# 2
# Requirements

# 1 Overview

Good user interface (UI) design involves understanding, so far as possible, the requirements for the system under development. Whether you are redesigning an existing computer-based system or designing a system that will computerize tasks currently being performed manually, you will find it a lot easier if you gather the necessary information in order to gain an understanding of the requirements.

Part 2 of this book concentrates on **requirements**. We will consider the following questions:

- What area of expertise, or domain, will the application be developed for?
- Who are the users?
- What do they want to do with the system?
- Where will it be used?

We then help you to analyze and make sense of the information for your UI design.

# 2 What You Will Find in the Chapters

Chapter 2 describes some techniques to use for finding out the requirements for the system. We introduce you to several techniques — observation, interviews, and questionnaires/surveys — that you can use in your requirements-gathering activities. Chapter 3 gets more specific. We detail the investigative activities for finding out about the the users of the system and the domain for the system. Chapter 4 explores the work or other tasks the users will perform with the system and the environments within which they will work.

In Chapter 5, we ask you to think about the information you might have gathered and how to analyze it. Analysis involves looking at the information gathered and deciding how it can inform the design of your UI. This will prepare you for the discussion of conceptual design that takes place in Part 3.

Chapter 6 describes creating usability requirements, the section of the overall requirements that specifically relates to the usability of the interface. We discuss constraints and trade-offs in creating requirements, and we describe prototyping and consider how it can be used for requirements gathering and for working toward an effective design with users and stakeholders. Prototyping is an important part of the iterative, user-centered design life cycle. You will meet it again throughout the course as you learn about designing the UI and about user evaluation of UI designs under development.

Finally, in Chapter 7, we take a break from theoretical material to look at a practical example. The first part of our case study illustrates how requirements were gathered in practice by Tokairo, UK, for the design and development of a system to collect worksheet information from truck drivers distributing oil-based products.

## 3 Learning Outcomes

After studying Part 2, you will be able to:

- Employ several techniques that can be used to gather the requirements for the design of a UI
- Describe the activities involved in gathering the requirements for the design of a UI
- Understand the role of prototyping in requirements gathering

## 4 Theoretical Influences

The chapters on requirements-gathering techniques, domain, users, tasks, and mental models draw from the fields of psychology and cognitive psychology. The section on environments draws from psychology and social/organizational psychology. The chapter on prototyping draws from computer science/software engineering.

# 2

# How to gather requirements: some techniques to use

## 1 Introduction

There are many techniques you can use to find out about the application domain, the users, their tasks, and the environment within which the system will be used. These techniques include observing users, interviewing users, and obtaining information from users via questionnaires or surveys. Our discussion here focuses on the use of these techniques for **requirements gathering**, but you will meet these techniques again later, when we discuss how they can be employed to evaluate user interfaces (UIs).

## 2 Observing Your Users

Going to observe users in their natural setting — observing them while they are doing real work in their real working environment or using a home system in their homes — is an essential part of user-centered design. In addition to finding out what users do, you can also discover what aspects of the current system they like and dislike. Observation of users in their workplace or home can be either direct or indirect.

### 2.1 Direct Observation

Direct observation is a straightforward activity and will rapidly provide you with an insight into the users, their tasks, and the environment for a computer system. Direct observation can be undertaken in many ways, but generally direct observation studies are classified as either field studies or controlled studies. Field studies directly observe users in their usual work or home environment, doing their normal work or home tasks, with the observer making notes about interesting behaviors. Controlled studies directly observe users in a place other than their normal environment (for example, in a usability laboratory), performing specially devised tasks, with the observer recording their performance in some way, such as by timing tasks or particular sequences of actions.

You will learn more about field studies and controlled studies in Part 4.

Direct observation is always worth doing, as it is an easy activity to undertake and always yields interesting data, but it does have some limitations. For example, it only allows a single pass at the information gathering (or data collection), and although the observer may take notes, it is hard to get a full record of user activity in one observation session. The observer has to make decisions about what is important to record, and there is no opportunity to review that decision and look at alternative data later on. Furthermore, direct observation is considered to be obtrusive and can alter a user's behavior and performance.

**EXERCISE 2.1 (Allow 10 minutes)**

Suppose you have been asked to go into a school where a prototype of a new multimedia teaching application is being tried out by groups of 10-year-olds for the first time. The developers have asked you not to interfere with the children's activities, but to note the kinds of things they do and what difficulties they encounter. What problems might you experience using direct observation?

**DISCUSSION**

A lot will be going on: children talking at once, getting excited, changing groups, and maybe taking turns using the keyboard. Some children may not have listened to the instructions and may be more interested in disrupting the activities of others than in joining in the lesson. You will not be able to write down everything you see or hear. You will have to decide what is important and focus on that, which may mean that you miss some interesting interactions. You may also get distracted yourself and thus miss things. When you try to make sense of your notes later, you may not understand your own cryptic comments or you may not be able to read your own writing. However, despite these problems, having gone into the school you will undoubtedly have a better idea of how the teaching application can be used. So even this kind of observation is better than none at all.

Direct observation is useful early in the life cycle as part of gathering the requirements for a computer system. If you want a permanent record of your observations, then some sort of recording equipment (such as video, audio, or interaction logging) should be used.

## 2.2 Indirect Observation: Video Recording

Video recording on its own is an alternative to direct observation as it provides a permanent record of the observation session. Sometimes video recording may be used with software that automatically logs users' keystrokes or interactions. Although collecting several kinds of information can be beneficial, it means that there is more data to analyze, which can be time consuming. Because indirect observation creates more distance between observers and users, it is considered to be more objective than direct observation. Although specially mounted recording equipment (the facil-

ities typically found in a usability lab, for example) is extremely useful, you may be surprised by just how much valuable data you can collect using ordinary consumer video equipment, especially now that small digital video recorders are available at a reasonable price. However, there are some important issues to consider. You need to plan the observation, which means thinking about what you want to find out and what kind of data you need. For example, in a study of the way that people use a UI in the context of their own workplace, it may be useful to record samples of them using the UI every day over a period of several days or weeks. These interaction samples could then be analyzed; categorizing the activities, for example, will tell you what the UI is used for, what work it helps the users to do, or how often a particular task is done. A study with quite a different and much finer focus might involve an in-depth examination of two users interacting with the UI over a period of just five minutes.

There can be practical problems associated with setting up video equipment. For instance, no matter how unobtrusive you try to be, users are likely to be aware that they are being filmed. One way of reducing the impact that the equipment has on their behavior is to leave it in place for several days before recording starts, so that the users grow accustomed to it. You will also need to decide how and when you will start and stop your recording, how you will label the recording so that you can catalog it, who will change the cassette, where the equipment will be physically located, and so on.

## 2.3 Points to Consider in Relation to Observation

Both direct and indirect observation will require you to make trade-offs. If you record data using video or logging software, then you can go back and look at it later. However, you may end up with an overwhelming amount of data to analyze, which can be a problem unless you have a clear idea of what you are looking for and what you want to find out. It takes many times longer to fully analyze video than it does to film it in the first place. If you record those things of interest by hand, however, your recording will probably be incomplete because you will miss things. You will thus have a less complete picture to review later.

Direct observation is the cheapest and most straightforward way of recording observations. Automatic indirect recording provides a permanent record that you can return to later and as often as necessary. The two techniques are not mutually exclusive, since you may use direct observation to initially plan your automatic recording.

### EXERCISE 2.2 (Allow 10 minutes)

Figure 2.1 shows a machine for purchasing tickets to travel on the Prague underground. It is a standard UI, much like the machines you might use to purchase travel tickets for train journeys in other countries. But do you notice anything unusual?


**Figure 2.1** A Prague ticket machine.

## DISCUSSION

As noted previously, the UI shown in Figure 2.1 is pretty much what you would expect of a machine that lets you purchase travel tickets. However, did you notice the areas on the right-hand sides of the machines, near the coin slots, where the paint had been scraped off? This wear on the machines was caused by users who thought that the coins would drop more effectively if they were rubbed against the machine before being pushed into the slot. The reasons for this particular wear pattern on the machines would have remained unknown if someone had not gone out and observed the ticket machine being used by real commuters.

What may not be immediately apparent is how this informs the design of the UI. Basically it implies that the finish on these machines needs to be more robust. These machines are already vulnerable, as they are situated in an outside environment and exposed to all types of weather and extremes of temperature. Any damage to their finish, beyond expected wear and tear, will shorten the working life of the machine.

# 3 Interviewing Your Users



Interviewing involves talking to or questioning users. It enables the gathering of information in a fast and friendly way. You will need to plan interviews carefully, deciding in advance who to interview, what questions to ask to gather the relevant information, and how long the interviews should be. There are two main kinds of interview: structured and unstructured (flexible). A **structured interview** has predetermined questions that are asked in a set way; there is little, if any, scope for exploring additional topics that might arise during the interview. In contrast, a **flexible interview** generally has some set topics for discussion and exploration, but no set sequence: the interviewer is free to follow up the interviewees' replies, and to find out more about anything that is said.

A flexible interview is less formal than a structured interview and is very useful early in the design process for gathering requirements and gauging users' opinions about a particular idea. If you intend to undertake a flexible interview, however, you will find it useful to have a rough plan of the topics you want to cover, particularly if you are inexperienced at interviewing. This rough plan can be either in your head or discreetly written on paper and kept out of view. As you gain experience, you will find that interviewing becomes easier. Another factor you will need to consider is how to make the interviewee feel comfortable so that rapport is established between you. This is particularly important if you are trying to gain information that the interviewee may feel embarrassed or concerned about telling you. For example, some people feel embarrassed about criticizing a system, particularly if it involves describing their own difficulties in using it. In general, people who lack confidence tend to assume that the mistakes they make are due to their own stupidity rather than to poor design. Alternatively, they may think that their opinions are trivial and of no interest to you, or that what they say is of no importance. If you want to obtain this kind of information, then you will need to create a friendly, unthreatening atmosphere by being casual yourself while keeping sufficient control to direct and channel the discussion so that you obtain the information you want. This requires practice and experience.

## 3.1 Points to Consider in Relation to Interviewing

In general, the more structured the interview, the easier it is for the interviewer (Welbank, 1990). The less structured the interview, the more scope there is for picking up relevant issues, but the harder it is for the interviewer. You will need to make a judgment about the right balance to strike. Another issue to consider is how you intend to avoid asking leading questions that provoke a particular response. You will gain a lot from doing a small pilot study: either try out your interview questions and practice your interviewing skills on one or two users who will not take part in the real study, or, if you have too few users, try it out on colleagues. Data analysis is, of course, more difficult with flexible or less structured interviews, but in general such interviews provide much richer information. It is standard practice to record inter-

views with users; you should seek permission to record, and users rarely object. As with video logging, the advantage of audio recording is that you have a permanent record. Audio recordings of interviews should be transcribed so that you can examine what has been said in detail. Subtle comments can be easily missed if you rely solely on notes taken during the interview, as your notes are likely to be incomplete. A disadvantage to audio or video recording interviews is that initially the technique may change users' behavior.

## 4 Questionnaires and Surveys

Questionnaires and surveys take a different approach to interviews for the purpose of gathering information. The focus shifts from the flexible and friendly approach provided by interviewing to the preparation of unambiguous questions and statements for the gathering of more precise information.

### 4.1 Types of Question Structure

Broadly speaking, there are two question structures for questionnaires: closed questions and open questions.

#### ▶ Closed Questions

A **closed question** asks the respondent to select an answer from a choice of alternative replies. Closed questions may require just "yes" or "no" responses, or they may have some form of rating scale associated with them. Which type you use will depend on whether you need simple or detailed information, as you will see from the examples below. The simplest rating scales are just checklists consisting of basic alternative responses to a very specific question. For example, a three-point scale that allows respondents to choose "yes," "no," or "don't know" is often used (see Figure 2.2). These questions are easy to analyze because all you need to do is to count the number of responses in each category.

More complex rating scales increase the number of points (or responses) to produce a multipoint rating scale called a **semantic differential**. The meanings of just the end points are given, as shown in Figure 2.3. Users are asked to select the point along the scale that most closely matches their feelings or opinion about what is being rated.

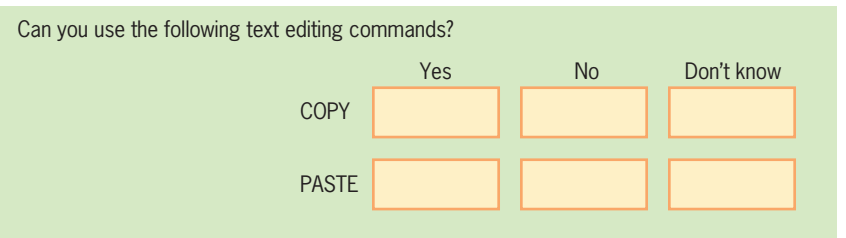


**Figure 2.2** An example of a simple checklist.

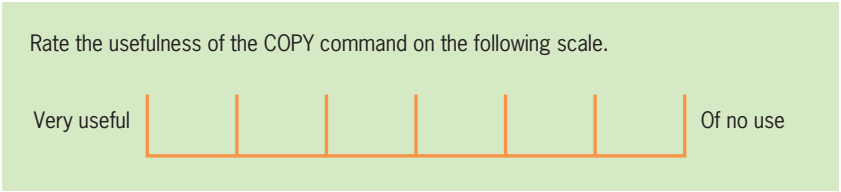


**Figure 2.3** An example of a semantic differential.

For more information on questionnaire design and attitude measurement, see Oppenheim (1999), a much easier book to read and use than its initial appearance would suggest.

You can explore a variety of views about the system such as whether the users think it is easy or hard to do certain tasks or whether it makes them feel good or bad.

Semantic differentials are often created with seven points, but five-point or even three-point scales can be just as effective and are quicker to analyze. You will get better results from semantic differentials if you make sure that the two adjectives at the end points are definitely opposed and are meaningful for each of the aspects that you are asking the users to rate. A series of specifically designed pairs of adjectives will often give you better results than asking users to rate a variety of aspects of the system from "poor" to "excellent."

A **Likert scale** is a selection of statements, each similar to a semantic differential, that when analyzed together portray a user's attitude. The construction of Likert scales requires statistical analysis that is outside the scope of this book.

Once a semantic differential has been completed by the selected population of users, then you can get a feel for the strength of opinion in the respondents by counting up the number of responses at each point in the scale. Although it is tempting to try to calculate a numeric value by adding up the plus and minus points score and dividing by the number of respondents, this can be misleading as some people rarely or never choose the outside values in the scale even though they have strong opinions, while others will choose extreme values to represent milder opinions.

### ▶ Open Questions

An **open question** allows respondents to say whatever they like in response, and they are used where there are no predetermined answers. Open questions typically start with phrases such as "What do you . . . ," "How do you . . . ," or "What ways . . . ." Limiting the amount of space on the form for the answer can encourage respondents to prioritize their points (Rubin, 1994). Open questions provide richer data than do closed questions, although the responses will be more time consuming to analyze as you you need to read each one and decide on some way of grouping and classifying them. If you have a fairly small sample, say up to 100 respondents, it may be quicker and just as effective to create a simple list of all the responses to each open question.

## 4.2 Points to Consider When Designing Questionnaires

Potentially, questionnaires can reach a large number of people, so it is important to ensure that they are well designed. A boring questionnaire that asks impertinent or

complicated questions will get a low response rate and may alienate your users. On the other hand, a carefully designed questionnaire that you have piloted can be a speedy way of getting data from a lot of users. There are several points to keep in mind when designing a questionnaire:

- Make the process easy for the person who is answering by keeping the questions simple, and ask as few questions as possible; unless absolutely necessary, aim for no more than two sides of letter paper or A4 paper (an ISO standard size of paper slightly longer and slightly less wide than letter paper).
- Make sure the questions are clear and unambiguous, as you will not be there to address any difficulties that the people completing the questionnaire may have.
- Make sure the questions will gather the information you need.
- Provide oppportunities for your respondents to offer information that you may not have thought about; for example, you might include some open questions or an "any other comments" box.

As with interviews, it is important to test your questionnaire by doing a pilot study, either with a small sample of users who will not be part of the survey or with some work colleagues.

If you need to survey a large number of users — to find out about their opinions and difficulties in relation to a system being redesigned, say — then closed questions will enable a large amount of information to be collected and analyzed relatively easily. Open questions provide a rich source of data, but making sense of this data requires more time. Generally, effective questionnaires contain a mix of both closed and open questions.

If you think you will need a more complex statistical analysis, then we advise you to consult a statistician while planning your survey. Many statistical packages are available to support data analysis; a good example is the Statistics Package for Social Sciences (SPSS). If you choose to consult a statistician, make sure you do so before designing your questionnaire. Many inexperienced evaluators fall into the trap of collecting data and then trying to decide what statistics they should apply after the fact.

## 5 Summary

This chapter explored several investigative techniques: observation, interviews, and questionnaires/surveys. Any or all of these techniques can be used in the requirements-gathering phase of UI design. Complementary investigative techniques are often used in combination; for example, you might use a questionnaire and also undertake some interviews, or you might use a questionnaire and also undertake some observation studies. This enables the strengths and weaknesses of the various techniques to be balanced.