

## **An Examination of Mobile Devices in the Workplace**

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As mobile devices become less expensive and continue to evolve in terms of their features, interfaces, portability, context-awareness, and bandwidth, they will become immersed in our professional and social worlds. The lines between mobile and non-mobile technologies will blur, just as the lines between various mobile devices are currently blurring. The globalization of work has transformed the workplace into a transparent landscape with less reliance on physical location and more emphasis on the context of the task and the technologies used to get work done. The popularization of mobile technologies has made it easier to navigate this landscape to accomplish work in everyday contexts.

Our objective is to examine the role of mobile devices at work in order to understand their impact on how work is done, how texts are shaped, and how information is exchanged. As mobile devices become more ubiquitous, it will become important for technical communicators to create texts with mobile devices in mind, because all texts will have the potential to eventually become texts for use on mobile devices. Additionally, the work of technical communicators, particularly when creating content for mobile devices, is likely to become as much about structuring a text as writing one. Since there were only limited studies on how to create texts and design content for mobile devices, we offer some best practices for technical communicators based on our research.

We provide an overview of existing research relevant to mobile devices and discuss how these devices fit into the workplace. We also provide a brief overview of Computer Supported Collaborative Work (CSCW), which will increasingly need to accommodate mobile device use. We look at mobile devices in terms of the modes of communications they use, how they adapt to the social and physical contexts in which they find themselves situated, and how texts must adapt to both the device and its contexts.

## ***A Brief Overview of Studies on Mobile Devices***

Research on mobile devices in the workplace primarily examines their impact on social interaction, context, usage, and design. Methods of research vary depending on the aspect of the mobile device being studied. Applied research is conducted in many of the studies that explore issues in mobile device design features, context-awareness, and location awareness. Basic research is conducted in many of the studies on social interaction and context. The majority of the research carried out is ethnographic; however there are some studies that use controlled settings to gather data (e.g., Albers and Kim, Schusteritsch and coworkers). The studies often used a combination of quantitative and qualitative methodologies. Surveys were frequently combined with case studies and field studies and at least one longitudinal study was conducted.

Contributions to the study of mobile devices come from **both** academia and from industry. The authors cited that are affiliated with academia came primarily from departments of Computer Science, Sociology, and Psychology—only a few sources were from Technical/Professional Communication departments (Swarts, Peters, Albers). Other studies were conducted by authors from professional fields in Information Technology (IT), Human Computer Interaction, and Telephony.

Some examples of typical studies related to mobile devices are summarized. Tamminen and coworkers examine how mobile devices are socially accepted into everyday life. Peters and Allough conducted a field study that tracked novice users over an extended period to determine how their mobile device use changed over time. Bardram and Hansen study how mobile devices facilitate cooperation through social awareness for non co-located workers. Dryer and coworkers study whether different types of mobile devices can trigger certain social responses during interaction. Swarts studies the use of PDAs for information organization and processing in medical settings. Isaacs and coworkers evaluate patterns of use in workplace Instant Messenger (IM) conversations. Nardi and coworkers also observe workplace IM, but in terms of informal conversations.

## ***Collaboration Using Mobile Devices at Work***

Collaboration requires individuals and groups to communicate, coordinate, integrate, and distribute work. This work can be done individually and then shared, potentially resulting in indirect collaboration, or done as a coordinated collaborative effort. Either way, these activities can be facilitated by people and computer systems as part of what Nardi and Whittaker describe as a “media ecology.” They suggest that the tools and communication modes used in work collaboration be chosen based on an “appropriate mix of face-to-face and other media depending on the work, its temporal sequence, the context, and the distances to be traveled” (102). Mobile devices are used in conjunction with other office tools to mediate the activities and tasks needed to do work. Therefore these devices must be adapted for integration with texts and other applications which support collaborative work. Some examples of specific collaborative activities performed in the workplace include: scheduling meetings and other events, retrieving and managing information about a co-worker or client, and communicating with a co-worker or client by calling, messaging, or e-mailing them.

When mobile device users need to participate in collaborative efforts, not only must appropriate modes of communication be selected, but communication and coordination must also be negotiated. The major field of study which examines these issues is Computer Supported Collaborative Work (CSCW), which was first introduced in the 1980s. Bannon and Schmidt define CSCW as “an endeavor to understand the nature and characteristics of cooperative work with the objective of designing adequate computer-based technologies” (360). The advent of mobile technologies is creating new issues in this field which must be addressed in order for CSCW to be done effectively in the evolving media ecology. As Luff and Heath point out, the ways in which mobility functions in “collaborative work have largely been overlooked in CSCW” (350). As Bannon and Schmidt note, “designing computer-based systems for cooperative work settings is like writing in water” (368). Changes in existing systems create changes in the way mobile devices are used, which spur more changes in existing systems, and so on. Because mobile devices are currently limited by the technology available, they are not fully ready to operate as a primary medium in a collaborative work environment.

Technical communicators should research the types of text structures that are most commonly used to create, distribute, and coordinate work activities through mobile devices. They should proactively become involved with research in CSCW and other fields such as Human Computer Interaction to determine what limitations users experience on mobile devices in terms of collaboration. For example, are shared database documents readable and usable on mobile devices? Should and can they be designed in chunks? How do these database documents link to other texts?

### ***Creating and Using Texts for Mobile Devices***

Mobile devices tend to have smaller displays and less memory than their non-mobile counterparts. Consequently, different approaches must be used for retrieving and using information. The user of the device and the creator of texts for the device must both adapt their approaches to the physical realities of the device and the context it is used in. Several studies examine how users adapt their approach to retrieving information and how content creators should adapt their approach to creating information.

Users who access information using a mobile device tend to access information in bits and pieces rather than in the larger chunks which often characterize non-mobile texts. Albers and Kim describe handheld information retrieval in terms of two major functions: simple look-up and information manipulation. Simple lookup is described as “locating and recognizing the desired information,” while information manipulation is described as “being able to look up information and then compare or compile information” (Albers and Kim, 2000, 126). Swarts observed his users manipulating information by using fragments of text to create their own “meta-texts” (169), context-appropriate texts which consist of information from several different sources viewed in sequence.

Assembling a text for a small mobile device demands a different approach than creating more conventional texts. As mentioned previously, users access and use much smaller bits of information when using a mobile device than when using a paper artifact or a desktop computer. Chu and Swarts both advocate “chunking” information into smaller pieces. Chu also notes that

when using smaller pieces of information, creators “must take great care to ensure information flow” (53). Swarts recommends that authors “plan texts for non-linear access” (171). This need is illustrated by the users in Swarts’ study, who not only accessed information non-linearly, but also interspersed information from several different sources. Users’ methods of non-linear accessing information will be structured around the mental models the users bring to the task. Albers and Kim describe a mental model as “a type of neuro-hyperlink” which helps the user make connections between bits of information (129). Swarts also calls on technical communicators to create “meta-mediational” structures, or textual structures which provide users with a framework into which they can insert information which is appropriate to their immediate needs (172).

The mental models used with mobile devices must also accommodate the effects of cognitive load and the limitations of short-term memory capacity. As Albers and Kim note, human short-term memory can only hold about seven coherent chunks of information at one time. Expert users can hold larger chunks of information, but are still limited to about seven items. This information is held for only about 20 seconds. Additionally, when users multitask, each task is allocated an equal chunk of resources, rather than a chunk proportional to the magnitude of the task (128).

Technical communicators must look at texts for mobile devices as non-linear structures. As with Web sites and other media, they should consider chunking texts into discrete fragments of information, but the chunks should be even smaller when they are being created for use on a very small display. Use of informational units should be facilitated by meta-mediational texts which will enable the user to meet his or her own needs in-the-moment.

### ***Selecting Mobile Communication Modes***

The communication mode used for a given work activity will dictate how texts should be designed for it. Communication can be encoded using text, graphics, audio, video, and can be distributed either synchronously or asynchronously. It is useful to look at mobile device communication in these terms rather than strictly in terms of the technologies currently available

(e.g. email, phone, IM, etc.) because as technologies advance, some of these tools are merging, and new tools are being introduced. For example, some of the newer mobile phones are now capable of playing music and broadcasting television shows.

### **Synchronous Communication Modes**

Synchronous communication tools such as IM and phone are most frequently used when more urgent or complex matters need to be handled. Perry and coworkers found that for traveling users, mobile phones were used for in-the-moment status updates with colleagues rather than email, which most often was used at the end of the day, when there was more time for access. Text messaging or Short Message Services (SMS) are forms of communication which are analogous to IM, and are sometimes used interchangeably with it, and sometimes used as a separate application. Many IM applications such as AOL have a forward-to-mobile option that allows messages to be routed to a mobile device in the form of a text message. When discussing the use of IM, Isaacs et al state that “28% of conversations were simple, single-purpose interactions” and “31% were about scheduling or coordination” but that “people rarely switched from IM to another medium when the conversation got complex” (2002, 11). The physical means used for instant messaging may affect whether IM or voice interaction is chosen, as the difficulty of composing a message using a mobile phone keypad may deter IM use.

Video conferencing is not often used for synchronous communication because of the technological barriers it creates. In the results of their research, O’Hara and coworkers state that “video is considered only if it does not also incur the effort costs, such as booking to use and set up for special equipment in dedicated rooms. If the required effort is too high, people resort to the simpler and more widely available audio telephony” (871). They suggest as these limitations ease, video use could become more common. O’Hara and coworkers point out that “as mobility has created shifts in behaviors and attitudes in audio telephony, it could also create shifts in attitude and behavior in video telephony” (872). The ability to view, record, and send short video clips on mobile devices is currently available. As video telephony becomes cheaper and easier to use, it is also likely to become a regularly used mode of communication for workplace activities.

Synchronous communication can also be used for longer interactions, such as audio conferences. While mobile devices increasingly allow participants to call into an audio conference from anywhere, it can be problematic. Yankelovich and coworkers point out that “audio problems were the single biggest factor in distributed meetings that were not effective” (5). As technologies improve, this is likely to be less of a problem, leading to more frequent use of audio conferencing using mobile devices.

### **Asynchronous Communication Modes**

Asynchronous communication modes such as email, web access and syncing between a handheld mobile device and a desktop or laptop computer are used for less urgent matters, in situations in which a permanent record is needed, and for information search and retrieval. E-mail systems traditionally used on the desktop are now also available on mobile devices. In 2003, Jakob Neilson recommended that “email must be reconceptualized for mobile devices. The old model of “anything sent to this address goes into this mailbox” doesn't work for mobile devices. He suggested that improvements in filtering were necessary for office e-mail so that “you can get what you need on the road without being bogged down by a flood of non-urgent messages” (Neilson). Filtering has advanced since his article was published and many PDA devices today have the ability to filter messages.

Among people under thirty, Short Message Services (SMS) tended to be used for quick messages. Häkkinen and Chatfield’s survey of voice and SMS use in cell phones found that “user responses described text messages as useful as an instant communication device...or as a message service (like email).” They also found that SMS increased frequency of communication among people under thirty, as they used text messaging to relay messages about things they would not have bothered to call about. This trend is likely to become more widely adopted for professional uses as more users of SMS enter the work force.

Many mobile technology tools include the ability to synchronize information. With syncing, employees can use their mobile device to remotely tap into work resources which allow them to manage tasks such as checking e-mail, viewing documents, updating or retrieving contact lists. For example, software such as IBM’s Lotus® EasySynch Pro allows users of Lotus

Notes to synchronize their e-mail, calendar, tasks, contacts, and journal information with their PDA.

Many mobile devices such as mobile phones and PDAs have the capability to search and retrieve information from the Web. In addition to internet access, these mobile devices can also be configured to access information on a company's intranet. Albers and Kim point out that "unlike the roaming behaviors supported by desktop interfaces, handheld Web environments are designed to provide more task oriented uses" (125). These tasks tend to involve the retrieval of specific information, such as directions, product specifications, etc.

Although technological limitations may restrict the use of certain communication tools on mobile devices, such as video conferencing, over time, these limitations will ease and eventually disappear completely. As this happens, texts which combine images, text, audio, and video will become the rule rather than the exception. With the advent of desktop publishing, technical communicators had to learn graphic design techniques to effectively create traditional texts. Future technological innovations will necessitate a similar shift, and they will also need to learn to use other forms of multimedia to communicate effectively on mobile devices.

### ***Contexts of Mobile Device Use***

As mobile device technology matures, mobile devices are becoming more integrated into everyday life, changing how work is done, while the environment they are situated in affects how work can be done with them. Mobile device use must be considered in terms of both the contexts they are situated in and the additional contexts they bring with them.

#### **Social Context**

Because they are used by and around people, mobile devices are naturally part of a social context. Mobile devices are subject to many of the same considerations as other technological devices but are different, in that they are highly visible, and are present in a wide variety of social contexts. Mobile devices are more likely to be used publicly and hence tend to be socially evaluated and to trigger social responses from the world at large. In work environments, whether a mobile device should be used depends on its appropriateness in the social context of the

situation as well as its appropriateness for the tasks that are being performed. The effect of social roles and patterns of use on the social acceptability of mobile devices are examined below.

Mobile devices are part of social contexts and part of this social context is the stigma which sometimes attaches itself to the use of computerized devices. As Dryer and coworkers note, “in many persons’ minds, computers are associated with a lack of social engagement. Those who are seen using a computer may be labeled with social stereotypes, like ‘geek’” (656). This stigma manifests itself in mobile contexts as well, particularly in settings where social sensitivity is especially important. Lottridge and coworkers noted in their study of PDA use among physicians that one reason some doctors were reluctant to use the devices in front of their patients was because it was too “impersonal” (5). However, in many professions, like information technology, instead of being viewed as impersonal and socially insensitive, professionals who have mobile devices are viewed as being ‘in touch’ and connected, and the geek stigma has a technical sophistication associated with it.

Social acceptance is also tied to habitual action. For instance, in their study of how people use their mobile devices, Tamminen and coworkers stated that “social acceptability of new context-aware technologies is dependent on how well they fit into the routinely carried out mundane processes of everyday life” (142). Peters and Allouch expand on this idea, pointing to an article by McQuail which asserts that the use of electronic devices is often “not very rational, motivated or planned, but is a result of habit, circumstance and change” as well as one by Aarts and coworkers which states that when behavior becomes habitual, it is “guided by automated processes, rather than being preceded by elaborate decision processes” (241). As mobile device use increases, the devices become more naturalized in both personal and professional communication transactions.

Technical communicators should consider how a mobile device’s social context, including habits of use and social roles, affects how texts for mobile devices are created and accessed. For example, when creating documentation for mobile phones, the user’s role and context of use must be considered. When the user needs help in using the function of the device, will they use a hardcopy guide or will they use the help information provided on the device

itself? Will the guide be used in the presence of others or in private? Are users of a mobile device likely to attribute usage problems they experience to device misuse or device malfunction?

### **Physical and Task Driven Contexts**

Work strategies and information management in mobile environments are driven by the physical contexts in which mobile work is done. As mobile devices become increasingly ubiquitous and service areas expand, the contexts that mobile devices can be taken into will also expand. A user's physical and task driven context is an important consideration when using mobile devices. Context-aware devices have surfaced, allowing mobile devices to react to changes in the user's context. This is a relatively new area of study and what is meant by "context" varies. Bradley and Dunlop define context as "a process whereby a person consciously or unconsciously compares an external context with acquired personal experiences/knowledge (both of which may contain task, physical, social, and temporal dimensions) to form goals for undertaking concise actions, possibly with other people and/or objects" (424). This definition is meant to encompass all possible contexts. Some definitions of context refer exclusively to the task being performed by the user at the time (what Bardram and Hansen refer to as the "work context"). Tamminen and coworkers describe context in terms of "modality selection." Some of the modes they described were "walking, waiting, hurrying, navigating, (and) sidestepping (making an unscheduled detour and then returning to the original errand)" (142). For example, if a person is in a meeting, their mobile device can be set to vibrate until the person indicates that their normal routine has resumed, at which point it provides voicemail notification.

Technical communicators should consider how texts from a mobile device will be accessed in terms of physical and task-driven context. The user may access a text on his or her mobile device discretely while working in a group, at a desk, or while walking down the street. Technical communicators need to create texts so that they are easy to view in a variety of contexts. This might involve additional considerations in amount of text displayed on the screen and the typography chosen. Technical communicators should consider designs that improve

recognition of menu tasks and reduce the amount of the text on the display that the user is required to parse through.

## **Merging Contexts**

The contexts in which mobile devices are used are often transparent and overlapping. Mobile devices permeate transient spaces, allowing us to “emerge from our office, work, and school into the urban fabric of cities and towns” (Paulos and Jenkins, 341). Work-related, personal, and civic contexts can demand simultaneous attention. Galloway describes ubiquitous computing as having “fluid and unpredictable” contexts in which “people, objects and meanings are all mobile” (1).

Another aspect of unpredictable contexts is the merging of the personal and the professional. People expect a mobile device to give them access, but may not consider the level of access it gives the world to them. Additionally, they may expect to contain their device use to one portion of their lives, only to find it leaking into every part of their lives. In Peters and Allouch’s study on PDA usage, they found that over time the PDA shifts from primarily being a work-oriented tool to a tool which is used for both personal and work-related tasks. They note that “all kinds of situations were mentioned by the participants for using the mobile PDA, which demonstrated the simultaneous use of the mobile PDA in both personal and work-related contexts,” (251). For example, the calendar feature on the PDA, initially intended to keep track of work appointments and meetings, is also used to schedule parties and doctors’ appointments.

Peters and Allouch also note that “the boundary between work and personal life slowly disappears as people use mobile communication technology during weekends and holidays for business purposes as well as for personal purposes while being at work” (252). Mobile devices change how the balance between work and life is negotiated, a change which has both positive and negative aspects. Tension can develop as a result of the need to continually negotiate the time spent on work-related tasks versus time spent on personal tasks. Sadler observes that “a person’s availability to others is shaped and dictated by the demands of the various activities, people, contexts, and situations that are encountered throughout the process of daily living” (49).

Tension can also develop between various work-related contexts. Both personal and work-place interruptions are expected and can impact work productivity. The “always on” mentality that mobile devices foster increases the probability of receiving personal communication at work or work-related communication at home. One way to minimize the impact of interruptions is through the use of context sensitive devices. Many of the strategies used to mediate workplace interruptions have been or can be adapted to mobile environments. As Bardram and Hansen point out, “ethnographic studies of co-located cooperative work show that people tacitly and unobtrusively align and integrate their activities in a seamless and highly sophisticated manner without interrupting each other” (193). Computerized interactions, on the other hand, frequently result in interruptions. For instance, one of the drawbacks of IM on both non-mobile and mobile devices is their ability to interrupt productive work. When using IM systems, for example, “presence is often negotiated with sentences like ‘are you there?’ or ‘do you have a moment?’” (192). These interruptions can produce a disruption of processes which results in reduced productivity. The problematic nature of interruptions is illustrated by the studies pointed out by Bardram and Hansen which show that 90% of brief interruptions are unplanned and only 55% of people who are interrupted continue their previous activity (193).

The merging of contexts created by mobile device use leads to privacy issues which must also be considered. With mobile devices, work and personal tasks can be created in public forums, within the sight and hearing of friends, coworkers, casual acquaintances, and complete strangers. As with interruptions, personal privacy practices are currently negotiated primarily by social cues and social norms. Standing in an area unoccupied by other people while placing a phone call is a visual cue which indicates that the call is private and the caller does not want to be interrupted. There is an expectation that people will treat mobile phone calls and messages as private communications despite the fact that they occur publicly.

Häkkinen and Chatfield found in their survey of mobile phone user privacy expectations that “users’ privacy is guarded by widely accepted, unwritten rules of treating mobile phones and messages as confidential” (222). This becomes less tenable as more sensitive information such as medical and financial records is transmitted to and from mobile devices. Chu notes that

“purchases of stocks and retail goods, and bank transactions on wireless devices will open many more access points to sensitive financial information of government institutions, businesses, and individuals” (56). As an increasing number of sensitive business tasks are performed in public areas, technologically-based strategies such as encryption, and privacy screens may become more frequently used.

Technical communicators should consider the intermingling of contexts when designing texts for mobile devices. Such texts need to be designed in a way which accommodates switching between texts and between contexts. Texts should also incorporate social cues which indicate the context and its level of sensitivity. Communicators should consider whether the information they are supplying could create problems if it enters a context other than the intended context. More analysis is needed on how mobile users divide their time and attention between collocated contexts.

## ***Conclusion***

The convergence and ubiquity of mobile technologies is changing mobile devices from a novelty to a necessity. Users’ decisions about how to encode and distribute information on mobile devices provides a framework for the creation of the texts. The social, physical, and merging contexts in which mobile devices are situated dictate how texts are created, used, and shared. Chunking and creation of meta-mediational documents to facilitate the use of chunks can be employed to create texts which can be used effectively in the wide variety of situations which mobile devices find themselves in. The combination of mobile devices and CSCW tools and strategies has the potential to provide increased flexibility to collaborate both in physical and virtual space.

Texts created for mobile devices will need to accommodate the inherent limitations of the devices as well as the wide variety of devices available. Users in collaborative work settings should be able to move through both physical and virtual configurations of the workplace. Enhancements in mobile devices should address both social and technological issues relating to how information is dispersed and utilized.

We found that technical communicators currently do not have a strong presence in the research on mobile devices as expertise is primarily dominated by researchers in Computer Science-Human Computer Interaction, Cognitive Psychology, and Sociology. Technical communicators bring would bring a unique perspective to the field. As advocates for users, and experts in genres and rhetorical situations, technical communicators would facilitate the creation of mobile device texts and interfaces which not only meet peoples' technological needs, but interact well with them.

### **Advice for Technical Communicators**

Technical communicators need to become more actively involved in understanding the dynamics involved in creating texts for mobile devices because the need for such texts is growing. More research is needed in all aspects of work-related mobile device use, especially issues concerning technical communicators. In particular, research needs to be done on how collaboration on work texts and activities could best be accomplished using mobile devices. Attention must be paid to the text's intended context, while keeping in mind that this text could be used anywhere. Technical communicators must accommodate not only the user's physical and task-based contexts, but the social context of the user. They should design texts which enable rapid context switching. Text should be created using small units which can be adapted to a variety of uses that will be usable on small displays. The ability to use multimedia effectively on mobile devices will be important. Technical communicators should become familiar with the genres commonly used on and with mobile devices, and particularly those used to perform work activities.

### **Future research**

Strategies for using mobile devices at work are still not well defined. Future research on mobile technology in workplace settings should explore how mobile devices are being used. For example, how can a mobile phone mediate workplace tasks? Studies of how mobile devices are being used at work could reveal the needs of users and the inadequacies of their devices. Some important questions to consider are how satisfied users are with their current mobile devices and

what features they require or would like to have to facilitate their work. Additional research might evaluate whether mobile devices are used in individual versus team-oriented settings and how users might transition from one type of use to the other.

Research strategies typically practiced by technical communicators—audience analysis, case studies, and studies of the genres which will be used on mobile devices could provide beneficial insights on how to make information that could truly be used, instead of merely manipulated.

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