Exploring the relationship between mobile phone and document use during business travel

Kenton O'Hara, Mark Perry, Abigail Sellen and Barry A. T. Brown

Abstract: Many IT companies recognise the importance of wireless communication in the development of new technologies. In order to better inform this development, this paper describes a study of mobile professionals focussing on their communication and document activities. The findings indicate the particular importance of verbal communication for these people and hence the value of the mobile phone. The study also brings to the fore the relationship between their use of the phone and their document activities. The findings have allowed us to develop a taxonomy of this relationship that provides a useful resource for thinking about design implications and new technology supporting mobile work.

Appliance Design Group, Hewlett-Packard Labs, Filton Road, Bristol, UK.
Dept. of Information Systems & Computing, Brunel University, Uxbridge, UK

KEYWORDS
Mobile phones, documents, mobile professionals, mobile technology, wireless communications

INTRODUCTION

The last five years have seen a startling boom in the uptake of mobile phone technology with sales far exceeding even the most optimistic predictions. This uptake is widespread across user groups, but in particular it has shown its value for the mobile worker. Many IT companies want to leverage this fact and develop new devices and services which will take the mobile phone in new directions, or which will exploit the fact that so many people already carry them. So, for example, we are already seeing the emergence of new kinds of data services where mobile workers can remotely access, send and receive documents and information.

The potential for combining phone use with other kinds of information-related activities is beginning to raise important questions for IT and telecommunications companies. For example, how and why should wireless communications be incorporated into mobile devices (such as PDAs) to allow people to create, display or manipulate information while on the move? What new data services might be useful to access via mobile phones? What document handling facilities should be incorporated into mobile phones? In order to answer such questions, we believe a user-centred approach is valuable in order to identify unmet user needs, and as a way of inspiring innovative design ideas for both products and services.

Our Approach

Our specific approach is to look for new design directions by studying the potential users of new technologies and their work practices. In the study we report here, we chose to look at mobile professionals and their work practices during business travel. One reason for this was that mobile professionals are an obvious target for many of the kinds of new work-related mobile devices which are being developed. But in addition, we have carried out studies of many different kinds of office-based workers over the years [e.g., 7]. We wanted to focus this time on workers on the move to find out in what way their needs are similar or different from their office-based counterparts.

In particular, this paper centres on particular aspects of the findings concerning their mobile communication and document activities (be they paper or electronic). In their reliance on talk and on text, mobile workers are no different from other kinds of workers we have studied over the years. However, as we will discuss, we found that the work practices of mobile professionals demonstrate some unique and interesting features of this relationship that office-based workers do not.

Previous Research

User-centred research of mobile work is only now really beginning to emerge as an important field in its own right. Despite the growing importance of mobile phone technology there has, to date, been relatively little research on their use with a few exceptions [e.g. 4, 8]. There have also been some important in-depth studies of mobile professionals in relation to their document activities [e.g., 1,6,]. However, there has been very little work explicitly looking at the relationship between mobile phone use and the document activities of mobile professionals while on business travel. Whittaker et al, [9] make some allusion to the role of documents as conversational resource while on the move as an interesting theoretical issue to consider but does not really develop it beyond the suggestion as an interesting area to consider for future thought. Luff and Heath [5] also present an interesting work practice example of remotely mobile collaborative work involving screen-based documents and wireless communication but again the concern of the paper is not explicitly with the relationship between mobile phone and document use.

The Study

On the basis of previous work such as segmentation studies of mobile professionals (such as the BIS study, ref), we were well aware of the diversity in the nature of mobile work, the ways in which they travel, and their documents and technology use. A pool of participants was collected from which 17 mobile professionals were chosen to provide a representative sample across a range of different mobile professions. They were as follows: Regional manager for a market research company; Corporate relations manager for a communications firm; Regional operations manager for a telecommunications company; Software sales manager; Managing director of an Italian import company; Account development manager for a major brewery; Business and sales manager for a lab equipment supplier; PR consultant; Medical research co-ordinator in a large hospital; International customer services manager for a telecommunications company; International marketing director; Civil servant (Executive Officer for Procurement); Sales and marketing manager for a software company; Production manager for a television company; Strategic Account Manager for the product support division of a computing company ; Business Development manager of a research lab; Project Manager in an e-business application department.

The study used a combination of diary techniques, interviews, and analysis of the technologies and documents used during specific business trips. This allowed us to ground the study in real activities and to use trip diaries and existing artefacts to unearth the detailed context of their document and communication activities. Another important aspect to the approach was to gather data both before and after actual business trips so that we could gain a longer term understanding of what happened during travel: what kind of preparations were made prior to travel, and what actually transpired during the travel episode. This helped to give a deeper understanding of the context surrounding the mobile professionals' activities. Details of this methodology can be found in [ref tech rep.].

FINDINGS

While the study generated a huge corpus of data, one finding which was particularly striking was the extent to which talk in a mobile context was supported by documents, and also vice-versa: document use was very often in comjunction with talk, whether it be face-to-face talk or on the mobile phone. These document-phone relationships in particular illustrate the ways in which the study participants made use of available tools and artefacts to accomplish their goals. They also show ways in which their technological resources limited what they could do, making conversation around documents problematic.

Considering each episode where both documents and mobile phones were used together, we found that the collection of episodes could be split into two groups: *docucentric* and *telecentric* interactions. Docucentric interactions were those where a document was the primary focus of attention during the episode whereas telecentric interactions were more focussed on the talk as the means of accomplishing the work. We found 5 main forms of docucentric interactions and 4 main forms of telecentric interaction which we will briefly describe:

Docucentric Interactions

Documents Triggering Phone Calls

Phone calls were sometimes triggered by the caller reading a document. In certain cases, this behaviour was necessary to the sender for the purposes of clarification:

"Sometimes it would be much clearer with a 'phone call because sometimes you find you've done six e-mails back and forth when one 'phone call would have got it all."

In this case, the phone call allowed clarification to be achieved thorough dialogue in a way that would be cumbersome through just document exchange.

In other cases, these documents were messages or queries that required a verbal response from the person being called. Often these document-triggered conversations involved a great deal of back and forth activity:

"I have a blue book that I write, it's my book that I use, my bible basically that I write everything down on and then I speak to so and so over the phone, put a pencil on something, then I have to go back to the director, my producer and then things roll on from there and then usually I'll confirm it, write down on the fax all the details of what I need and then they'll send me a fax through for costs of exactly what I've got because I quote for everything, they send you a quote through. You might have to get back to them then and saying this quote's too much and they come back and give you another quote and then finally everything's sorted."

Phone Calls to Confirm Delivery of Documents

The phone was sometimes also used to check whether a fax had been received and acted upon. This stems from the difficulty of ensuring both that the document (e.g. fax or email) had been accurately sent, and that the recipient had received it or been able to access its content. This knowledge is important to the sender: it is not enough to know that they have sent a document, but that they must also know that it has been retrieved by the recipient. Document sending when making hotel bookings is a typical instance of this: callers need to know that their booking information has been received so that when they arrive at the hotel, they do not need to worry that they have somewhere to stay.

The mobile phone was also used to draw attention to the fact that a document had been sent and needed to be looked at urgently. This was particularly important for the mobile professional receiving incoming information. For example, given that email communication was not something that

was checked on a frequent basis while away on travel[1] verbal communication over the mobile phone (including voice mail access) was a more efficient way of attracting attention to a sent document than an email message

"The mode of work these days seems to be that urgent issues get communicated through Voice mail. E-mail is less of a tool for urgent communication. Sometimes voice mail is sent referring to e-mail. No details on the telephone but it needs urgent attention. Voice mail is a more immediate contact form today… It's more accessible because you can do it from far more places geographically than you can e-mail - car, airport lounges, home, as opposed to which e-mail needs to be in the office most of the time. It's also quicker both to connect and to listen to and to respond to."

Phone Calls to Elaborate on Documents

Phone calls were sometimes used to build a context around the purpose of a document and any actions associated with it. Documents often did not refer directly to an activity, or were incomplete and required further explanation. This additional information could be easily conveyed over a telephone call. In the case of the mobile professionals, the mobile telephone was a critical technology for this purpose. The interview with the managing director of the Italian import company illustrates this:

"Often if it's a major fax, I'll call after the fax and go through it with them…Check they've got <it> and check they're going to do something about it and check that they understood it fully."

The mobile phone was also used as a back up technology, as in the case of problems with the fax with transmission quality. In the following instance, use of the phone and the fax provided a combined solution to the problem of following directions to a hotel, the telephone adding a degree of flexibility to communication:

"I was a bit concerned that she might get a bit lost so I said I'd leave my mobile on, ring me any time – because the fax I sent through to her, she didn't get the information on time. It was last minute, she needed a hotel, so I faxed it through."

Phone Calls to Access Remote Documents

In some cases, people made calls to access information on or about documents that they did not have direct access to whilst they were away from their home office base. In these instances, they would call up the owner of the document, or someone who had access to the document, and get them to read out or forward the information from that document to them. In one instance, an interviewee said he occasionally forgot key documents and was often asked for information that he did not have on him, and that he asked his office to fax the document to his hotel's fax machine:

"The fax solves a lot of problems".

Another example of this behaviour involved a request from the Brewery Account manager for an electronic document to be emailed to her. A phone call on the mobile phone was necessary for this because email was something that she could only conveniently check outside office hours when back in the hotel room. The mobile phone allowed her get closure on the task as and when it came to mind. In addition, the urgency of the situation required that immediate feedback be given that the task was in hand. This was something that was best achieved through the synchronous communication of the mobile telephone.

Phone Calls For Device Proxying

A related issue to the above was the use of the mobile phone as a device proxy. While on business travel, the mobile professionals often do not have convenient access to the same document technologies and resources they have back in the office. These needs also arise opportunistically within the unfamiliar and unpredictable environments where they must work while on business. In these circumstances, the mobile phone acted as an extremely versatile tool that acted as a proxy to document technologies such as fax machines back in the office. For example, the lab equipment salesman needed to send a fax to a customer while in his car**.** Because he did not have access to a fax in the car and also because he did not readily have access to the information in document form[2], he made a call on his mobile phone to his office requesting that they find the necessary document and fax the full details to the customer.

Other examples of this include the use of the mobile phone to dictate letters and the use of the mobile phone to listen to emails being read and to responses:

"No but if it was urgent there would be enough information that I could ring up the office normally and speak to my secretary, she does shorthand and she can type it as quick as I

---

[1] For those who used email while away, it was generally something that they would check only once or maybe twice a day when they had opportunity to download it. The end of the day in the hotel room was a typical scenario for downloading and dealing with email.

[2] This was interesting in itself that the participant did not have access to the information necessary to complete the demands of the phone call. Predicting the need for taking the document was not possible because of the whimsical nature of the phone call during what would otherwise be dead time in the car. As such, not only was the technology not available to make the fax but nor was the document. So while a mobile faxing device could have been useful in situations like these, this must be interpreted within the context that mobile professional will often not have the information they want to be able to make the fax.

can say over my mobile 'phone, you know letter to so and so really urgent must go out, dear Mr so and so reference our conversation I have pleasure in quoting you for this blah, blah, blah, that's the price Linda, you know and she'll end and whatever it and I'll say nip in my drawer and get the technical information, get it in the post this afternoon, he's really chasing it. You know that sort of thing happens but I can do that on the 'phone. I can do most things verbally."

Whilst the telephone does act as a device proxy, it is not, however always the ideal task for the job:

"I mean I use a mobile telephone probably because I haven't got a mobile fax, it would be nicer for me because I find myself ringing up one person in the office and I might ring him up ten minutes later to say I'd forgotten something so if I could sort of you know during the day jot down everything I had to tell one person in the office and send off a fax then you've also got the written record and so it's safer."

Telecentric interactions

Document Discussion During Phone Calls

As with face-to-face conversations, a number of the telephone calls were based around some form of document discussion. These would range from a simple quick glance to reference information in support of the conversation to more in-depth document discussion that could also involve some form of annotation of the discussion document. Paper documents were particularly important in this activity because of its viewing and annotation properties. Also, like the phone, paper could be used flexibly within the wide range of ecological circumstances encountered by the mobile professional without being affected by the technology infrastructure constraints of locations such as meeting rooms, hotel rooms or in cars.

The importance of documents as conversational resources can be seen through the difficulties experienced by mobile professionals in certain situations. For example, one participant expressed some of the difficulties when not being able to view documents in mobile situations such as in the car.

"You do need to see the information, if I could see it myself it would be a lot easier… I'm asking so many questions, is it this, is it that, can you see this, can you see that?"

Note-Taking During Phone Calls

People frequently needed to make notes when they were telephoning either for recording contact details, action items or information that needed to be discussed there and then. Often such note-making made use of whatever paper was to hand in order to avoid disrupting the conversation.

"Did I make any notes, yes I made some notes on the newspaper because she called me so I made it on the back of a newspaper, two points… just so that I could again capture the thoughts as she was going through it…the numbers that I had in there I would be able to play with them and look down at them and reference them"

Although the act of note-making while on the phone is not exactly a novel finding per se, these activities nevertheless presented some particular problems for mobile professionals because of their limited resources for writing or scribbling. Within the car this characteristic of telephone behaviour would sometimes cause difficulties for those actually on the move such as drivers, who regularly made and received calls whilst on the move:

"No it is a problem when you're driving, the mobile phone and the messages and remembering things, writing things down. I haven't managed to solve that problem yet."

Some important information was retained in the technology, such as the number of the caller being retained by the mobile telephone. For other, and particularly for complex information, many people had to resort to scribbling notes down whilst they were driving, or pull over to the side of the road.

Documents to Elaborate on Phone Calls

In certain instances, verbal communication in itself was not sufficient to convey all the information necessary for the task situation. Additional follow up material, such as fax, email or posted documents would sometimes need to be distributed to elaborate on the information in some way. In the cases of people faxing documents on the move it followed on from a phone call in over 40% of occasions. For example, one of the participants was in his car where he had a free hour available so made a phone call to a customer using his mobile about some equipment for he was trying to sell. While he was able to give the customer enough overview information to get them interested, they wanted full written details to peruse before they would commit to buying. The phone call was not sufficient in itself to make the sale because the customer needed time to look through the details more closely and in his own time. There was therefore a need to support the verbal telephone communication with paper based visual information that would support the customer's needs. This required that some information be faxed to the customer in support of the phone call. Because he did not have access to a fax in the car and did not readily have access to the information in document form, he made a call on his mobile phone to his office requesting that they find the necessary document and fax the full details to the customer.

Documents as Records of Phone Calls

In some cases, people needed to have records of telephone calls. These were required for a number of reasons, including the recording of telephone numbers or client names for later archiving and retrieval. Sometimes they contained detailed information that was drawn from the telephone call to use later (an example being telemarketing

surveys). Other follow-up documents confirmed the details of the call as an official record of the conversation. In the example below, the TV production manager was asked how he made a booking for film stock. He used a paper record so that he knew exactly what he had ordered:

"Just being on the phone basically, being on the phone, speaking to people over the phone and then putting something down on a fax to confirm it...I've got to get everything down on paper so I know in my mind what I've got, what I've got coming, who I've got coming and then basically slap it in lists."

IMPLICATIONS FOR MOBILE TECHNOLOGIES

The findings have highlighted an interesting interrelationship between mobile phone and document activities of mobile professional work practices that has hitherto been underplayed. Categorising this relationship between mobile communication and mobile document activities in this way provides us with a useful framework within which think about new technologies. The categorisation helps highlight existing problems and can suggest new opportunities. Such a framework can also be used to provide a basis on which some initial assessments about emerging technologies can be made in terms of their role within the work practices of the mobile professional.

When thinking about the design implications of these findings it is important to consider the particular need of the mobile professional for technologies that can flexibly accommodate their information needs across the wide range of unpredictable circumstances and contexts. One of the reasons why artefacts such as the mobile phone and paper were so useful to these people is precisely because they respect this need. They offer "lightweight" solutions that allow creative use on the fly rather than trying to predict all problems and throwing technology at each and every one. Design implications should leverage these artefacts and build upon existing widespread technology infrastructures.

Bearing these issues in mind let us consider some potential technologies that are suggested by the taxonomy. A logical starting point for us to consider would be a potential relationship between scanning technologies and mobile phones. Scanning technologies integrated with mobile phones might offer an number of opportunities to integrate phone and document use. For example, in the case of *documents triggering phone calls,* small scan heads within a mobile phone could be used to access contact information from document cover pages. By tethering the scanner to the phone, software could even convert these marks on paper into phone numbers that could be immediately dialled at the press of a button. Furthermore, replying to queries in particular sections of text might be made easier by allowing callers to scan in the relevant sections and send them on for the call recipient to look at during the phone call. Taking this further, larger scan heads might be used for the purposes of scanning in whole documents. This would help in the sharing and clarifying of documents as we discussed in *Documents to elaborate on phone calls.* It would also allow for quick follow-up to phone calls for notes and records taken during a conversation (i.e., as in *Documents as records of phone calls).* Such solutions could be based around integrating scan head technology within mobile phones or around tethering portable scanning appliances with mobile phone technology. These can then allow document distribution through fax and Internet channels.

There are also implications around technologies that more closely integrate access and distribution of electronic documents with mobile phone technology. Web-based document repositories may provide some benefit here by offering widespread accessibility to documents. Xerox's MobileDoc system (formerly the Satchel system) [3] is designed to confer these sorts of benefits by allowing remote access to electronic document repositories through the Internet using simple document "tokens". Tokens can be beamed to "Satchel-enabled" devices for printing or viewing. These kinds of technologies are important because they leverage the ability of the mobile phone to access documents, which can then either be printed out or viewed on laptops. Mobile workers can then more easily send documents promised in conversations, or even jointly discuss them while talking. However the success of these activities depends to some extent on the mobile worker's surrounding infrastructure, the ability to connect to the Web, for example, or the availability of Satchel-enabled printers or laptop displays. In many respects it is good that such systems employ existing technology infrastructures that can be exploited when available. But as we have seen, part of what the mobile worker needs is freedom to work without infrastructure. Thus their dependence on these additional technologies may mitigate their value.

Other technology options to be considered within this framework are shared displays for the purposes of discussing documents during phone calls. This kind of approach has been explored extensively in the CSCW literature [e.g., 2]. There have also been there have even been commercial systems such as HP's Omnishare. Such systems have not achieved widespread success because they are cumbersome in their approach and depend heavily on new technology infrastructure. This is not suitable for the unpredictable circumstances of the mobile professional. Cameras on laptops or mobile phones may offer some solution in this area that deserves some consideration and investigation though as with the shared display technologies are probably ultimately too cumbersome for these circumstances.

The audio facilities of mobile phones could also be exploited for various categories within the taxonomy. Recording audio snippets such as contact details and action items during a phone call could support activities within

the *Note-making during phone calls* category especially for in-car conversations where other forms of note-taking are difficult. The legal implications of this are perhaps preventative but other audio recording facilities could be integrated within the phone for after-call recording of action items and contact details. Such audio recording facilities might also be used in support of activities within the *Phone calls to elaborate on documents category.* Providing context in the form of a short verbal message that can be attached to documents both paper and electronic. For example audio annotations could be created and played back using mobile phone technology. Audio files could be attached to emails or linked with paper documents and accessed through a URL or barcodes link.

Finally, techniques for viewing and annotating documents using PDAs while using the mobile phone provides interesting possibilities. For example, by tethering a mobile phone to a PDA or by incorporating PDA functionality into a phone, *Note-making during phone calls* could be supported. Callers could make notes which are then automatically tagged with information about the phone call such as details about where, when and who was called. This could provide records of phone calls. Callers can also make notes about action items that are then sent to one's To-Do list. This could be augmented by having an automatic To-Do button that records a snippet of the conversation as a reminder to future action.

CONCLUSION

In conclusion the findings have shown the importance of the mobile phone for the work of mobile professionals. In contrast to the laptop, the flexibility, versatility and convenience of the mobile phone have made it a ubiquitous device in terms of who owns one, whether it is taken on trips and where it is subsequently used. As such it is rather like paper, and the link between paper documents, and indeed documents in general, provide an important leverage point for thinking about new technology ideas. While providing some descriptive analysis of how mobile workers use both communication technology and documents to manage information on the move, we hope to have demonstrated that looking at the relationship between talk and text offers new insights for mobile technologies.

ACKNOWLEDGMENTS

The authors would like to thank the study participants for generously giving their time and effort in this study. Thanks also to Marge Eldridge and Colin I'Anson for their comments on earlier drafts of the paper.

REFERENCES

1. Eldridge, M., Lamming, M., Flynn, M., Jones, C., & Pendlebury, D. (1999). Research methods used to support development of Satchel. *Proceedings of INTERACT '99*.

2. Ishii, H. (1992). Clearboard: A seamless medium for shared drawing and conversation with eye contact. *Proceedings of CHI '92*. ACM Press, 525-532.

3. Lamming, M., Eldridge, M., Flynn, M., Jones, C., & Pendlebury, D. Satchel: Providing access to any document, any time, anywhere. To appear in *Transactions on Computer-Human Interaction, Special Issues entitled "Beyond the Workstation: Human Interaction with mobile Systems.*

4. Laurier, E. (1999). Conversations in the corridor. *Second Workshop on HCI for Mobile Devices,* Glasgow, Scotland, May 1999.

5. Luff, P., Heath, C. (1998) Mobility in Collaboration. In *Proceedings of CSCW '98Conferenceon Computer-Supported Cooperative Work.* ACM Press, 305-314

6. Puuronen, S. and Savolainen, V. (1997) Mobile information systems - executive's view. *Information Systems Journal, 7*, 3-20.

7. Sellen, A. and Harper, R. (1997) Paper as an analytic resource for the design of new technologies. In *Proceedings Of CHI 97: Conference on Human Factors In Computing Systems*. New York: ACM Press, 131-137.

8. Vanaanen-Vainio-Mattila, K. & Ruuska, S. (1998). User needs for mobile communication devices. *First Workshop on HCI for Mobile Devices,* Glasgow, Scotland, May 1998.

9. Whittaker, S., Frohlich, D. and Daly-Jones, O. (1994) Informal workplace communication: What is it like and how might we support it? In *Proceedings Of CHI 94: Conference on Human Factors In Computing Systems*. New York: ACM Press, 131-137.