Personal Information Infrastructures for Everyday Lived Experience: A Challenge for the Future

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Abstract

This paper presents one possibility for the future of technology-supported mobility. It draws upon findings of a series of field studies of mobile technology use undertaken since 2001 to construct the concept of 'personal information infrastructures' that support people's everyday lived experience. Underpinning the concept is the belief that we should shift our focus from studying individual technologies and their application to narrow sets of activities or purposes. Rather, it suggests that we should study everyday experience and generate ways that combinations of technology can support the breadth of needs, purposes and contexts that characterise our lives. Some of the implications of this vision are discussed and future research areas are outlined.

Keywords: Personal Information Infrastructure; Mobility; Experience; Personal technologies;

1. Introduction

The previous six years have seen rapid and radical changes in the penetration, acceptance and use of technologies to support people while they are mobile[1]. The short time span between mobile technologies being widely available and their acceptance has been unprecedented; these technologies are now described as 'pervasive' or 'ubiquitous'. These levels of acceptance rest on the availability of affordable devices and services and perceptions by a range of user cohorts that these technologies are highly useful. Given this acceptance, we are now trying to define a possibility space within which future trends will occur.

This paper argues that we should not try to decide whether organisational, or entertainment, or social, or personal applications will be the 'killer apps' for the future. Instead it draws on the findings of a series of intensive field studies undertaken since 2001 to suggest that the most striking outcome of increased use of mobile technologies has been dissolution of the boundaries previously imposed on purposes and contexts of technology use. Notions of public and private, organisational and personal, 'at work' and 'at home' are less relevant to mobile technology use. Consequently, our challenge for the future is to move beyond prescribed purposes and contexts of use in order to provide technological support for life as experienced: enhancing our everyday lives in multiple ways by providing multiple services that cross work, education, entertainment and social boundaries.

Existing research has examined aspects of experience and related them to technology including the experience economy, where experiences are staged as commercial events (Pine and Gilmore 1998), and interaction experience, that examines users' experiences of technology (Preece, Rogers and Sharp 2002). This paper takes an alternative approach and suggests that we need to focus on people's everyday lived experiences. Instead of designing technologies for a specific purpose (such as managing contacts or listening to music) or

[1] I call these 'mobile technologies', though some of them are fixed and others may be temporarily stationary, because they support people as they move from place to place.

context (‘at work’ or ‘with friends’), this involves a holistic approach. The aim is to design to support people as they live their everyday lives, shifting their attention from education, to work, family and friends, navigating interactions with institutions such as banks and governments while dealing with young children or a crisis at work. These are our everyday lived experiences. The role of future mobile technologies is to support, enable or enhance these everyday experiences.

Central to this approach is the concept of a ‘personal information infrastructure’. Mobile technologies are personal technologies carried on the person and accessible to the individual. In studying use of mobile technologies the primary unit of interest is therefore the individual, connected through a web of people and technologies to other individuals, groups, organizations and societies in the larger world. The increasing disconnection of the individual from local social and geographical ties is a characteristic of post-modern society (Pescosolido and Rubin 2000); mobile technologies are being used to overcome this fragmentation (Carroll et al. 2002) and to re-connect using technology rather than public spaces or physical proximity. These individuals require an ensemble of technologies that serves individual and personal rather than group or corporate needs; they require an information infrastructure that is personal. A personal information infrastructure enables connection with diverse people, data and systems at an individual rather than aggregated level, enabling data and services to be customized to personal, real-time situated needs.

This approach, of viewing the key drivers of future mobile technologies as the support and enhancement of human experience via a personal information infrastructure, has implications that include:

- an even greater need for inter-disciplinary research, design and implementation teams
- understanding of users’ appropriations of the technologies that are currently available to them and the ways that they are combining these technologies to meet their needs
- a holistic rather than reductionist view – of human needs (and analysis techniques), technology design and applications
- as a result of the complexity and unpredictability of this holistic approach, an evolutionary approach to design is recommended; just look at developments over the last 5 years and ask: ‘how many of us predicted the current state of mobile technology use?’

The following section contains a review of existing research examining the relationship between technology and experience, and its inherently techno-centric focus is noted. The paper then argues that this approach needs to be broadened – instead of providing enhanced user experience of technology, we should be aiming to use technology to provide users with enhanced experience. Thus, the focus switches from experience of technology to technology-supported life experience. This is captured in the concept of a personal information infrastructure. The paper presents a model of the elements of a personal information infrastructure and then concludes with a brief discussion of some theoretical and practical implications of this argument.

2. Mobility

Mobility signifies movement; entities and activities that are mobile can be contrasted to those that are stationary or fixed. Mobility may involve people who are wandering within the one location, traveling between locations, or visiting at a new location (Dahlbom and Ljungberg 1998:230). Therefore, technology-supported mobility has two aspects (Carroll 2004):

- either the technology is, or is capable of being, mobile or
- the user is, or is capable of being, mobile while using technologies.

A stationary person may draw upon ICTs that are carried or attached to their bodies (such as laptops, BlackBerries or wearables) to access applications and services provided either as part of the device or available remotely. Alternatively, a mobile person may interact with fixed technologies that are accessible as they move (such as those provided by networked environments, such as an internet cafe, information kiosk or computers at a hot desk). Finally, a user may access a mobile technology while on the move; for example, when two people in transit using mobile phones to rendezvous. Mobility enables interaction between diverse people, technologies and data sources from any place at any time. All or some of the people, technologies and data may be mobile.

Mobility challenges many of the assumptions and concepts that underpin the disciplines that study the design, development and use of ICTs (such as Information Systems, CSCW and HCI). To date we lack a rich set of metaphors for mobility, have few precedents to guide us in imagining future mobile practices and must deal with the implications of emergence, appropriation and context (Carroll 2004). Firstly, technology use may emerge in unexpected ways from the interaction between the human user, the user's activities, the contexts of use and the technologies. Emergent outcomes are especially likely when the user is mobile because mobile technologies facilitate an ad hoc approach to life (Carroll, Howard, Peck and Murphy 2001). For example, users can make and change decisions on the fly in response to remote entities (such as friends texting an invitation) or locational cues (a 'special' SMS offer invites passers-by to take a coffee break). Secondly, users appropriate technology to meet their situated needs: technology use is the outcome of a process of exploration, evaluation and adaptation by different users in different situations (Carroll et al. 2002). Text messaging is a powerful example of such appropriations: '.. it was not designed or marketed to consumers. It was seen as a way for phone companies to alert customers to network problems or other issues and used for little else until the late 1990s' (Wall Street Journal Europe 16 Oct 2003). Exploration of this technology led to positive evaluations of its value to users and adaptations such as SMS abbreviations and pranking.

This paper takes as its starting point an ongoing program of intensive field research that has been examining mobile technology use. Five projects were undertaken between 2001 and 2004. Two projects examined young people aged between 16 and 22 years, the third examined post-graduate IT students, the fourth young working professionals and the fifth studied IT professionals. Part of the research program involved imagining future practices that led to construction of an envisionment method called Acting Out in Context (Carroll 2004b). The metaphor of a 'technology portfolio' has been proposed to describe observations of the participants' selections of technology while mobile (Carroll 2005). This paper builds on the findings of the research program and aims to outlines some possibilities for future developments in mobility. This involves stepping back from the turmoil, hype and diversity of user practices apparent in the field, selecting some of the key themes apparent in the trajectory of 'mobility' over the previous six years, and proposing a vision that is compatible with the observations and themes. The outcome frames the future of mobility in terms of users' everyday experience, where the challenge for the design and application of technology is to support these experiences.

3. Experience

There are many different descriptions, definitions and classifications of experience (Czikszentmihalyi 1990; Dewey 1958; Forlizzi & Battarbee 2004). Experience may involve multiple senses and inputs. Experience is subjective because it depends on human perceptions and interpretations: "experience is inherently personal, existing only in the mind of an individual who has been engaged on an emotional, physical, intellectual or even spiritual

event" (Pine & Gilmore 1998). Understanding and evaluating experiences can be social, where discussions, narratives and analyses with others retrospectively shape these perceptions. Experience is dynamic: it unfolds over time. It is the outcome of some human engagement – that may be passive (listening to a podcast), active (singing) or interactive (instant messaging remote friends); and the meaning of experience is shaped and interpreted over time (Buchenau & Fulton Suri 2000).

Forlizzi and Battarbee (2004) identify three types of experience:

- experience – "the constant stream of 'self-talk' that happens while we are conscious"; our understanding of our external environment and internal state of mind, often formed in relation to other actors, events and environments.
- an experience – a particular episode that is remembered with specific connotations (positive or negative) and having a distinct start and finish.
- co-experience – an experience in a social context that is shared, interpreted and given meaning with others.

The first type, experience, is what is characterised in this paper as 'everyday lived experience'. The other two types are particular instances of experience in general. The second type, an experience, has received much attention. Examination of highly enjoyable moments by Csikzentmihalyi (1990) - that he called a 'flow experience' - identified their essential characteristics as a challenge requiring skills; a chance of completion; opportunity to concentrate single-mindedly; clear goals; immediate feedback; control over activities; and expansion of self through the experience. Challenge, control, absorption and self-actualisation are characteristics of optimal rather than everyday experiences. Technologies such as computer games, entertainment applications and the experience economy aim to provide these optimal experiences. Technological support for the third type, co-experience, includes systems for technology-mediated communication and virtual group support. Also, users have appropriated mobile technologies (e.g. the voice call, texting and camera functions on mobile phones) to support co-experience.

Recently, computer-based disciplines have become attentive to the emotional or affective aspect of computing, leading to greater emphasis on understanding and enhancing experience. Two examples are the experience economy and interaction experience. Both aim to provide a memorable or pleasurable experience from interaction with a staged event (experience economy) or technology (user experience).

3.1 Experience economy

Pine and Gilmore (1998) believe that experience is the next focus of business attention, following on from product and service. The concept of the 'experience economy' relates to competition grounded in providing rich and memorable experiences for customers. These experiences will be staged or performed as offerings to customers in order to compete; these offerings might be a 'travel experience' a 'honeymoon experience' or a 'retailing experience'. These are special events, not part of customers' everyday lived experience: "An experience occurs when a company intentionally uses services as a stage, and goods as props, to engage individual customers in a way that creates a memorable event." (Pine & Gilmore 1998).

In line with their view of the experience economy, Pine and Gilmore classify an experience on two dimensions:

- participation, from passive (at symphony concert) to participating in creating or enacting the experience
- connection, or the relationship connecting customers with the event or performance, ranging from absorption (seeing its entirety from afar) to immersion (being in the middle of it).

They use these dimensions to derive five experience-design principles for creating a memorable and positive experience in a commercial context.

3.2 Interaction experience

Although the stated aims of interaction design are "creating user experiences that enhance and extend the way that people work, communicate and interact" (Preece, Rogers & Sharp 2002:6), much of the research in this area focuses on technology not everyday lived experience. There is a wealth of work on understanding and enhancing the user experience that results from interacting with technology (e.g. Buchenau & Fulton Suri 2000; Forlizzi & Battarbee 2004). Research into user experience may focus on the user, the technology or the interaction between the two (Forlizzi & Battarbee 2004); however, the two latter views are techno-centric as they are based on the interaction between people and technology – and the experience of interest is that the results from this interaction. Experience, then, is based on the users' experiences of – and with – the technology.

A similar view is expressed by Crampton Smith (2004) who argues that ".. the devices we use are increasingly conceived not as products in themselves but as the interface, the access point, to the services behind them." As shown in Figure 1, in this view services are seen through the viewpoint of a technology and users' everyday experience is remote, lurking in the background, unarticulated and unconsidered.

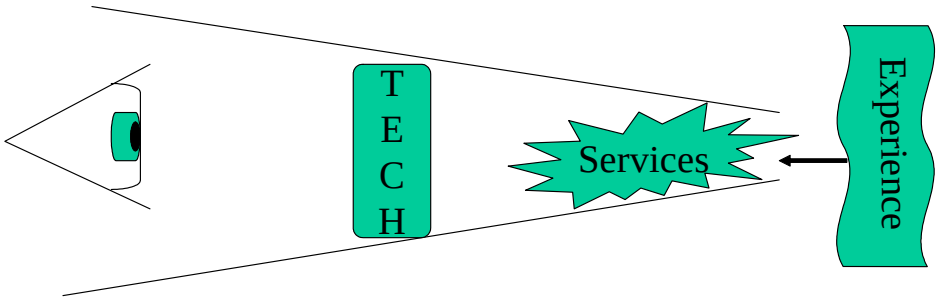

Fig 1: Services seen through the lens of technology

This preoccupation with technology, even as the access point of services, reflects a techno-centric view of the world. Crampton Smith states that the job of the designer is to "design the whole experience of the service so it is coherent and satisfying." But in what way is the service coherent? Is it consistency between the service and the technology that provides it? Surely we need to look beyond such internal coherence to a larger picture: external coherence implies that the services – and the technology – are coherent with the rest of the user's lived experience.

Crampton Smith (2004) believes that a second challenge is to reconcile what is possible, given current limitations and constraints of technology, with what is desired, given users' needs and wants. She discusses both quality, and qualities, of experience: "those things that go beyond pure function to give us satisfaction and pleasure." Quality of experience relates to everyday experiences while the qualities of an experience relate to memorable or optimal experiences. Crampton Smith believes that technology designers are still focused on function rather than on experiential factors. However, studies of mobile technology use demonstrate that users have moved beyond functionality and are selecting and combining available technologies to both enhance their everyday experience and enable memorable experiences (Carroll 2005); in this way, users' 'design in use' is ahead of interaction design.

The use of multiple technologies to support users' experience in a specific context is evident in Bannon et al's work on museum experiences (Bannon et al. 2005). Building on understanding of visitors' experiences at a museum constructed through intensive field work, the team designed and integrated artifacts together "into a coherent visiting experience". The type of experience here is a learning or entertainment experience in a particular context but, nonetheless, illustrates an alternative approach of focusing on the experience (in a museum) and constructing an ensemble of technologies, processes and people to enhance that experience.

Makela and Fulton Suri (2001) identify shortcomings in designing experiences *for* users. They argue that the subjective and interpreted nature of experience means that it is unlikely that designers can predict or control the experiences that people will have with technology innovations. Studies of users' appropriation of mobile technologies that describe both the creative adaptations of the technology and the new use practices that they facilitate support this argument (Carroll et al 2002, 2003). Therefore, Makela and Fulton Suri suggest that designers should aim to support users' creativity so they can create the experiences themselves.

This paper builds on and extends the views of both Bannon et al. (2005) and Makela and Fulton Suri (2001). It sees services and technologies through the lens of the user's experience of life. Technology is invisible or only partly visible – it has receded into the background; even the service may be invisible, hidden behind the user's experience that is the prime focus of attention. This is because, in many cases, the user is only interested in the quality of her everyday life and *how* this is achieved is not pertinent. Thus, it is not our relationship with the technology but the ways that (the support provided by) technology can enable and enhance our lives that is crucial. This view is illustrated in Figure 2.

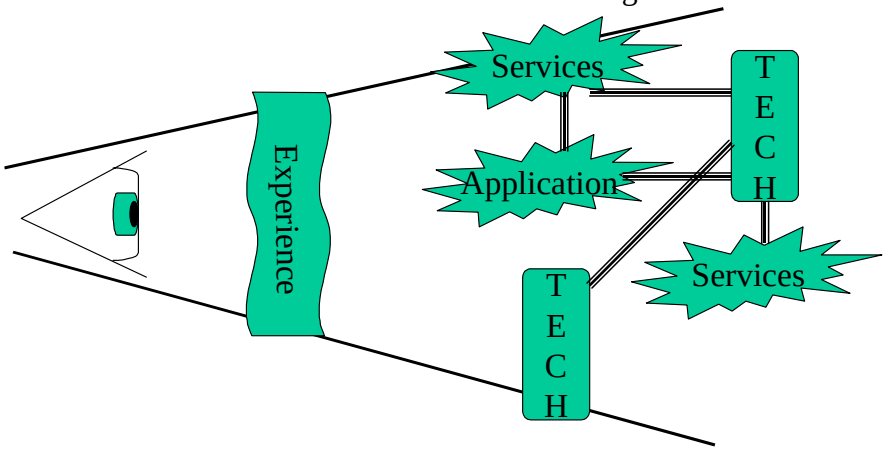

Fig 2 Services and technology supporting the user's lived experience

Another way of representing these relationships is through the metaphor of a personal information infrastructure that is developed in the next two sections.

4. Information infrastructures

Information infrastructures are "integrated sets of equipment, systems, applications, processes, and people dedicated to the processing and communication of information" (Ciborra and Hanseth 2000). Ciborra and his associates examined the complex corporate information infrastructures that support the global operations of large multinational companies. They concluded that these infrastructures are not the predictable outcomes of planning or strategic management but rather that "Patching, alignment of heterogeneous actors, and bricolage (make do) are the most frequent approaches we found … irrespective of

whether management was planning or strategy oriented, or inclined to react to contingencies." Infrastructures evolve in unexpected ways, slipping away from management's intentions or control mechanisms.

Unpredictability is a characteristic not only of the construction of these information infrastructures but also of their operation. Ciborra uses the word 'drift' to capture the essential nature of infrastructures: "they deviate from their planned purpose for a variety of reasons often outside anyone's influence." While these infrastructures provide the capability for control (to standardise, integrate and streamline), in use they drift; this drifting then gives rise for the need for greater control. In the corporate world "Although technology allows us to sharpen our governance capabilities, we seem to end up deploying technology to create a world that resists control (Postman 1992)." In a more generic sense, this fits with Forlizzi and Battarbee's observations about the difficulties of trying to predict or control the use of technological innovations.

Ciborra and Hanseth studied large, complex corporate information infrastructures. This paper applies the concept of an information infrastructure on a micro-scale: the information infrastructures that support, and are partially constructed by, individuals. And, just as Ciborra and his associates used intensive field research in the corporate world to draw conclusions about infrastructures, this paper reflects on the findings of intensive field research studying individuals and small groups to outline the view of a personal information infrastructure.

Practices of young people aged between 16 and 22 (Carroll et al. 2002, 2003), IT professionals (Carroll, Kjeldskov, Tobin and Vetere 2003), an established friendship group of 16 year olds (Carroll and Hartnell-Young 2004) and IT post-graduate students (Carroll 2005) were studied and analysed. The participants spanned diverse ages, educational backgrounds, economic status and gender in a developed country. These projects employed multi-method research designs including interviews, participant observation, focus groups, on-line diaries and analysis of provider bills. These studies provide a rich picture of the way that people are integrating technologies into their practices as they move from place to place, working studying, socialising and relaxing. They also capture changing patterns of mobile technology use over time.

One finding from the series of projects is that mobile technologies are inherently personal technologies: they are with the user 24X7 and usually carried on the user's body. A common checklist on leaving home is "keys, wallet, phone". A young male stated: "I feel kind of naked without my phone." Another said that when people ring his mobile, 'It's me they ring, not my home'. The participants use mobile phones to "add value to their lifestyles, satisfy their social and leisure needs and reinforce their group identity"(Carroll et al. 2002:58). More recently, mobiles are subsuming other personal devices such as watches or cameras: many young people use their phone as a timepiece and a watch is a piece of jewelry worn only for decoration. It is the personal nature of these technologies that has been a powerful influence on the dissolution of boundaries between work, study, entertainment and social activities.

The participants are discriminating and make thoughtful choices in their selections and uses of technology (Carroll et al. 2003). The metaphor of a 'technology portfolio' was proposed to describe their selections and deployment of technologies (Carroll 2005). All participants had accumulated a rich and diverse set of technologies that could meet their needs as they move from place to place undertaking various activities. The contents of their portfolios are selected from the vast array of available devices, media, applications and non-electronic resources according to their personal preferences, those of their peer group, their perceived needs and purposes for different activities in likely situations of use. These technologies may be combined to meet participants' real-time needs for support while they are on the move. However, the technology portfolio metaphor only addresses one portion

(devices, applications and functions) of the overall information infrastructure that is accessed by individuals while mobile.

5. The Personal Information Infrastructure

The ubiquity of mobile technologies, the vast array of mobile devices (for example phones, PDAs, MP3 players, USB keys, digital cameras, laptops) and improved telecommunications networks provide people with a selection of data, applications and technologies to provide support in their everyday lives, rather than just narrow segments of those lives. This is a fundamental change from a singular technology that is used in a predetermined context to meet a need to an ensemble of technologies that are mixed and matched, adapted and enhanced, accessed and enacted to support people's everyday lived experience. In this paper, the ensemble is called a personal information infrastructure, as shown in Figure 3.

The depth of the personal information infrastructure encompasses digital data and data sources, the applications that draw on these data and the multiple devices that a user may employ. The personal information infrastructure is also broad, so that it includes all aspects of the user's experience, some of which can be supported or enhanced by technology, both electronic and non-electronic. Underlying these more visible aspects of the personal information infrastructure is the technical infrastructure; users may have more limited choices in regards to this part of their infrastructure.

The concept of a personal information infrastructure addresses the essentially personal nature of mobile technologies. It incorporates the ensembles of services, technologies, data and functions 'behind' the experience pictured in Fig 2. It includes more than the technology portfolios that people construct from available devices, applications, systems and non-electronic technologies. The personal information infrastructure includes digital data drawn from diverse sources including government, commercial operators, organisations, communities, social groups and personal data of the individual; and the technical infrastructure that makes these data accessible (such as the internet, telecommunications networks, search engines, data bases as well as the standards, protocols and legislative requirements that govern privacy and security). It also represents users' everyday experience and some of the aspects of that experience (education, entertainment and work, for example). It shows that this infrastructure supports all aspects of everyday experience rather than just one aspect or purpose.

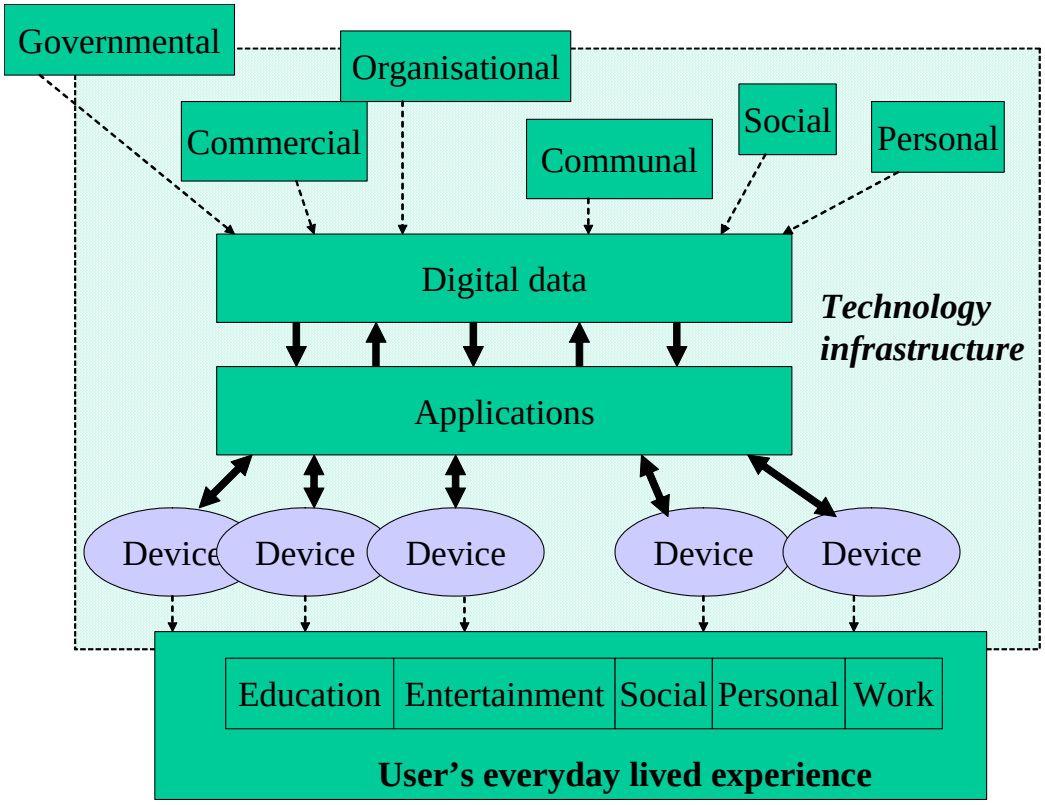

Figure 3 The personal information infrastructure

An implication of Figure 3 is that we should not look at a narrow slice of the personal information infrastructure (some data from one source, accessible by an application running on a device to support a particular task for a particular purpose). A holistic approach entails heeding the breadth of the activities, purposes, emotions and needs that constitute human experience. It directs our attention to the inter-relationships both between levels (types and formats of data and applications accessible on certain devices) and at each level (combinations of types of data, complementary applications and selected technologies, for example). Figure 3 demonstrates the argument that 'an experience' – in the work, entertainment or educational realm – is only one aspect of a person's experience of life. Implicit in the figure is the belief that a focus on an individual task (managing contacts, for instance) is only one small part of the overall work of managing life experience. This is not rejecting the value of creating memorable experiences or of analysing tasks within a work context; however, Figure 3 illustrates that these are sub-tasks that may be subsumed in the overall aim of supporting and enhancing the everyday experience of people. It emphasizes the importance of looking more closely at the relationships between devices, applications and the functions provided by devices and their relationships to the personal needs of people in different contexts. One place to start is to examine, in the field and experimentally, the selections and combinations that people are making to construct their own, improvised and ephemeral personal information infrastructures (see Carroll 2005; Makela and Fulton Suri 2001).

6. Conclusion

This paper has argued that the key challenge for future mobile technologies is supporting and enhancing everyday human experience via a personal information infrastructure. This

challenge is predicated on the ability and willingness of professionals from different disciplines (psychology, marketing, sociology, information systems, cultural studies, computer science and management, for instance) to work together to investigate ways that technology can support experience and to design and implement ensembles of systems, devices, processes and infrastructures to achieve this.

On a more abstract level, the vision requires a holistic rather than reductionist approach. Currently, much of our research and the development, innovation and implementation of technologies is focused on an individual unit of analysis (user, device, application, data source). One implication of the argument of this paper is to place such research and practice within the overall context of the information infrastructure. A more fundamental implication is to shift from the individual unit of analysis to a more comprehensive view of the personal information infrastructure. This requires greater sensitivity of the relationships between the elements of these infrastructures and the purpose of supporting everyday experience. Analysts might ask: 'where does this task fit into the work, and where does the work fit into the experience?' Designers might consider the relationship between the functionality of this mobile phone to that provided by other mobile phones, a BlackBerry, an iPod and a USB key. And managers may perform cost-benefit analyses of providing a PDA to staff in the knowledge that time-slices of use will be devoted to personal, entertainment and social interactions.

This holistic approach is novel, complex and dynamic and so an evolutionary approach is recommended. Such an approach can build on understanding the way that users are currently appropriating mobile technologies (Carroll et al. 2002; Makela and Fulton Suri 2001) and the ways that they are combining these technologies to meet their real-time situated needs. These concepts are similar to Ciborra's concept of drift although applied to information infrastructures at the individual, micro level rather than the corporate, macro level. Ciborra noted that corporate infrastructures drift in order to meet the unexpected challenges faced by organisations as their needs, capabilities and environments unfold over time. Similarly, people are constructing their own improvised information infrastructures from the materials 'to hand' – including well-tried technologies such as pen and paper, fixed and mobile devices and innovative applications and services – in order to meet their emerging, unanticipated and unstable needs.

How can we achieve this vision? Careful examination of people's experiences is essential, given the complexities of everyday life, the rapid changes in practice and the innovative appropriations common with mobile technologies. A foundation for constructing a possibility space begins with people's experiences, enhanced through investigation of the support that technology can provide (from current usage trends, appropriation practices and technology selections), coupled with awareness of technological capabilities and emerging possibilities. From here we can identify needs that are not met, gaps in satisfaction or isolated technology 'silos' (where mono-functional devices, partial coverage or incomplete data lead to frustration).

Shifting from an individual to a holistic unit of analysis is challenging: Makela and Fulton Suri (2001) suggest design principles to support people's creativity that are applicable here. Some of these principles can be applied to this vision of the personal information infrastructure through technology that is:

- open-ended. This provides multiple ways of combining and recombining physical or digital elements on the one device. This could be extended to incorporate multiple, interrelated technologies that can be included in a technology portfolio.
- social. This allows others to participate in its adaptation and use, in recognition of the social nature of mobile technology use.
- malleable. This gives users some control over the functionality.

- robust. Thus, users' exploration of the technology is encouraged and easy recovery from undesirable states is possible.
- flexible. This enables people of different skills, circumstances and needs to gain value from the technology, and
- personal. One of the key drivers of mobile technology use is the ability to adapt and customise it to users' personal needs and desires; the inability to personalise mobile phones influenced some users to reject the technology (Carroll et al. 2003).

These principles provide a foundation for an evolutionary approach to designing and implementing future mobile technologies that will support users' everyday lived experience.

In the developed world at least, we are facing the ascendancy of the 'personal needs' economy where the focus is on immediate, individual needs and where mobile, semi-engaged citizens move through multiple relationships, workplaces, educational organisations and social groups (Pescosolido and Rubin 2000). In such a world, a personal information infrastructure allows people to select and combine an individual set of devices, services and applications that draw on diverse data to support their everyday experience of the world.

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