

## **ABSTRACT**

With the proliferation of wireless devices comes the challenge of designing information systems that can effectively support mobile users. Fundamental to meeting this challenge is determining users' information needs in mobile environments. This paper proposes a framework for information needs in mobile environments based on studies of mobile office workers and other users in mobile settings.

### **FRAMEWORK FOR INFORMATION NEEDS**

The authors developed this framework after reviewing previous research that documented the use of mobile applications, and the use of applications in mobile settings. Information used in mobile applications comes either from the device itself or from another source over a wireless communications link. Much of the research found dealt with mobile workers, but there is an increasing amount of research that documents activities that are more personal in nature, such as cell phone use among friends and the use of a mobile tourist information system. The framework also represents the authors' opinion as to categories that seem appropriate for mobile information needs.

The framework consists of eight categories of information needs: personal, interpersonal, communications, co-location, navigation, calendar, real-time, and task-specific. Task-specific information needs are further broken down into archival and dynamic information needs. Information needs that fall under each of these categories are further classified by setting, either business or social. This is meant to delineate information needs in a strictly business setting from those in other settings. Some of these categories can overlap for certain information (i.e., information could be classified under more than one category), and there may be interaction between the categories (which is not considered in this paper). The framework is summarized in Table 1, which gives examples of information that can be classified in each category for each setting. Each framework category is discussed further in the following sections.

#### **Personal**

This category deals with information that is specific to the user, but may be needed in a mobile setting. For the most part, it is private information that would not be readily shared with others. In the business context, examples include travel-related information, such as past expenditures. Paycheck details and benefit levels are also personal information. In a social context, needed

information might include account balances and medical records. Personal information needs to be secured in mobile environments, but we leave that topic to another discussion.

#### **Interpersonal**

Interpersonal information is shared and gained through informal communication. The information needs here are usually not task specific. In the business context, examples include knowledge of office activities and an awareness of projects involving co-workers and other teams. In the social context, interpersonal information is gained from casual interaction with family, friends, and one's social circle.

Many studies [e.g., 1, 3, 4, 5] have shown the importance of informal communication and awareness in the workplace, especially for activities requiring collaboration, such as product design and systems development. Such "water cooler" talk is essential for keeping people informed of office events and concerns, of who is doing what, and of the context in which other people are working. It also supports the execution of work-related tasks and the co-ordination of group activity. Thus, informal communication and awareness of office activities build a sense of community – an important facet of work [1, 3]. Mobile workers have been observed to value this as well. They call or e-mail their co-workers to keep informed of what is happening at the office and of any emerging issues that may need to be resolved [7].

#### **Communications**

New communications technologies, such as mobile telephony, e-mail, voice mail, and text messaging, lie at the core of what makes mobile work possible. These technologies allow for efficient, formal communication between any number of people without regard to location. It has been observed that mobile workers often utilize dead time by checking voice mails from most anywhere – in the car while driving, at the airport, at home – using a mobile phone [7]. Others peruse their e-mail if they have the means to do so. Furthermore, it has also been shown that some people even use their e-mail to send *themselves* reminders or notes, as well as other resources they may need for their job, such as presentations and documents [7].

Instant messaging (IM) is fast becoming part of workplace communication. Nardi, Whittaker, and Bradner [5] showed that people used IM for short questions and clarifications, coordination and scheduling, arranging impromptu social meetings, and keeping in touch with friends and family.

On a more social note, teenagers have also been shown to use a variety of media to maintain and enhance social connections [8]. Mobile phones, text messaging, and sometimes email, helps teens communicate with their

friends while offering them more privacy and flexibility than traditional land-line phones (which can be monitored more closely by parents).

### **Co-location**

This category deals with information pertaining to the location of people and objects, and how close they are to each other. In a business context, co-location information might describe the availability and proximity of computing resources in the surrounding area, as well as the status of co-workers who might need to be contacted by phone. In social contexts, co-location information might track the locations of friends and family, or indicate nearby restaurants, stores, and medical facilities.

Unlike office workers who know the location of resources such as printers, product experts, and technicians, mobile workers are usually not as fortunate. Always moving from one place to another, mobile workers are unlikely to gain familiarity with the environments that they encounter [7]. Therefore, mobile workers have a need for information concerning location and availability of physical and human resources, especially when unanticipated situations arise.

One of the most often cited uses of location-based services is the ability to locate the geographical positions of friends and loved ones while on the move. Even without location technology, mobile phones can offer access to location information. The question "where are you?" can be used to monitor location and activity to a certain degree. The information given in these situations is highly subjective, and dependent on the relationship and level of trust between the two people communicating. Mobile phones are often given to teenagers by parents to monitor their activities.

### **Navigation**

People have a need to know not only where they are, but also how to get from one location to another. With the greater availability of the Global Positioning System (GPS) and other location technologies, it has become possible to install navigation systems in cars, handhelds, cell phones, and other mobile devices. Location technology can direct emergency personnel to an accident scene and can be used for e-commerce applications. Telematics, such as the OnStar system, put distressed travelers in immediate contact with assistance and direct hungry travelers to the nearest appropriate restaurant. Traffic advisory systems can guide a driver to his or her destination or warn of impending traffic jams. One can even call a taxi from an unknown location without the need to give directions lessening the uncertainty of being in unfamiliar places [2].

### **Calendar**

Office workers have been observed to have different uses for their personal calendars. Diary or journal calendar formats allow the user to record past activities and expenditures. As such, calendars are used not simply for

scheduling or reminding, but also for tracking and recording events as they happen.

Groupware calendar systems (GCS) were initially developed for group scheduling purposes. However, in practice, GCS have been found to support a variety of other functions. In a study on the use of Calendar Manager [6], a GCS system used at Sun, 88% of its users reported using their calendars for meeting schedule negotiation, but 70% also reported using calendars for locating people. Furthermore, browsing colleagues' calendars was also used to verify meeting arrangements and to find meeting details like location. This same action of looking at other people's calendars also supports coordination, as some people were found to copy events from colleagues' calendars and to schedule their own activities around existing.

### **Real-time**

Real-time information concerns emerging events, changes, updates, and other occurrences that are not planned, but are important to the user. In business settings, real-time systems often require a constant exchange of information among co-workers to ensure smooth operations. These systems need to constantly monitor activities, and schedule (or re-schedule) events for efficient and successful operations. Staying too long at one job due to unseen circumstances may result in the inability to support other customers in a timely fashion.

In social settings, up-to-date news and personally relevant information are in demand. Many telecom companies offer real-time updates of topics such as news, sports, weather, and traffic. Other information of interest to individuals in a real-time environment includes that pertaining to event announcements, such as merchandise sales or event tickets going on sale. Changes in the health and status of family members is also real-time information needed by individuals. Automatic re-scheduling of activities might be useful under certain emergent circumstances.

### **Task-specific**

In addition to information needs that can be classified under the preceding categories, individuals will also have information needs that are specific to a task at hand. A doctor may need access to drug interaction information when writing a prescription for a patient. For firefighters, access to blueprints of burning buildings or decontamination procedures for toxic spills could be critical. A group of friends may want to see reviews of the movies playing at the local theater as they wait in line to buy tickets. A person might want to show photos of objects or individuals (e.g., children, home, pets) that they are discussing with others. Some of the information needed for tasks will be archival (static) in nature, such as product specifications, financial reports, phone directories, and class notes. Other information, especially expertise and opinions from friends and co-workers, is more dynamic in nature.

## DISCUSSION

The framework presented in this paper is meant to give a useful overview of what mobile users need, and hence, the services that they may value. Although information has been classified into eight categories, these categories are not exclusive or absolute. Some of these categories can overlap for certain information (i.e., information could be classified under more than one category), and there may be interaction between some of the categories. For example, a field service technician may need to know the best way to travel from his current location to his next appointment. In this case, we have task-specific information that is also navigation information. If we factor in finding the best route based on current rush-hour traffic, it becomes real-time information.

This paper has attempted to remain technology-independent when categorizing the mobile information needs of individuals, but there is probably some bias in the framework based on current mobile technologies and applications. This framework also does not consider other technology issues such as what devices should be used to access needed information, or how to present the information to the user. The next step in determining the information needs of mobile users is to verify the findings and framework presented in this paper. Hence, it is essential to perform empirical research involving mobile users in actual settings. Most likely this will involve the observation of users in real environments, through ethnographic or other methods, along with user interviews and questionnaires.

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**Table 1 – Framework for Mobile Information Needs**

Category		Business Setting	Social Setting
Personal		- Travel itinerary - Expense records	- Bank account balances - Medical records
Interpersonal		- Gossip - Water cooler talk	- Gossip - Chats
Communications		- E-mail, Voice mail - Online and text messaging	- E-mail, Voice Mail - Online and text messaging
Co-location		- Status of co-workers, clients - Availability of equipment	- Status of friends, family - Availability of equipment
Navigation		- Directions, Maps - Location-based services	- Directions, Maps - Location-based services
Calendar		- Meetings - Deadlines	- Appointments, Birthdays - Social events
Real-time		- New assignments - Project status - Requests for information, Orders	- Sports scores, Weather, Concert announcements - Stock prices, Merchandise sales - Family member health
Task-specific	Archival	- Manuals, Technical specifications - Reports, Financial information - Phone directory - Notes form staff meeting	- Movie reviews - Photo album, To-do lists - Phone directory - Notes from class
	Dynamic	- Expertise of co-worker - Assistance of secretary	- Expertise from friends - Opinion of family member