As a management strategy, LUCID makes the commitment to user-centered design explicit and highlights the role of usability engineering in software development by focusing on activities, deliverables, and reviews. At each of the LUCID stages there are specified deliverables and timely feedback through reviews, for components such as:

- *Product definition:* high concept for managers and marketers
- *Business case:* pricing, expected revenues, return on investment, competition
- *Resources:* duration, effort levels, team members, backup plans
- *Physical environment*: ergonomic design, physical installation, communication lines
- *Technical environment:* hardware and software for development and integration
- *Users:* multiple communities for interviews, user testing, and marketing
- *Functionality:* services provided to users
- *Prototype:* early paper prototypes, key screens, running prototypes
- *Usability:* set measurable goals, conduct tests, refine interface and goals
- *Design guidelines:* modify existing guidelines, implement review process
- *Content materials:* identify and acquire copyrighted text, audio, and video
- *Documentation, training and help:* specificy, develop, and test paper, video, and online versions

The thoroughness of the LUCID framework comes from its validation and refinement in multiple projects. The templates and techniques it provides help design teams structure their activities and deliverables. Because each project has special needs, a design methodology is only the starting point for project management. While LUCID is designed to promote an orderly process, with iterations within a stage and predictable progress between stages, the framework will need to be adapted to the realities of specific projects and organizations. And while the concept of flow from stage to stage is a useful structure for organizing user-centric design activities, some projects may require the design team to back up and redo earlier stages if elements of the product concept change dramatically.

3.5 Ethnographic Observation

The early stages of most methodologies include observation of users. Since interface users form a unique culture, ethnographic methods for observing them in the workplace are becoming increasingly important. Ethnographers join work or home environments to listen and observe carefully, sometimes

stepping forward to ask questions and participate in activities (Fetterman, 1998; Harper, 2000; Millen, 2000) (Fig 3.3). As ethnographers, user-interface designers gain insight into individual behavior and the organizational context. User-interface designers differ from traditional ethnographers in that in addition to understanding their subjects, user-interface designers focus on interfaces for the purpose of changing and improving those interfaces. Also, whereas traditional ethnographers immerse themselves in cultures for weeks or months, user-interface designers usually need to limit this process to a period of days or even hours, and still to obtain the relevant data needed to influence a redesign (Hughes et a1., 1997). Ethnographic methods have been applied to office work (Suchman, 1987), air-traffic control (Bentleyet a1., 1992), and other domains.

The goal of an observation is to obtain the necessary data to influence interface redesign. Unfortunately, it is easy to misinterpret observations, to disrupt normal practice, and to overlook important information. Following a validated ethnographic process reduces the likelihood of these problems. Guidelines for preparing for the evaluation, performing the field study, analyzing the data, and

Figure 3.3

Preteen researchers with the University of Baltimore's KidsTeam observe children's reading habits in the home (left). Researchers in Paris brainstorm ideas for new familytechnologies with families from France, Sweden, and the United States (right).

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reporting the findings might include the following (Rose, Plaisant, and Shneiderman, 1995):

- Preparation
  - Understand organization policies and work culture.
  - Familiarize yourself with the system and its history.
  - Set initial goals and prepare questions.
  - Gain access and permission to observe or interview.
- Field Study
  - Establish rapport with managers and users.
  - Observe or interview users in their workplace, and collect subjective and objective quantitative and qualitative data.
  - Follow any leads that emerge from the visits.
  - Record your visits.
- Analysis
  - Compile the collected data in numerical, textual, and multimedia databases.
  - Quantify data and compile statistics.
  - Reduce and interpret the data.
  - Refine the goals and the process used.
- Reporting
  - Consider multiple audiences and goals.
  - Prepare a report and present the findings.

These notions seem obvious when stated, but they require interpretation and attention in each situation. For example, understanding the differing perceptions that managers and users have about the efficacy of the current interface will alert you to the varying frustrations that each group will have. Managers may complain about the unwillingness of staff to update information promptly, but staff may be resistant to using the interface because the login process takes six to eight minutes. In preparing for one observation, we appreciated that the manager called to warn us that graduate students should not wear jeans because the users were prohibited from doing so. Learning the technical language of the users is also vital for establishing rapport. It is useful to prepare a long list of questions that you can then filter down by focusing on the proposed goals. A\vareness of the differences between user communities, .such as those mentioned in Section 1.5, will help to make the observation and interview process more effective.

Data collection can include a wide range of subjective impressions that are qualitative or of subjective reactions that are quantitative, such as rating scales or rankings. Objective data can consist of qualitative anecdotes or critical inci-

dents that capture user experiences, or can be quantitative reports about, for example, the number of errors that occur during a one-hour observation of six users. Deciding in advance what to capture is highly beneficial, but remaining alert to unexpected happenings is also valuable. Written report summaries have proved to be valuable, far beyond expectations; in most cases, raw transcripts of every conversation are too voluminous to be useful.

Making the process explicit and planning carefully may seem awkward to many people whose training stems from computing and information technology. However, a thoughtful applied ethnographic process has proved to have many benefits. It can increase trustworthiness and credibility, since designers learn about the complexities of an organization firsthand by visits to the workplace. Personal presence allows designers to develop working relationships with several end users to discuss ideas, and most importantly, the users may consent to be active participants in the design of their new interface.

3.6 Participatory Design

Many authors have urged participatory design strategies, but the concept is controversial. The arguments in favor suggest that more user involvement brings more accurate information about tasks and an opportunity for users to influence design decisions. However, the sense of participation that builds users' ego investment in successful implementation may be the biggest influence on increased user acceptance of the final system (Damodaran, 1996; Muller, 2002; Kujala, 2003).

On the other hand, extensive user involvement may be costly and may lengthen the implementation period. It may also generate antagonism from people who are not involved or whose suggestions are rejected and even force designers to compromise their designs to satisfy incompetent participants (Ives and Olson, 1984).

Participatory design experiences are usually positive, and advocates can point to many important contributions that would have been missed without user participation. People who are resistant might appreciate the somewhat formalized multiple-case-studies *plastic interface for collaborative technology initiatives through 'video exploration (PICTIVE)* approach (Muller, 1992). Users sketch interfaces, then use slips of paper, pieces of plastic, and tape to create low-fidelity early prototypes. A scenario walkthrough is then recorded on videotape for presentation to managers, users, or other designers. With the right leadership, PICTIVE can effectively elicit new ideas and be fun for all involved (Muller, Wildman, and White, 1993). Many variations of participatory design have been proposed that engage participants to create dramatic performances, photography exhibits, games, or merely sketches and written scenarios.

Careful selection of users helps to build a successful participatory design experience. A competitive selection increases participants' sense of importance and emphasizes the seriousness of the project. Participants may be asked to commit to repeated meetings and should be told what to expect about their roles and their influence. They may have to learn about the technology and business plans of the organization and be asked to act as a communication channel to the larger group of users that they represent.

The social and political environment surrounding the implementation of complex interfaces is not amenable to study by rigidly defined methods or controlled experimentation. Social and industrial psychologists are interested in these issues, but dependable research and implementation strategies may never emerge. The sensitive project leader must judge each case on its merits and must decide what is the right level of user involvement. The personalities of the participatory design team members are such critical determinants that experts in group dynamics and social psychology may be useful as consultants. Many questions remain to be studied, such as whether homogeneous or diverse groups are more successful, how to tailor processes for small and large groups, and how to balance decision-making control between typical users and professional designers.

The experienced user-interface architect knows that organizational politics and the preferences of individuals may be more important than technical issues in governing the success of an interactive system. For example, warehouse managers who see their positions threatened by an interactive system that provides senior managers with up-to-date information through desktop displays may ensure that the system fails by delaying data entry or by being less than diligent in guaranteeing data accuracy. The interface designer should take into account the system's effect on users and should solicit their participation to ensure that all concerns are made explicit early enough to avoid counterproductive efforts and resistance to change. Novelty is threatening to many people, so clear statements about what to expect can be helpful in reducing anxiety.

Ideas about participatory design are being refined with diverse users, ranging from children to older adults. Arranging for participation is difficult for some users, such as those with cognitive disabilities or those whose time is precious (for example, surgeons). The levels of participation are becoming clearer; one taxonomy describes the roles of children in developing interfaces for children, varying from testers to informants to partners (Druin, 2002) (Fig. 3.4). Testers are merely observed as they tryout novel designs, while informants comment to designers through interviews and focus groups. Design partners are active members of a design team, which in the case of children's software will naturally involve participants of many ages-the intergenerational team.

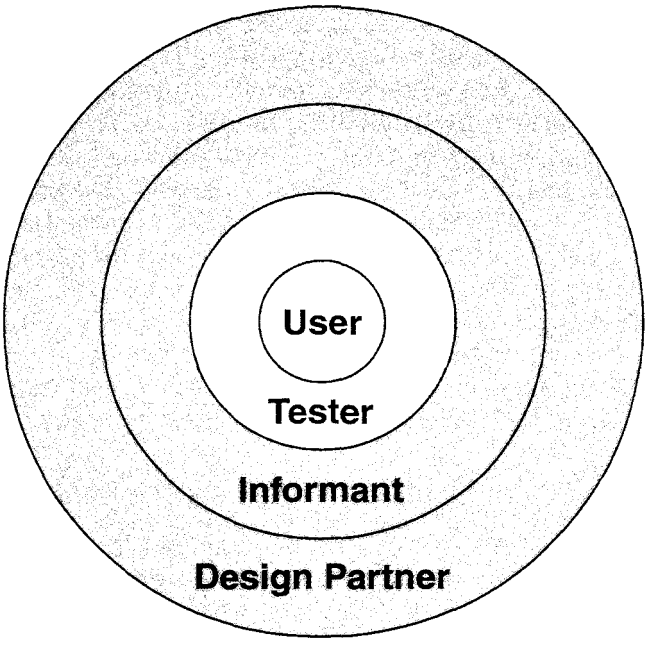

Figure 3.4

Druin's model of the four levels of user participation. The blue areas (informant and design partner) represent stages of participatory design.

3.7 Scenario Development

When a current interface is being redesigned or a well-polished manual system is being automated, reliable data about the distribution of task frequencies and sequences is an enormous asset. If current data do not exist, then usage logs can quickly provide insight.

A table with user communities listed across the top and tasks listed down the side is helpful. Each box can then be filled in with the relative frequency with which each user performs each task. Another representation tool is a table of task sequences, indicating which tasks follow other tasks. Often, a flowchart or transition diagram helps designers to record and convey the sequences of possible actions; the thickness of the connecting lines indicates the frequency of the transitions.

In less well-defined projects, many designers have found day-in-the-life scenarios helpful to characterize what happens when users perform typical tasks.

During the early design stages, data about current performance should be collected to provide a baseline. Information about similar systems helps, and interviews can be conducted with stakeholders, such as users and managers (Bodker, 2000; Carroll, 2000; Rosson and Carroll, 2001).

An early and easy way to describe a novel system is to write scenarios of usage and then, if possible, to act them out as a form of theater. This technique can be especially effective when multiple users must cooperate (for example, in control rooms, cockpits, or financial trading rooms) or multiple physical devices are used (for example, at customer-service desks, medical laboratories, or hotel check-in areas). Scenarios can represent common or emergency situations with both novice and expert users.

In developing the National Digital Library, the design team began by writing 81 scenarios that portrayed typical needs of potential users. Here is an example:

> *K-16 Users:* A seventh-grade social-studies teacher is teaching a unit on the Industrial Revolution. He wants to make use of primary source material that would illustrate the factors that facilitated industrialization, the manner in which it occurred, and the impact that it had on society and on the built environment. Given his teaching load, he only has about four hours total to locate and package the supplementary material for classroom use.

Other scenarios might describe how users explore a system, such as this optimistic vision, written for the U.s. Holocaust Museum and Education Center:

> A grandmother and her 10- and 12-year old grandsons have visited the museum before. They have returned this time to the Learning Center to explore what life was like in her shtetl in Poland in the 1930s. One grandson eagerly touches the buttons on the welcome screen, and they watch the 45-second video introduction by the museum director. They then select the button on "History before the Holocaust" and choose to view a list of towns. Her small town is not on the list, but she identifies the larger nearby city, and they get a brief textual description, a map of the region, and a photograph of the marketplace. They read about the history of the town and view 15-second videos of the marketplace activity and a Yiddish theater production. They bypass descriptions of key buildings and institutions, choosing instead to read biographies of a famous community leader and a poet. Finally, they select "GuestBook" and add their names to the list of people who have indicated an affiliation with this town. Further up on the list, the grandmother notices the name of a childhood friend from whom she has not heard in 60 years-fortunately, the earlier visitor has left an address.

This scenario was written to give nontechnical museum planners and the Board of Directors an idea of what could be built if funding were provided. Such scenarios are easy for most people to grasp, and they convey design issues such as physical installation (room and seats for three or more patrons with sound

isolation) and development requirements (video production for the director's introduction and conversion of archival films to video).

An elaborate scenario development process was conducted to help U.S. statistical agencies formulate a vision for a Statistical Knowledge Network. Patterns of citizen requests were combined with agency proposals to develop 15 brief scenarios, using first-person format, such as these two that were the basis of empirical tests of proposed interfaces:

> I'm a social activist in the Raleigh-Durham, North Carolina area and have become increasingly concerned about urban sprawl and the loss of rural areas for both farming and recreation. I need statistics to support my claim that significant differences occur when urban development occurs in rural and/or farming areas.

> I would like to open a grocery store specializing in organic products in the greater Seattle metropolitan area. What are the trends in production and consumption of organic food products? Would the Seattle area be a good place to locate?

Some scenario writers take a further step and produce a videotape to convey their intentions. There are famous future scenarios, such as Apple's *Knowledge Navigator,* made in 1988, which produced numerous controversies. It portrayed a professor using voice commands to talk with a bow-tied preppie character on the screen and touch commands to develop ecological simulations. Many viewers enjoyed the tape, but thought that it stepped over the bounds of reality by having the preppie agent recognize the professor's facial expressions, verbal hesitations, and emotional reactions. In 1994, Bruce Tognazzini's *Starfire* scenario for Sun Microsystems gave his elaborate but realistic impression of a large-screen work environment that supported rich collaborations with remote colleagues. By 2003, cell-phone developers were producing scenarios on how personal, family, and commercial relationships would change due to mobile video communications- an appealing example is the Japanese NIT DoCoMa's *Vision 2010: Beyond the Mobile Frontier,* which shows how a family can realize its goal of remaining in close contact while children go to study far away from home.

3·8 Social Impact Statement for Early Design Review

Interactive systems often have a dramatic impact on large numbers of users. To minimize risks, a thoughtful statement of anticipated impacts circulated among stakeholders can be a useful process for eliciting productive suggestions early in the development, when changes are easiest.