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Unpacking user relations in an emerging ubiquitous computing environment: introducing the bystander

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Abstract
The move towards technological ubiquity is allowing a more idiosyncratic and dynamic working environment to emerge that may result in the restructuring of information communication technologies, and changes in their use through different user groups' actions. Taking a 'practice' lens to human agency, we explore the evolving roles of, and relationships between these user groups and their appropriation of emergent technologies by drawing upon Lamb and Kling's social actor framework. To illustrate our argument, we draw upon a study of a UK Fire Brigade that has introduced a variety of technologies in an attempt to move towards embracing mobile and ubiquitous computing. Our analysis of the enactment of such technologies reveals that Bystanders, a group yet to be taken as the central unit of analysis in information systems research, or considered in practice, are emerging as important actors. The research implications of our work relate to the need to further consider Bystanders in deployments other than those that are mobile and ubiquitous. For practice, we suggest that Bystanders require consideration in the systems development life cycle, particularly in terms of design and education in processes of use.
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Introduction

As the increased mobility and pervasiveness of technology moves us towards the era of ubiquitous computing so, it is argued, new socio-technical challenges will emerge (Lyytinen and Yoo, 2002; Lyytinen et al., 2004). This notion of ubiquitous computing takes two forms: the 'physical' disappearance of the technology as the miniaturisation of devices and their integration with other everyday artefacts occurs and the 'mental' disappearance of the technology where users cease to recognise its presence (Weiser, 1991; Norman, 1998; Streitz and Nixon, 2005). Proponents of ubiquitous computing herald an era of 'calm technology' where a variety of services are available on an 'any time, any where' basis through a range of heterogenous resources (Weiser, 1991; Kleinrock, 1996; Weiser and Brown, 1997; Johanson et al., 2003; Russell et al., 2005; Gellersen, 2005). However, there is also considerable disquiet regarding the pervasiveness of such technology, it need to be constantly nurtured and the potential infringements of privacy it may impose in terms of both users' temporal and physical personal space (Ciborra et al., 2000; Green, 2002; Lahlou et al., 2005).

Information systems research has increasingly recognised that individuals are tenacious and frequently pursue personal goals despite constraints imposed by work, organisations or society – the notion of human agency (Hirsch, 1997; Orlikowski, 2000; Boudreau and Robey, 2005). As mobile and ubiquitous computing is posited as liberating users, so the adoption of a human agency perspective to provide insight into the dynamics between emerging information technologies and their use in social settings seems particularly appropriate. Therefore, adopting a human agency perspective, we examine the interdependencies among mobile and ubiquitous technologies and various user groups and explore how the structures embodied within these emerging technological artefacts are being adopted, adapted and evolved in practice by them

(Orlikowski, 2000). To compliment this, we use Lamb and Kling's (2003) conceptualisation of social actors as a mechanism for analysing the complexity of user group dynamics within a case study of the UK Fire Service and Rescue service where emerging ubiquitous and mobile information communication technologies (ICTs) are being employed. Drawing on the notion of user group dynamics, our research question is: 'Do ubiquitous computing environments bring new challenges for user relations in the context of use?' We extend the concept of the user and illustrate that the advent of mobile and ubiquitous computing may fundamentally change the power relations among the intended and unintended ICT user groups.

We begin by considering mobile and ubiquitous computing and the potential implications for user relations. A discussion on the framework we have used for analysis is then presented followed by details of the research approach that was taken. We then present an interpretation and discussion of the field data. After this, the conclusions from the study and its implications for research and practice are given.

Background

Historically, there has been a tendency to assume that the ICT artefact is a self-contained entity that is affected and affects the social setting in which it is deployed (Orlikowski and Iacono, 2001). Specifically, early structurational models have suggested that, during the socio-political process of technological development, rules and resources (or 'structures') are embedded within the technology (Orlikowski, 1992; DeSanctis and Poole, 1994). However, this notion of 'structure' assumes technological stability and that the rules and resources exemplify recurrent social practice, this notion disregards empirical evidence that has shown that as the technology meshes with its social context of use, so humans appropriate technologies in new ways, transposing new meaning and purpose onto the said technology (Orlikowski, 2000; Boudreau and Robey, 2005; Lamb and Sawyer, 2005). Indeed, it is argued that a more useful approach, especially for emerging technologies is to recognise the dynamic nature of such technologies, the recursive and incremental nature of user interaction, and instead focus on: 'what structures emerge as people interact recurrently with whatever properties of the technology are at hand' (Orlikowski, 2000: 407). Hence, the dominant rational models based on the principles of technological determinism that have been prevalent in the majority of social analyses of computing have more recently been superseded by a range of less deterministic theories, for example, those utilising Institutional Theory (Avgerou, 2000; Butler, 2003), Structuration Theory (Orlikowski, 1992, 2000; DeSanctis and Poole, 1994) and the Social Shaping of Technology (Howcroft et al., 2004) all of which accommodate consideration of human agency, social interpretation and user appropriation and enactment as explanations for the plethora of contradictory outcomes from the use of technology in organisations.

In this section, we provide an overview of user relations within mobile and ubiquitous computing to date highlighting how new structures and opportunities for agency can emerge and co-exist with, or replace, those already in place. To provide theoretical support for analysing the dynamics between various user groups and mobile and ubiquitous ICTs, we refer back to the notion of human agency and use Lamb and Kling's (2003) conceptualisation of the user as a social actor to guide the interpretation of our findings. In doing this, we see mobile and ubiquitous ICTs as malleable, in that, while they may be inscribed with a particular structure, they are appropriated in situ as they are enacted by various user groups. As applied to our study, this lens allows us a richer understanding of how social actor characteristics, combined with a recognition of human agency and the particular features of mobile and ubiquitous computing artefacts may have implications for user relations, particularly in terms of surfacing new perspectives on user groups.

Mobile and ubiquitous computing: The need for a focus on user relations

As Arnold (2003) suggests, mobile and ubiquitous technologies have a paradoxical, Janus-faced quality that allows the user to be simultaneously 'close and distant', 'private and public', 'busy and available' or, as Ciborra et al. (2000) suggest, the 'hospitable host' constantly nurturing the technology in order to ensure a successful relationship. For example, in many working environments the advent of mobile technologies is creating 'interaction overload' (Kleinrock, 1996; Ljungberg and Sorensen, 2000) and mobile workers may actually have less control over the management of their work, experience more interruptions or become addicted to the technology, as witnessed by many users' constant desire to consult their technology (Kristoffersen and Ljungberg, 1999). The use of mobile technologies in public spaces may also change the relationships between public/private and 'the virtual and the real' (Kakihara et al., 2002; Middleton and Cukier, 2006). Indeed, the format, timeframe, mobility of the tasks possible in such environments and the nature of the interactions taking place all point to user relations issues (Olson and Olson, 2000; Wiberg and Ljungberg, 2001; Sørensen and Pica, 2005). Furthermore, as with other technologies, users are beginning to interact with these new and emerging artefacts in different and unconsidered ways regardless of how they are controlled or directed, the concept of human agency means that users will 'tinker' with them, technological drift will occur, new users and uses will emerge (Orlikowski, 2000; Ciborra, 2002). However, to date, very little effort has been expended on discussing the user relations issues associated with such socio-technical arrangements, and even less on explicitly differentiating among users and the social structuring of their agency.

Within information systems, the literature on Primary Users, those who interact with ICTs directly, is well developed. However, other user roles are less well defined. Indeed, although Russo (2000) identifies that more diverse groups of individuals are being drawn into information systems projects, and Keeble and Loader (2001) call for the involvement of wider society in the design of computer systems, the matter has yet to be taken up further in any depth. The notable exception is the earlier work of Friedman and Cornford (1989), who explicitly identify Secondary Users as a group, those who are affected by an

information system but who do not come in direct contact with it.

In the mobile computing field there have been numerous studies on Primary Users, for example on the actual mobility and freedom that mobile technologies allow (Dahlbom and Ljungberg, 1998; Ljungberg and Sorensen, 2000) and on the erosion of control over the working environment (Kristoffersen and Ljungberg, 2000; Wiredu and Sorensen, 2006). There are also a limited number of studies that point to the presence of other user groups, for example transferring from manual to technology-based systems causing users to disengage from the data (Heath and Luff, 2000), and 'stranger' groups engaging with technologies that are imposed on them, the main studies in this area being on third-party reactions to mobile phone conversations (Weilenmann and Larsson, 2002; Monk et al., 2004). As these emerging studies have begun to illustrate, the enactment of mobile and ubiquitous technologies can change the dynamics among intended and unintended user groups and it is this issue that we contribute towards. From previous work, we draw on our definitions for Primary and Secondary User groups (Ferneley and Light, 2006):

Primary Users: Those who are intended to interact directly with the technology, they input data, manipulate data and may consume the output.

Secondary Users: Those who are not intended to interact directly with the technology but are intended consumers of the output.

Conceptualising the use of ubiquitous computing

There is a growing recognition that the traditional view of the user is a little 'thin' and that, in practice, users interact, often simultaneously, with multiple ICTs, have varying expectations of the technology and assume a range of roles with a variety of other people in complex environments and that therefore a more socio-technical stance should be employed (Nygaard, 1986; Suchman, 1987; Mumford, 1991; Karsten, 1995; Howcroft et al., 2004). Indeed, some authors have rejected the entire notion of user. For example, Dervin (1989) prefers to consider those who interact with ICTs from the internalised perspective of the user rather than the external perspective of the observer and considers users in terms of their communication and information seeking behaviours. Similarly, Lamb and Kling (2003) question the concept of user arguing that the traditional cybernetic models of the use of ICTs do not consider context and furthermore that the user does not perceive themselves as such but rather see ICTs as tools that support their wider interactions and may have differing perspectives on the purpose of the ICT (Karsten, 1995). To support this view, Lamb and Kling offer the alternative concept of a 'social actor' who is constituted through the interplay between the dimensions of: affiliations, environments, interactions and identities. Affiliations are the networks of relationships that link an organisational member to their industry and associated national and international networks. With reference to the individual social actor, any affiliations they engage in are both them representing the interests of the group or organisation they are part of and, embedded within, which are also their own personal interests. Environments are the ethical and regulatory framework within which the organisation must, or chooses to, operate. Environmental issues can be imposed by legal constraints but may also be as a result of organisational formalisation or industry wide adoption of specific ICT. Interactions are the information exchanges that take place; typically organisations have a prescribed interaction style that is deeply embedded within their culture. Identities are the notion of 'self' whether at individual, group or organisation level that the interactions generate. For example, the ICT interactions that result in the development of a departmental electronic presentation can be viewed as a computerised notion of the department (or group's) 'self'.

Lamb and Kling's conceptualisation provides a useful structure for exploring the milieu of ICT interactions that social actors engage in. Like Lamb and Kling, we recognise that the atomic user model is insufficiently rich for exploring human/technology interactions and that users should not be treated as a homogenous, decontextualised group. Thus, we propose that the tenets of the social actor conceptualisation can be used to shape contextualised categories of users and use Lamb and Kling's framework to explore mobile and ubiquitous computing user relations with reference to the various contextualised user (or social actor) groups.

Research methodology

To examine user relations from multiple user perspectives requires an understanding of the social and contextual relationships that influence the organisation, there can be no single explanation of success (Hirschheim et al., 1996). Our epistemological assumptions are that no individual account of social reality can be proven correct. One approach to gaining such understanding (or 'rich insight'), particularly where the phenomena cannot be studied outside of the context in which it occurs, is the case study and the principle of generalisation from empirical statements to theory (Walsham, 1993; Klein and Myers, 1999; Lee and Baskerville, 2003). The case presented here being a UK Fire Brigade, which is forging a path towards ubiquitous computing by trialling various technologies that allow access to information 'anytime-anywhere' and also to enable the capture of information 'in situ' for later use and reflective learning. Similar work on the use of ICTs in the emergency services has been conducted by Brigham and Introna (2006) who use Ciborra's (2002) notions of hospitality, care and Gestell to explore the adoption of mobile data systems by the fire service on the hospitality, by Nulden (2003) on facilitating police patrol mobility via mobile ICTs, by Landgren (2005) on sense-making en route to fire incidents, by Sørensen and Pica (2005) on task/technology fit in time and safety critical work within the police service, by Allen and Shoard (2005) on information overload and the use of Blackberries by senior police officers, and by Tapia and Sawyer (2006) on American police officers access to criminal justice and law enforcement databases via public wireless networks.

Data collection

These findings are part of a wider study being conducted into the fire service personnel's receptiveness and attitudes towards new technologies and their use in supporting

information dissemination and knowledge management. The fire brigade studied is one of the largest in the UK consisting of approximately 2700 staff of which 400 are support staff. The Brigade has 123 operational watches. The average age of a fire officer was 42 and it is not uncommon for watch members to have worked together for 15–20 years. As fire fighters rely on each other for their personal safety, and, as at operational level the organisation is structured around watches, a strong notion of 'family' results. There are tight bonds between individuals and a strong sense of 'can do' or willingness to help.

Due to health and safety issues, the fire brigade we were working with would not allow us to collect first-hand data from live incidents. Therefore, interviews and focus groups were conducted between July 2003 and July 2005. To date, 14 interviews have been conducted with middle and senior management and 24 out of 123 watches have participated in focus group sessions. Each participating watch consisted of between seven and 15 male fire officers. The sessions lasted between 2.5 and 5 h, 21 out of the 24 sessions were recorded and the collected data amount to over 120 h of transcribed discussion. Additionally, a senior member of the fire service attended the majority of focus group sessions. The focus groups were aware that he was a member of the fire service whose purpose was to act as a necessary translator due to the highly technical and acronym-ridden nature of the organisation. He was not usually known to the watch, did not engage with the focus group discussion unless asked to and was dressed in civilian clothing. Each focus group was attended by two or three researchers, one researcher led the session while the other researcher(s) acted as scribe noting inflection, body language and group dynamics, they also supported the facilitation when the need arose.

Data collection used a storytelling approach (Denning, 2000; Snowden, 2002), guided by Myers (1997) assertion that good interpretive research should present multiple viewpoints of those involved and their different problems, a number of people contributed to the scenarios, scenarios were cross checked with other staff who were present at the incidents and our interpretations were re-presented back to them. Thus, we believe we have an intersubjectively agreeable and plausible set of accounts. From 102 scenarios produced, 58 included elements of computing that may move towards ubiquity including the use of mobile phones, GIS or GPS systems, onsite databases, remote sensors and mobile plasma screens.

While observation of the scenarios would have been insightful particularly because the interactions of interest to this research are, by their very nature, highly contextualised, the use of the interview and focus group for data collection also had significant merit. The regimented nature of the fire service and the various interactions meant that, while from an observational perspective the fire officers may appear to engage with the various technologies, underlying rationales and motivations for the style of interaction would only be surfaced via discussion. Perhaps the ideal would have been a combination of observation, interview and focus group sessions however, as observation was not possible, the richness of the storytelling approach employed during data collection provided a mechanism for revealing the layers of perception that form belief systems and attitudes within the organisation while the generation of collective stories, in their creation, imparted new knowledge among the contributors while freeing stories from the bounds of the individual raconteur or the bias of nostalgia.

Data analysis

We see data collection and analysis as an intertwined process and thus this section is somewhat artificially divided from the previous one. The initial intention of the study was to examine user relations in ubiquitous computing environments with a particular focus on the often overlooked Secondary User and, by necessity, their relation to Primary Users. During the focus group discussions, drawing upon the principles of the hermeneutic circle and contextualisation (Gadamer, 1975), we were able to identify different users and user groups and their role in various fire service incidents. In further cognisance of Klein and Myers' principles of dialogical reasoning and multiple interpretations, these were continually thematically analysed and revised against Lamb and Kling's constructs of affiliations, environments, interactions and identities and by explicitly considering 'the technology' and the groups that directly/indirectly interacted with it in each given scenario, whether they were intended to or not. As data collection and analysis progressed it became clear that a further group was present that did not fit the 'intended user' categories of Primary or Secondary User. Unintended actors such as the crew in fire engines and various members of the public emerged from the stories generated in the focus groups. We deemed these a particularly important group that needed considering in user relations discussions, especially, although not exclusively, in ubiquitous and mobile computing projects. Thus, we pursued this line of enquiry further, soliciting further examples and, through analysis, the notion of the Bystander began to emerge.

Case studies

In this section, we look at case examples of three technologies that were being trialled within a vision of moving towards ubiquitous ICTs within the context of fire service incident response. In all cases, the software utilised was mature standard package applications that had been successfully adopted in other domains, the fire brigade under study had been tasked by the UK Fire and Rescue service to test the various applications' suitability for use with the context of the fire service. Within each case there is an introduction to the technology and its context of use. Then, the case is thematically presented based upon the analysis of the data vis-à-vis the emergent user group categories and Lamb and Kling's four-dimensional social actor conceptualisation, the empirical data points are labelled with Lamb and Kling's theoretical constructs of affiliations, environments, interactions and identities. A within-case analysis is summarised in a table at the end of each case study.

Case 1: Are they lost? – The use of incident-based traffic modelling software

This incident occurred in a city centre location. The brigade was called to a welder's van where oxyacetylene cylinders, which are highly flammable, had overheated and were in

danger of exploding. A 200 m exclusion zone around the cylinders was made resulting in the rail and tram networks, a number of arterial roads and a major car park being cordoned off. Professional members of the public who work within the city centre were the car park's main users. Five fire engines were deployed and all fire fighters located close to the cylinders wore protective clothing in case the cylinders exploded. From the general public's perspective there appeared to be nothing happening. A plasma screen was erected, linked to a laptop using an application that allowed them to model alternative traffic flows dependent on which roads they chose to close. Previously such models would have been generated by the control office that would then communicate possible closure scenarios to the incident ground that would then decide which closure option to implement. The aim was to give a visible interpretation of the problem to all fire service personnel, see Table 1, section 'Interactions' (Interactions (1.1)).

Primary Users

The intended Primary Users were senior fire and police service personnel who could work collaboratively by modelling the exclusion zone and a variety of road closure options to reduce animosity and find a mutually agreeable road closure solution (Affiliations (1.5)). Senior incident-based fire service personnel commented on feelings of empowerment and enhanced professionalism as the use of

Table 1 Summary of Case 1

User groups		
Primary user	Secondary user	Bystander
Lamb and Kling's social actor theoretical constructs		
Affiliations		
1.8: Perceived improved upward and downward communication 1.5: Technology as a collaboration enabler	1.11: Devolution of technology relegates previous primary users to a secondary user or bystander role	1.11: Devolution of technology relegates previous primary users to a secondary user or bystander role 1.16: Lack of understanding of the role of the technology in the scenario 'toy' rather than necessity
Environments		
1.17: Regulatory framework is simultaneously devolved and centralised via access by senior officers to traffic flow data 1.19	1.14: Culture of the role does not expect to see choices or information	1.14: Nature of the role does not expect to see choices or information 1.15: Data availability and bystander interpretation enabled (although not necessarily improved) decision making
Interactions		
1.1: Expected outcome to facilitate data transfer between geographically dispersed primary users 1.7: Improved decision making 1.9: Perceived rapid transfer of information to operational personnel	1.1: Expected outcome facilitate data transfer from primary users to geographically dispersed secondary users 1.12: Intended secondary users can utilise technology to generate alternative models and subsequently 'inform' primary users 1.13: Information overload, especially because, as secondary users, the same attention is not paid to the specifics, rather it is 'interest' value so all changes of state are not noted. Moves recipients to a bystander role	1.15: Data availability and bystander interpretation enabled (although not necessarily improved) decision making
Identities		
1.6: Empowerment, enhanced professionalism 1.10: Higher levels of primary users emerge as technology gives new users access to the incident ground, relegation of primary users to secondary user status	1.15: Notion of 'self' as instruction rather than information recipient	1.18: The general public, in their interpretation of the data on the plasma screen, take on a secondary user role, essentially that of an operational member of the fire service

the technology enabled them to make informed decisions at the incident ground (Identities (1.6), Interactions (1.7)). They further perceived that these decisions, and indeed the rationale for them, had rapidly transferred, via the plasma screen, to operational personnel (Affiliations (1.8), Interactions (1.9), Environments (1.17)).

However, although the services reached a collaborative decision on road closures, after the road closures had been in place for approximately half an hour the incident ground personnel were contacted by more senior officers and 'advised' to open certain roads as there was serious traffic congestion (Identities (1.10), Environments (1.17). It transpired that the remote senior officers had been using the same modelling software to generate alternative models and that, prior to devolution of the technology to the incident ground the control office would have generated a whole range of road closure permutations but only transferred their perception of the 'best' two or three options (Affiliations (1.11), Interactions (1.12), Identities (1.10)). By devolving the technology to the incident ground the incident ground personnel had indeed become empowered Primary Users, however in this scenario, when that empowerment resulted in an outcome that was not agreeable to remote management the incident ground personnel were effectively overruled and remote management assumed the role of Primary User.

While control of an incident ground always resides with a geographically present officer (usually the most senior officer on the ground) in this incident, while command of the actual incident remained with the physically located senior officer, the decision-making process that they engaged in with the aid of the mobile technology was being overridden by a remote Primary User who was also modelling the scenario. The senior officer at the incident ground effectively became a Secondary User.

Secondary Users

While the models were highly useful to senior personnel the additional aim of informing the incident-based operational staff (intended Secondary Users) met with mixed success. As multiple models were displayed on the plasma screen Secondary Users became confused as to which model was going to be implemented (Interactions (1.13)). The first model that was displayed was widely assumed to be the 'final solution' so, while no Secondary User attempted to implement the model as they had not been directed to do so by a more senior officer, they still had an expectation that, in time, the first model displayed would be implemented and therefore mentally prepared themselves. As a result, there was considerable disquiet when a second and then subsequent models were displayed, Secondary Users ceased to understand the rationale for having the screen there, they were not used to seeing 'options' but, due to the highly regimented nature of the fire service, expect to be given clear instructions that they should not deviate from (Environments (1.14), Identities (1.15)). Additionally, a number of fire officers stated that they could not interpret the model or expressed disbelief at the proposals generated by the modelling software. Different symbols and notations were used by the modelling software to represent various features including closure of transport lines, density of traffic flow and funnelling points (potential blockages). The modelling software also produced models that the fire fighters, with their high level of context knowledge, disagreed with. For example, the incident occurred in an area of urban regeneration and there were a number of topology changes that had occurred since the software had been released that resulted in a loss of credibility for the software as it began to recommend the closure of roads that had subsequently been built on or no longer went anywhere. Moreover, the shift in operational staff being shown options was a dramatic change in culture. Historically, this group expected, and were expected to, follow orders, not be involved in the decision-making process. Thus, the combined effect was that they could not understand the model, disagreed with the model or did not want to take responsibility for the model's implementation, they disengaged with the technology and moved to a Bystander-like role that was consistent with the organisational system in use before the introduction of technology (Interactions (1.13), Identities (1.15), Environments (1.14)).

Emerging Bystanders

The presence of the plasma screen attracted the attention of the general public, many of whom were attempting to gain access to the car park that was inside the exclusion zone. While senior management believed the plasma screen gave an appearance of professionalism a number of members of the public regarded the technology with amusement (Affiliations (1.16)):

> members of the public couldn't work out what the screen was there for. I heard two people joke that it was a bloody great big A to Z [road map] and didn't we know where we were? – Officer.

Of more concern was the interpretation that several members of the general public made of the data. The traffic flow model displayed on the screen clearly showed the location of the overheated oxyacetylene cylinders, which was represented by a large red icon. Several members of the public made a judgement of the location of their cars relative to the cylinders and, despite repeated requests by fire fighters not to enter the exclusion zone, decided to cross into the zone and retrieve their cars (Interactions (1.15), Environments (1.14, 1.15)). Effectively they moved from a Bystander to a non-sanctioned Secondary User role and, using the displayed data, made, what they believed to be, an informed decision to 'cross the line' (identities (1.18)). A summary of the within-case analysis is presented in Table 1.

Case 2: Shut up, I'm driving – The GPS trial

The second case concerns the trialling of a global positioning system (GPS) to support the journey to incidents. While fire station personnel usually have detailed geographical knowledge of their local area, there are increased requirements for fire crews to provide cover for areas that they may not be so familiar with. The GPS was therefore intended to give support rather than direct instruction. However, despite repeated reassurance, the fire crews who took part in the focus groups perceived the GPS

to be an intervention rather than an aid (Identities (2.1)). The GPS was also being used to provide an accurate view for the control office of the fire engine's journey between mobilisation and attendance at the incident ground (Interactions (2.2)). Unlike the previous scenario details presented here are an amalgamation of a number of different incidents involving the use of GPS.

In the focus groups, a major physical concern regarding the GPS was not the use of the technology but its safe storage so that the fire fighters could disengage from it confident in the knowledge that it was safely stowed on board and would not 'fly around the cab' if they had to travel at high speeds. Furthermore, it became evident that there was much informal communication between fire engine teams regarding the most appropriate place to store the GPS while travelling to an incident (Affiliations (2.8), Interactions (2.8)). There was also considerable discussion regarding the GPS's lack of awareness of context, that the system did not contain data about the 'nature' of roads – the extent of double parking, traffic calming measures or household waste collection routes (Interactions (2.9)).

Primary Users

The aim had been for the Primary Users to be the fire fighter responsible for providing direction to the driver. In fact the GPS system reduced their professionalism and opened them up to some ridicule (Identities (2.1)). There was voracious debate each time a navigator either altered their route decision as a result of a suggestion made by the GPS, in which case the debate tended to focus on the navigator's 'submission' to the technology or when a navigator overrode the GPS's proposed decision, in which case the debate concerned the navigator's confidence in overriding the 'correct' route (Identities (2.4), Interactions (2.1, 2.5)). Also, there was derision in the fire engine over the speed with which the system could identify where they were (Affiliations (2.6), Identities (2.1)):

> It's too slow, you've turned and decided where you are going before it's decided where to go, I'd rather have Fred giving me a hard time than what's happening right now – it's coming up with ideas and you know that half the pump is thinking 'no turn left now' it was easier when we just had me and Steve sorting it – Driver.

In discussion with the navigators it became apparent that they found these debates stressful and made them question their decision whist at the same time they felt the need to present a somewhat 'aggressive' stance against erosion of their professionalism by the technology, in effect they were fighting to maintain their decision-making autonomy (Identities (2.1), Affiliations (2.6)).

Secondary Users

The driver was a key Secondary User of the GPS, while not engaging directly with the technology the aim was for them to be 'informed' by it (Interactions (2.2)). However, several drivers discussed the stress that the overload of information supplied by the GPS caused (Interactions (2.10)). Specifically, when directions were supplied by another fire fighter there is a tacit understanding based on possibly years of working together regarding when directions may be required (Environments (2.11)). By the technological intervention of the GPS the fire fighter providing directions began to supply significantly more, frequently superfluous, information. In effect the GPS 'deskilled' the navigator (Interactions (2.1), identities (2.1)).

The other key Secondary User group were Control. By implementing the GPS Control were able to continually monitor the location of fire engines while they were in transit and did not have to rely on radio communication (Affiliations (2.12, 2.13)). This had been perceived as a key benefit of the implementation; however, when the system was released it immediately became apparent that the monitoring of the journeys was shifting the power base towards Control (Affiliations (2.13), Environment (2.11)). Historically, officers in charge of incidents had arrived at an incident and spent a short length of time, possibly only seconds, assessing the situation before reporting to Control that they had arrived. With the advent of the GPS this short assessment space was lost, Control were immediately aware that the crew had arrived at the incident and began requesting feedback. Indeed a number of officers reported incidents where heated exchanges with Control had ensued as they were demanding instant feedback rather than allowing the on-site team time to assess the situation (Identities (2.1), Affiliations (2.6, 2.12)). Effectively, Control were using the GPS as a surveillance mechanism of which they were the Primary User. Furthermore, Control began to record incident journey plans as the technology enabled them to capture this information. Although few incidents were recorded of Control querying routes taken there was considerable discussion on the possible future ramifications of Control holding such records (Interactions (2.2)). The 'purpose' of Control's Secondary User role was not clearly disseminated.

Emerging Bystanders

The chief Bystanders in this scenario were the crew members who were not driving the engine or responsible for directing the driver. However, the focus groups retold of repeated incidents where crew members became very vocal about the GPS's proposed routes, effectively turning them from disengaged Bystanders to engaged Bystanders who were causing disruption in the fire engine, hence the informal decision that was reached – not to use the technology when on the way to an incident (Affiliations (2.14), Interactions (2.5), Environments (2.15)). An important point here is that they were not Secondary Users as the output of the GPS was never intended to be used by them, only by the navigator. A summary of the within case analysis is presented in Table 2.

Case 3: Listen to me, not the laptop – The hazardous chemicals incident

In incidents where hazardous chemicals are involved, the usual procedure was to contact Control and request advice from available peers who had undertaken hazardous chemicals training. As part of the mobile computing trials, a hazardous chemicals procedures database had been loaded on to a laptop, the aim being to bring specialist

Table 2 Summary of Case 2

User groups		
Primary user	Secondary user	Bystander
Lamb and Kling's social actor theoretical constructs		
Affiliations		
2.6: Technology perceived as replacing or breaking down the human network or individual's autonomy 2.8: Resistance to technology operates as a 'bonding' aid to disparate groups 2.12: Technology allows new primary users or an 'upward shift' in primary user 2.13: Dichotomy between technology appearing to empower primary users and in reality introducing new, covert, primary users	2.6: Technology perceived as replacing or breaking down the human network or individual's autonomy 2.8: Resistance to technology operates as a 'bonding' aid to disparate groups	2.14: Technology allows bystanders to engage in discussion, changes team dynamics, causes derision in the group, information no longer on a 'need to know' basis
Environments		
2.11: Tacit understanding of 'terms of engagement' disrupted by technology	2.11: Tacit understanding of 'terms of engagement' disrupted by technology	2.15: Tacit understanding of 'terms of engagement' disrupted by technology
Interactions		
2.1: Technology usurping professionalism 2.8: Technology 'war stories' operate as a 'bonding' aid to disparate groups 2.9: Technological limitations cause disengagement with the technology	2.2: Data transfer empowering secondary users 2.5: Data transparency empowers secondary users 2.8: Technology 'war stories' operate as a 'bonding' aid to disparate groups 2.9: Technological limitations cause disengagement with the technology 2.10: Information overload causes stress	2.5: Data transparency empowers bystanders
Identities		
2.1: Technology usurping professionalism 2.4: Technology allows secondary users or bystanders to question the decision making of the primary user – transparency of the data	2.4: Technology allows secondary users or bystanders to question the decision making of the primary user – transparency of the data	2.4: Technology allows secondary users or bystanders to question the decision making of the primary user – transparency of the data

knowledge to the incident ground (Affiliations (3.1), Interactions (3.2)).

In this scenario, the brigade was called to a hazardous chemical incident at a small chemical manufacturing company. They were greeted by the chief chemical engineer, who explained that the fire was in a secure chamber. The hazardous chemical was in an inner flask that was being cooled and not in immediate danger of overheating, what was on fire was corrugated paper in an outer chamber that could be accessed by opening a door to the secure chamber and extinguishing the fire with water. The chemical engineer was confident that the chemical was safe but had called the fire brigade in accordance with the company's health and safety policy. His expectation was that the fire officers would enter the building and extinguish the fire with water and that it was a simple process. However, the hazardous chemicals procedures database on the laptop held a different recommendation; due to the hazardous nature of the chemical it recommended full breathing apparatus, decontamination units (showers) and a specific type of fire extinguishant (Affiliations (3.3, 3.4), Interactions (3.5)). When this was reported back to Control a more senior fire officer was dispatched to the incident and the 'at incident' fire fighters were told to wait for instructions (Environments (3.6)). As a result, the chemical engineer lost his patience, went into the building and put the fire out himself (Identities (3.7), Affiliations (3.8)).

Primary Users

The Primary Users of the database were the fire officers at the incident. However, the presence of the laptop effectively made them disengage with the practical 'common sense'

approach to the incident, which was to listen to the expert who was present and instead they relinquished control of the situation to the technology (Affiliations (3.4)). At the informal, watch based, debrief the common consensus among the fire fighters was that, if the laptop had not been present, they would have accepted the expertise of the chemical engineer, confirmed to Control that it was a paper fire and swiftly put it out (Identities (3.9)). On informing Control, who had access to the same data but could not apply that data within context, the incident based fire fighters effectively became Secondary Users, their decision-making capabilities were removed, the technology deprofessionalised them (Affiliations (3.1), Identities (3.9)):

> there we all were putting on full breathing apparatus and the chemist guy is going in and out of the building in sandals and a t-shirt, I mean this guy deals with this stuff every day, we looked like right pillocks – Officer

Secondary Users

The secondary users of the laptop were Control. Because of the regulation embedded within the software, control benefited from the outputs generated by the software in terms of the influence this had on the decision-making processes of the fire officers at the incident. The software 'told' them to get Control involved (Affiliations (3.12), Environments (3.6), Interactions (3.15)). As a result, Control were empowered and were able to stipulate that the set procedures be followed (Identities (3.14), Identities (3.16)).

Emerging Bystanders

The key Bystander was the chemical engineer. As soon as he had viewed the database output and saw the recommendations he made the decision to extinguish the fire himself, by using his personal expertise and contextual knowledge he made a decision that was contrary to the fire brigade's recommendations (Environments (3.13), Interactions (3.10), Identities (3.7)). The other Bystanders at the incident were members of the company's workforce who had evacuated the building. As it became obvious that the fire brigade were not going to follow the chemical engineer's recommendations, various members of the workforce began to crowd round the laptop to see the hazardous chemicals procedures database's recommendations (Environments (3.11), Affiliations (3.8), Interactions (3.10), Identities (3.9)). The Bystanders then began attempting to influence the fire officers' strategy (Environments (3.11)):

> some of the lab guys came over and were telling us to stop looking at the computer and listen to the chemist, he'd got 10 years service or something and these blokes just kept saying 'will you listen to him, he knows what he's talking about – Officer

The researchers have since followed up the incident with the chemical company and, while their health and safety procedures still comply with regulations, they have been changed so that if such an incident occurred again the fire service would not immediately be called (Affiliations (3.12), Environments (3.11)). A summary of the within-case analysis is presented in Table 3.

Discussion

Our cases bring to the fore the importance of considering diversity within and among user groups. We argue that mobile technologies have an emergent and evolving structure that encourages various user groups to appropriate the technologies, circumvent the inscribed ways of using the technologies and construct new structures as they iteratively interact with said technologies. Using Lamb and Kling's (2003) conceptulalization of the user as a social actor immersed in the milieu of social and technical arrangements, we appropriated their framework to analyse our case data focusing on the four social actor dimensions of affiliations, environments, interactions and identities. Unlike Lamb and Kling (2003) who tend to focus on the social actor as situated within the organisation, our work extends the notion of social actor to those in a Bystander role both internal and external to the organisation.

In popular parlance, the notion of the Bystander is quite well known and exemplified by the Yiddish term 'kibitzer', one who sits at the bridge table, but not as a player, merely to observe the game. In social psychology, the notion of the Bystander has long been recognised (Latané and Darley, 1970; Pettijohn, 1992; Petty and Cacioppo, 1996) however, within information systems their presence has received scant attention. Much of the work on bystanders stems from Latané and Darley (1970) original model of bystander intervention, which proposes that a bystander's decision on whether to engage in a situation is founded on three social psychological processes – social influence, audience inhibition and diffusion of responsibility. Latané and Darley's work focuses on emergency situations and proposes that the number of people present and the influence of those people on an individual determine if the individual is likely to get involved. Dovidio et al. (1991) extend this concept by arguing that a bystander's identity is linked with a concept of 'we-ness' (defined as 'a sense of connectedness or categorization of another person as a member of one's own group' (p.102)), which determines whether they are willing to engage based on whether the bystander perceives themselves to be part of the group they are immersed in, even if this is a 'stranger' group in a public setting. Furthermore, numerous studies have built on Latané and Darley's principle of diffusion of responsibility showing that the more bystanders that witness an emergency the less responsibility an individual is prepared to take, in a 'stranger' group individuals' may be reluctant to be identified as an individual who can take the lead, or dichotomously a specific bystander can remain anonymous while taking the lead (c.f. Latané and Nida, 1981; Pettijohn, 1992; Petty and Cacioppo, 1996).

The social psychology literature on Bystanders is a useful starting point for considering the emerging dynamics between bystanders and mobile technologies. It is their role and influence as a distinct category of user, particularly with reference to the enactment and appropriation of differing mobile and ubiquitous ICTs and the embodied and emergent structures associated with them that we wish

Table 3 Summary of Case 3

User groups		
Primary user	Secondary user	Bystander
Lamb and Kling's social actor theoretical constructs		
Affiliations		
3.1: Technology replacing or changing the structure of affiliations 3.3: Technology replacing external affiliations	3.12: Technology has a long-term effect on affiliations, change in the affiliation structure and responsibilities	3.4: Technology trusted over obvious external expertise 3.8: Transparent decision making process weakens the affiliation, the bystander feels empowered to act, the 'mystic' of the primary user's decision making process is lost 3.12: Technology has a long-term effect on affiliations, change in the affiliation structure and responsibilities
Environments		
3.6: Explicit knowledge results in formalised procedures	3.6: Explicit knowledge results in formalised procedures	3.11: Exposure to the decision making process makes the employees of the chemical company less prepared to accept the autonomy, leadership and direction of the primary user 3.13: Regulatory framework embedded in the software in the laptop results in the chemical engineer taking matters into their own hands
Interactions		
3.2: Automation of knowledge transfer 3.5: Explicit technology-based knowledge overriding tacit knowledge	3.15: Access to decision-making data and process empowers control	3.10: Access to decision-making data and process empowers those at the chemical company
Identities		
3.9: Technology usurps professionalism 3.16: Control maintains dominant position over Ffire Ffighters at the incident.	3.14: Control maintains position as regulators of professional activity and public safety	3.7: Relegation of decision making to technology allows decision-making process to become transparent and empowers those at the chemical company

to highlight. We provide the following definition of the Bystander, which emerged from the research study:

Bystanders: Those who are exposed to (Primary and Secondary User interactions with) a given technology and its outputs, either consciously or subliminally but are not intended to react or respond to this.

In particular, we note how Bystander relations with other user groups, and those institutions deemed technological and social, are potentially subject to socially structured human agency resulting in their affirmation and deinstitutionalisation. This can take the form of changes to, or the reinforcement of user affiliations, environments, interactions and identities.

In our cases, the enactment of mobile technologies shaped the value of such affiliations leading to the affirmation, modification and destruction of those already in existence as well as contributing to the creation of new ones. For example, the GPS trial led the Primary Users, Secondary Users and Bystanders to join forces in rejecting the technology and, in the laptop case, the fire fighters and the general public shared a sense of frustration and diffusion of responsibility, which ultimately led to a member of the general public overcoming their inhibitions (in line with Latané and Darley 1970) observations on the social psychological influences on Bystanders) and, with a sense of exasperation, take action. In these cases, the affiliation with control was either weakened or broken. Moreover, at the traffic flow modelling incident we can see how the operational fire fighters who were intended as Secondary Users, shifted to an 'unintended' Bystander role based on the required interactions and the implications for their identity in the work environment. Additionally, the affiliations with the intended Bystanders at the incident, the public, are shown to be important. First, the fire fighters were perceived to be relating to the technology not the situation at hand. Second, their relationship to the

technology was seen as detrimental to the situation, undermining their professionalism and social influence (again as in line with Latané and Darley1970) and effectively encouraging a Bystander, a member of the public with no sanctioned role, to take an opportunistic decision that they could retrieve their car safely.

A second key theme of our analysis concerns the enactment of mobile technologies and their environment. We show that while ubiquitous and mobile computing use can allow for grass roots environmental change, it can simultaneously afford increased top-down regulation that can be actively implemented very rapidly. Thus, it affords new opportunities for human agency and the creation of structure. For example, institutional practices collapsed, the use of the GPS 'encouraged' Bystanders to get involved in giving directions where they would not previously have done so and the use of the traffic flow modelling software in public view enabled Bystanders to change to an un-sanctioned role, make their own assessment of the situation and question the professional judgement of the fire fighters. Similarly, exposure to the laptop made various members of the public less accepting of the autonomy, leadership and direction of the fire service, in each case an unexpected outcome of the deployment of the mobile technologies resulted in the diffusion of responsibility in practice. However, environmental influences are situated in a given time and place, agency in environments is socially and historically structured. For example, the existing structure in the cab was reaffirmed as the GPS system was switched off – it did not have a chance to stabilise.

Third, our analysis of the interactions, the information exchanges that take place between diverse user groups are shown to shape user relations. Moreover, we show how the different groups flexibly interpret and mobilise such resources to achieve their ends. As we have already suggested, this might involve working with a given technology, working against it or working with others to achieve similar aims. The nature of such interactions are shown to be formal and informal, technology based and non-technology based. Thus, what we can also see is that, far from solely being a disengaged user group, Bystanders will, in an opportunistic manner, become involved in interactions even though they are not intended to be, effectively changing roles and becoming a new user group. This is evident in all the cases. Considering Latané and Darley (1970) theory of Bystanders which, although it can be applied in wider contexts, specifically focuses on the notion of interaction and can be used to examine how Bystanders, within the context of engagement with mobile technologies, may turn from a 'disengaged' to an 'engaged' stance. For example, social influences encouraged the 'disengaged' Bystanders at the traffic modelling scenario to 'engage', they perceived themselves to be able to accurately interpret the data they were presented with on the plasma screen. Similarly, the inhibitions that would usually manifest themselves in the interactions between the fire service personnel and the general public were repeatedly shown to break down when those interactions were mediated or facilitated by mobile technologies, again Bystanders perceived themselves to be empowered by their exposure to the technologies (Latané and Darley, 1970).

Fourth, our analysis supports Lamb and Kling's assertion that the identity of a user is wider than that associated with the technology being related to at the time. However, by taking a user relations perspective and being more specific about categories of user groups, we show how Primary, Secondary and Bystander groups, and the technologies they enact, are implicated in the shaping of identities. Perhaps the most prominent, and interesting aspect of our analysis here, bearing in mind our focus on ubiquitous and mobile computing, are considerations of intended and unintended formations and enactments of agency and structure. For example, although the GPS aimed to empower the navigator (Primary User) by providing technological support to get them to the incident quicker it had a disempowering effect, the navigators questioned their own judgement and other crew members similarly placed differing interpretations on the data. Similarly the fire fighters at the chemical fire began to question their professional judgement. These insights have further implications for Bystander identities. The operational fire fighters who were intended to be Secondary Users of the plasma screen felt this was inconsistent with their professional identity and were more comfortable with a Bystander position. Whereas, in the same scenario, the presence of the technology led to some members of the public actively engaging with the technology, something that had not been intended. In effect, they assumed the 'custodian of safety' aspect of the fire fighters' identity. This also happened with the chemical engineer, and to a lesser extent the employees of the chemical company in the chemicals fire case. The use of the GPS also shaped identities, in that the fire engine crew took on a collective navigator identity, the notion of 'we-ness' (Dovidio et al., 1991). Clearly, this can have implications for assessments of professionalism, surveillance and the subsequent changing of user status between Primary, Secondary and Bystander.

Conclusions

Mobile and ubiquitous computing deployments can have contradictory outcomes and there is a need to investigate this further, particularly the social implications. With this in mind, our study has attempted to shed light on user relations in such deployments by drawing on Lamb and Kling's (2003) social actor framework and explicitly contextualising the user. Moreover, we have combined this with a practice lens to surface the role of the enactment of mobile technologies in shaping user relations. Thus we conceptualise users as part of a broader context, and not just with their hands on 'the technology'. Furthermore, the technology is taken as malleable in that, while it may have a preferred application, it is enacted in situ as necessary, or, indeed, at times serendipitously.

Our study introduces a group of users new to information systems research, Bystanders, and their role in such situations. Although Bystanders have been considered outside of the information systems community, such studies do not consider the role of ICTs as we do here. In each of our cases, we identify Bystanders as users and show that they can move from a 'disengaged' to an 'engaged' role and interact with mobile ICTs in unexpected

ways. A potential consequence of this is that the affiliations, environments, interactions and identities of Primary and Secondary Users and the ICTs may be subject to change or affirmation. This is why Bystanders matter – they can make a contribution. This study therefore has a number of implications for research and practice and we discuss a few of them here.

In terms of research, we have to ask – are Bystanders specific to mobile and ubiquitous computing deployments? We think not. ICTs that people are not intended to interact with pervade our lives – consider desktop personal computer screens on the desk in your doctor's surgery or the cashier's terminal at your local supermarket. Indeed a form of 'ripple effect' may occur with bystander interactions subsequently used further down some for of 'chain' of unintended users. Therefore, further research into Bystanders in other environments would be welcome. We also may not have identified Bystanders were it not for the particular features of the emerging mobile and ubiquitous technologies that we were studying. Therefore, this research acts as a prompt to search for other insights that might be gleaned from such areas of application, especially while they are emerging and not taken for granted. Moreover, given the generalisability of the Bystander construct to other environments, further work that investigates the similarities and differences between mobile and ubiquitous computing deployments and 'traditional' ICT infused ones could be useful in surfacing other concepts and theories.

In terms of practice, perhaps the most obvious implication relates to systems development, implementation and use, and the need to consider unintended users. Analysts and designers need to work with intended users to specify and build products that take account of the presence of any potential Bystanders. This may mean building products that enable Bystanders to enact technologies, or indeed, refine products, their implementation and their use so that such potential users are excluded. For example, the ergonomics of the use of the plasma screen might need to change to ensure public safety or wider design issues may need to be considered to improve security, for example consider the case of the bystander (in the role of thief) opportunistically stealing an ATM user's pin number. However, of course, it is impossible to build, implement and use technologies that work perfectly for everyone, all the time. Therefore, given the wider user base of ICTs where Bystanders are involved, then a further implication relates to the process of (re)educating intended users and Bystanders. For example, the public would not think of climbing on a fire engine and using it to take their groceries home, yet, they were quite happy to use the data on the plasma screen to suit their own objectives. Intended users need to be aware of, and be able to manage, a wider pool of potential users. Bystanders need to use their judgement, which may of course require learning new rules.

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