The electric meter installer also described how Connect-Talk could bring his colleagues 'closer' together and support more face-to-face exchanges:

> *"Maybe see them more, through the job, either helping each other or helping each other out more because you know exactly who has got what and who is closer in your area."* [Electric meter installer]

The Dynamic-List application differed in this respect: for the hairdresser, even if the application allowed more communication between colleagues, it was not allowing the *right kind* of communication. She went on further to explain that she could envision wasting time meeting a colleague to borrow some supplies when they did not have the exact stock she was looking for because of the absence of verbal communication through the system. The plastics sales specialist also noted that relationships between him and his colleagues would become impoverished if verbal communications were taken out of the equation for negotiating meetings. A critical problem with Dynamic-List then, is not that it does not allow rich enough

communication between co-workers to facilitate coordination and collabo-ration, but that it threatens to supplant verbal communication and the spe-cific qualities that verbal communication brings to exchanges between co-workers.

Another problem identified for 'always-on' awareness technology was that it might adversely affect the way the users would respond to their ob-ligations as members of their respective communities:

> *"It's got benefits ... but if you were maybe tired and just wanted to go home you couldn't kid on you were no-where near them, and you would feel obliged to go help them..."* [Hairdresser]

It would appear then that the introduction of such technologies *could* adversely affect community bonds if they are designed and adopted with-out sensitivity to the needs of group dynamics.

5.7.4 Building and maintaining social and domestic bonds

The mobile workers interviewed noted how Connect-Talk could support their social activities. For example, although the plastic sales specialist felt his colleagues and clients had good access to him while he was working (because of his company mobile and landline phones), he usually switched his personal mobile phone off on working days or put it onto a silent ring-ing profile. In light of this, he felt that V-mail would be useful for manag-ing his personal phone calls:

> *"...for emergencies that would be ideal. Just stating 'urgent' – I would be looking that immediately. It could be family or loved ones just phone you up."*

Overall, the work life and home life of our mobile workers were often intertwined: work colleagues could become personal friends, and personal friends could become clients or co-workers. As users, they tended to assess the probes from both perspectives.

5.7.5 Privacy and 'user control'

During the interviews the mobile workers often brought up 'privacy' and 'control' concerns. For example, while discussing the scenarios for the Dynamic-List, the mobile workers identified instances of potential use that

they considered an 'invasion' of privacy, something they were keen to avoid:

> *"…it's always the case that you don't want management to know what you are doing but they are always the opposite. They are your enemy aren't they? … whereas colleagues - it doesn't really matter."* [Plastic sales specialist]

Although the electric meter installer did not mind his colleagues knowing his work activities, the risk of colleagues finding out personal activities was also a very real concern. Conversely, the hairdresser was worried about hairdressing colleagues in her neighbourhood finding out about her work activities, not because of embarrassment over personal matters, but instead for the very real threat that other hairdressers would try to steal business away from her if her activities were too open.

Another issue raised by the mobile workers was that of user control over the management of their own work activities. Some of the mobile workers grudgingly admitted it would be acceptable for their managers to do it, but except for the chiropodist (who was not in control of her own daily work plan), the participants were not positive about their work colleagues changing entries in their dynamic to-do-lists without asking their permission:

> *"Oh, no, I wouldn't like anyone changing it… No! Let me know and I would 'okay' it beforehand."* [Electrician]

To summarise, 'privacy' and 'user control' issues are important elements to consider, although they have not been widely addressed in mobile systems, other than with respect to encryption and data access. Yet, as we have seen from our research these concerns are often more socially contested, and such concerns are very important to individual users in terms of their willingness to accept new technology.

5.7.6 Technological Implications

While the implications of the study are limited to the participants selected and the forms of probe technology examined, they offer important insights into mobilisation work and the communication and informational requirements of mobile workers. What we have seen from the data is that a central focus for the design of future mobile technologies is on connectivity with other people, and whilst remote document and file access may be occasionally desirable, this does not appear to figure highly as a necessary

function, whether or not those interviewed were involved in knowledge-intensive professional work, or other forms of work.

1. *Supporting lightweight mobile interactions*: Low-effort/quick-to-operate interactions were highly valued. Without this, participants may employ workarounds or reject the technology. When supporting lightweight interactions mobile technology should not distract unnecessarily from the main activity at hand or it is likely to be rejected. Similarly, attention-distracting technologies can cause safety issues for mobile users.

2. *Support for verbal communication when mobile*: The data emphasises the primacy of voice over other forms of interpersonal connectivity. Media spaces, like that supported by Connect-Talk, can be successful at supporting mobile work activities through providing effective awareness of the activities of others. In contrast, Dynamic-List failed, in part, to support many forms of mobile work because it ignored how mobile workers often rely on voice communications to support negotiations when organising meetings.

3. *Balancing social awareness with individual privacy*: While the mobile workers often needed to know where others were and what activities they were engaged in, it was noted that the technology should avoid 'invading' their privacy. For example, it is often enough to effectively support awareness if it is merely indicated that someone is unavailable to talk on the system, without displaying why they are unavailable to talk. Mobile work is different from that carried out in open plan environments, where supervisors and colleagues are usually well aware of co-workers activities; it often involves a mobile worker working at their own discretion, and making quick decisions in response to dynamic circumstances. Extra sensitivity needs to be exercised when supporting more awareness of this kind of workers' activities to avoid resentment or misunderstanding developing between managers and employees. Mobile technologies then, should provide enough awareness to accommodate effective action but not so much that privacy is threatened. The thin line can easily be crossed, and technology should accommodate different users' sensibilities by providing those users with control mechanisms over their presentation of awareness information to others.

4. *Flexibility to support individual and community needs*: Different mobile communities need different types of support to aid effective work practices. In mobile communities, issues of trust, privacy and accountability are important constituents of the work situation, and these issues need to be flexibly supported by mobile technology to accommodate a whole range of users and their individual needs. Mobile technologies should also seek to support not just the work activities of mobile workers but

also their lifestyles, as much of this is bound in with the mobile component of their work.

5. *Supporting obligations and accessibility in communities of practice*: In mobile communities, social and organisational obligations and accountability are part of the job. During the probe evaluations, several mobile workers expressed worries about being obligated to help out other colleagues, or worried about their accountability to management who could be constantly aware of their current whereabouts through the use of location-aware technologies. This suggests that the mobile communication technologies of the future need to be sensitively designed to support the nature of the communities that people work in. One way to approach this is to allow different levels of technological accessibility to other mobile workers, for example, by allowing private conversations as well as more open conversations. While this approach is already apparent in technologies like Internet chat-rooms, more research needs to be done to see how to implement such mechanisms to effectively support the interactions needed for mobile work.

5.8 Discussion and Conclusion

One of the critical questions that we set out to examine was to understand the work that people had to do in order to be able to conduct their jobs when they were mobile. The data documented in the studies gives an important insight into this: how mobile workers make use of the environmental resources around them, plan ahead, make use of travelling time, build and exploit communities of practice, maintain an awareness of colleagues and organisational changes, and manage and connect their private and working lives. This all contributes to developing a clearer picture of what mobile work is beyond the individual work scenarios themselves.

Yet disconnecting mobilising work from its primary work objectives is to miss an important part of the larger picture: work and the co-ordination of that work are intimately bound together, the one meaningless without the other for those that it concerns in their daily, lived experiences. At the risk of over-labouring this, we could say that understanding the work of doing the work is analytically inconsequential without considering the achievement of the primary work objectives. This rather academic point has an important role to play in the design of mobile technology. The simple provision of technological mechanisms for mobile interaction that allow work to take place will not, by themselves, enable mobile work, or more effective mobile work. Such mechanisms can only be effective when

they mesh with the individual particularities of the work contexts and the working practices of the people concerned. Providing an opportunity to support mobilisation work will not necessarily be useful where the work practices are in conflict with the design. By providing flexible opportunities for action, and resources that can be adopted when they are found to be useful, we can give users of mobile technology access to different and a richer set of mechanisms for interaction that can be used to mobilise their own work. In this sense, a formal mobile information system that requires a particular form of engagement to perform mobile virtual work will probably fail because it does not support existing practices and contexts.

What we are getting at here is that when we consider the terms 'mobile virtual work' and the 'mobile virtual organisation' and try to understand the nature of these activities, these terms are only really useful as placeholders for the diverse range of applied practices and technologies that constitute the material experiences of mobile workers. The work is itself not virtual (ah, wouldn't that be a welcome treat!); rather, by placing resources and technologies so that they are accessible through a 'virtual' technology, work can be conducted 'as if normally'. The attentive reader will notice a good deal of gloss here: 'normally' is being used in its broadest sense to accommodate performance, and not practice.

The 'virtual' part of work then, needs to accommodate aspects of mobilisation work, and more so than through the provision of a 'virtual desktop', even if that desktop is designed to accommodate the ergonomic restrictions of the mobile users. Access to information on the activities and accessibility of other people (whilst accounting for the reservations exposed by the probe study participants) is clearly one such criterion. Whilst this requirement for 'awareness' information can be also seen in the literature in remote CSCW and groupware applications, being mobile, and accessing (or making available) this information has its own particular design problems. Similarly, and building on awareness, creating and maintaining links with a community of practice (or even a *mobile* community of practice) also presents designers with a complex problem: how can mobile users contribute to and gain value from communities that they spend much of their time physically remote from. Work-time, as well as family and social relationships are important too, in ways that we have seen that demonstrate how the demands of mobility cut across traditional work/leisure time and occupational/social boundaries, and these offer very different resource sets to mobile workers than the canonical office worker.

Extending the findings beyond the individual worker, we can envisage how mobile technology can have impacts on a wider organisational picture. An important finding from the research, and which can be seen indirectly in the work of much of the mobile academic literature on mobility,

is that a very large part of the connectivity that is required (and used) by mobile workers is directed towards remote *people*, and not remote *things* (e.g. documents and remote devices). This aspect of connectivity is not supported by most mobile technologies, apart from the mobile telephone, interestingly, the most common MVW device in use. There is an argument here that the participants' requirement for this access to other people may be to use them as a proxy to access currently inaccessible remote things (see Perry *et al.,* 2001), but close inspection of the data does not appear to bear this out for a large number of the instances reported. What we see is a great deal of social interaction and community building, activities that cannot be reduced to simple goal driven action. The organisation then, as both a closed commercial entity or open community of practice, is clearly a valuable informational resource for enabling the mobilisation of work.

In terms of the implications of the research for organisational theory, it is harder to speculate on outcomes, as these are related to phenomena that extend beyond the technologies available, encompassing governmental policy (e.g. the move away from or towards self employment), and social change (e.g. fragmentation of the family unit or an increasing geographic dispersal of social relationships), as well as other factors, such as demographic shifts, which may for example affect norms of social interaction. Nevertheless, mobile technologies do offer resources to mobile workers that free them from the boundaries of their employer organisation. We see networks of organisation emerging that appear atypical of office work, as friendships and occupational alliances are appropriated in the performance of an individual's work. At its simplest level, we see this as people keep their (personal, and occasional work) mobile telephone numbers as they move between jobs. At the other level of the scale, mobile workers can work for multiple organisations simultaneously, keeping abreast of awareness information and other ongoing organisational activities.

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