UNIT-I

Introduction: Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession

Managing Design Processes: Introduction, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Usability Testing and Laboratories.

Introduction

Human performance and user experience with computer and information systems will remain a rapidly expanding research and development topic in the corning decades. The interdisciplinary design science of *human-computer interaction* began by combining the data-gathering methods and intellectual framework of experimental psychology with the powerful and widely used tools developed from computer science. Then, contributions accrued from educational and industrial psychologists, instructional and graphic designers, technical writers, experts in human factors or ergonomics, information architects, and adventuresome anthropologists and sociologists. And now, as computers and user interfaces are becoming the basis for increasingly powerful sociotechnical systems, policy analysts, economists, lawyers, privacy advocates, and ethicists are playing a growing role.

User interfaces help produce business success stories and Wall Street sensations. They also produce intense competition, copyright-infringement suits, intellectual-property battles, mega-mergers, and international partnerships.

User interfaces are also controversial because of their central role in national identification schemes, homeland defense, crime fighting, medical records management, and so on.

At an individual level, user interfaces change many people's lives: effective user interfaces for professionals mean that doctors can make more accurate diagnoses and pilots can fly airplanes more safely; at the same time, children can learn more effectively and graphic artists can explore creative possibilities more fluidly.

The steadily growing interest in user-interface design, which spans remarkably diverse communities, stems from a desire to improve the user experience.

Making these diverse applications successful requires contributions from researchers and practitioners in many fields. Academic and industrial researchers are developing descriptive taxonomies, explanatory theories, predictive models, and prescriptive guidance, while experimenters are collecting empirical data as a basis for new theories. Techniques such as direct manipulation, telepresence, and virtual reality may change the ways that we interact with technology, think about our work, or relate to our friends.

As face-to-face interaction gives way to screen-to-screen, does organizational loyalty and personal trust dissipate?

Designers face the challenge of providing services on small-, wall-, and mall-sized displays, ranging from portable devices such as cell phones or pocket computers to large plasma panels and projected displays. The *plasticity* of their designs must ensure smooth conversion across display-size variations, delivery by way of web browsers or the telephone, translation into multiple languages, and compatibility with accessibility-support devices for disabled users.

Usability Requirements

Every designer wants to build high-quality interfaces that are admired by colleagues, celebrated by users, and imitated frequently.

Designers then propose multiple design alternatives for consideration, and the leading contenders are subjected to further development and testing (see Chapters 3 and 4). User-interface building tools (see Chapter 5) enable rapid implementation and easy revision. Evaluation of designs refines the understanding of appropriateness for each choice.

Effective interfaces generate positive feelings of success, competence, mastery, and clarity in the user community. The users are not encumbered by the interface and can predict what will happen in response to each of their actions.

The U.s. Military Standard for Human Engineering Design Criteria (1999) states these purposes:

• Achieve required performance by operator, control, and maintenance personnel

• Minimize skill and personnel requirements and training time

• Achieve required reliability of personnel-equipment/software combinations

• Foster design standardization within and among systems

These functional purposes are good starting points, but effective interfaces might also enhance the quality of life for users or improve their communities.

The first goal in requirements analysis is to ascertain the users/ needs-that is, what tasks and subtasks must be carried out.

Goals for requirements analysis.

1. Ascertain the users' needs.

2. Ensure proper reliability.

3. Promote appropriate standardization, integration, consistency, and portability.

4. Complete projects on schedule and within budget.

A vital second goal is to ensure proper reliability: actions must function as specified, displayed data must reflect the database contents, and updates must be applied correctly. Users/ trust of systems is fragile;

The third set of goals for designers is to consider the context of use and promote appropriate standardization, integration, consistency, and portability. As the number of users and software packages increases, the pressures for and benefits of standardization grow.

Incompatible storage formats and hardware and software versions cause frustration, inefficiency, and delay. Designers must decide whether the improvements they offer are useful enough to offset the disruption to the users.

Standardization refers to common user-interface features across multiple applications. Apple Computers 0992,2002) successfully developed an early standard that was widely applied by thousands of developers, enabling users to learn multiple applications quickly.

Integration across application packages and software tools was one of the key design principles of Unix. (Portability across hardware platforms was another.) If file formats are used consistently, users can apply multiple applications to transform, refine, or validate their data.

Consistency primarily refers to common action sequences, terms, units, layouts, colors, typography, and so on within an application program. Consistency is a strong determinant of success of interfaces. It is naturally extended to include compatibility across application programs and compatibility with paper or non-computer-based systems.

Portability refers to the potential to convert data and to share user interfaces across multiple software and hardware environments. Arranging for portability is a challenge for designers, who must contend with different display sizes and resolutions, color capabilities, pointing devices, data formats, and so on.

The fourth goal for interface designers is to complete projects on schedule and within budget. Delayed delivery or cost overruns can threaten an interface project because of the confrontational political atmosphere in a company, or because the competitive market environment contains potentially overwhelming forces.

Usability Measures

Eventually a touch screen interface with reduced functionality and better information presentation was developed and became a big success in the public reading rooms. The next step in evolution was the development of a World Wide Web version of the catalog to allow users anywhere in the world to access the catalog and other databases. These changing user communities and requirements each led to interface revisions, even though the database and services remained similar.

Careful determination of the user community and of the benchmark set of tasks is the basis for establishing usability goals and measures. For each user and each task, precise measurable objectives guide

the designer, evaluator, purchaser, or manager. The ISO 9241 standard focuses on admirable goals *(effectiveness, efficiency,* and *satisfaction),* but the following usability measures, which focus on the latter two goals, lead more directly to practical evaluation:

1. Time to learn. How long does it take for typical members of the user community to learn how to use the actions relevant to a set of tasks?

2. Speed of performance. How long does it take to carry out the benchmark tasks?

3. Rate of errors by users. How many and what kinds of errors do people make in carrying out the benchmark tasks? Although time to make and correct errors might be incorporated into the speed of performance, error handling is such a critical component of interface usage that it deserves extensive study.

4. Retention over time. How well do users maintain their knowledge after an hour, a day, or a week? Retention may be linked closely to time to learn, and frequency of use plays an important role.

5. Subjective satisfaction. How much did users like using various aspects of the interface? The answer can be ascertained by interview or by written surveys that include satisfaction scales and space for free-form comments.

Every designer would like to succeed in every category, but there are often forced tradeoffs. If lengthy learning is permitted, task-performance times may be reduced by use of complex abbreviations, macros, and shortcuts.

After multiple design alternatives have been raised, the leading possibilities should be reviewed by designers and users. Low-fidelity paper mockups are useful, but high-fidelity online prototypes create a more realistic environment for expert reviews and usability testing. The user manuals and the online help can be written before the implementation to provide another review and perspective on the design. Next, the implementation can be carried out with proper software tools; this task should be a modest one if the design is complete and precise. Finally, the acceptance test certifies that the delivered interface meets the goals of the designers and customers.

Usability Motivations

The enormous interest in interface usability arises from the growing recognition of how poorly designed many current interfaces are and of the benefits elegant interfaces bring to users. This increased motivation emanates from developers of life-critical systems; industrial and commercial systems; office, home, and entertainment applications; exploratory, creative, and collaborative interfaces; and sociotechnical systems.

1 Life-critical systems

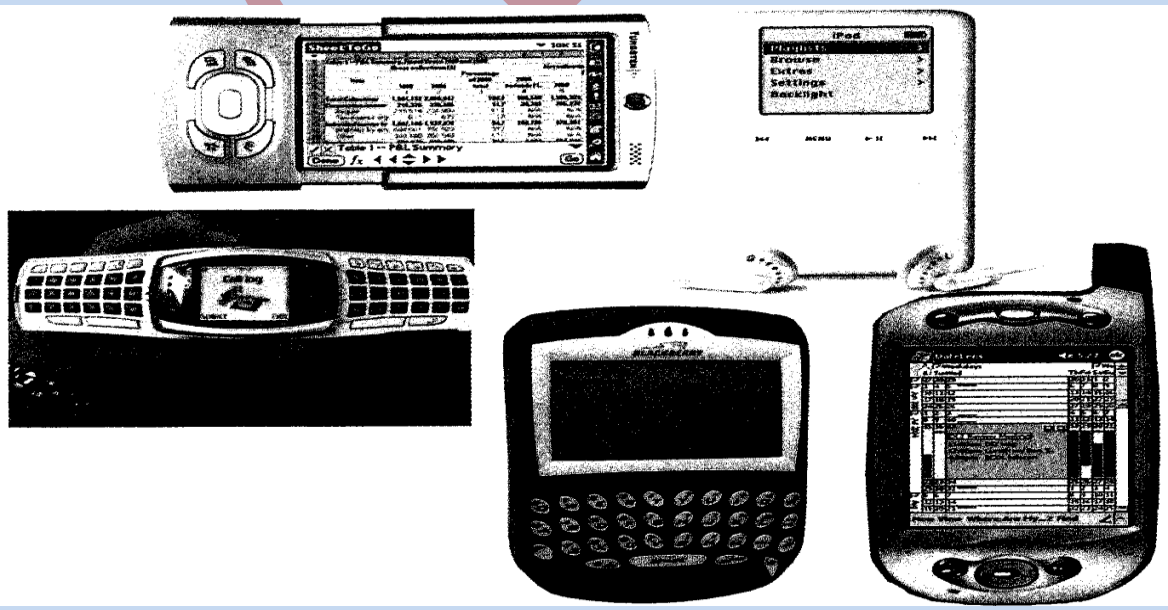
Life-critical systems include those that control air traffic, nuclear reactors, power utilities, police or fire dispatch, military operations, and medical instruments. In these applications high costs are expected, but they should yield high reliability and effectiveness. Lengthy training periods are acceptable to obtain rapid, error-free performance, even when the users are under stress. Subjective satisfaction is less of an issue because the users are well-motivated professionals. Retention is obtained by frequent use of common functions and practice sessions for emergency actions.

2 Industrial and commercial uses

Typical industrial and commercial uses include banking, insurance, order entry, inventory management, airline and hotel reservations (Fig. 1.8), car rentals, utility billing, credit-card management, and point-of-sales terminals. In these cases, costs shape many judgments. Operator training time is expensive, so ease of learning is important. Since many businesses are international, translation to multiple languages and adaptations to local cultures are necessary. The tradeoffs for speed of performance and error rates are governed by the total cost over the system's lifetime (see Chapter 11). Subjective atisfaction is of modest importance; retention is obtained by frequent use. Speed of performance becomes central for most of these applications because of the high volume of transactions, but operator fatigue, stress, and burnout are legitimate concerns. Trimming 10% off the mean transaction time could mean 10% fewer operators, 10% fewer terminal workstations, and a 10% reduction in hardware costs.

3 Office, home, and entertainment applications

The rapid expansion of office, home, and entertainment applications is the third source of interest in usability. Personal-computing applications include e-mail, bank machines, games, educational packages, search engines, cell phones, and mobile devices are shown in below.



For these interfaces, ease of learning, low error rates, and subjective satisfaction are paramount because use is frequently discretionary and competition is fierce. If the users cannot succeed quickly, they will abandon the use of a computer or try a competing package. In cases where use is intermittent, clear,

easy-to-remember procedures are important, and if retention is still faulty, comprehensible online help becomes important.

4 Exploratory, creative, and collaborative interfaces

An increasing fraction of computer use is dedicated to supporting human intellectual and creative enterprises. Exploratory applications include World Wide Web browsing (Figs. 1.11 to 1.13), search engines, scientific simulation, and business decision making. Creative environments include writing workbenches, architectural design systems (Fig. 1.14), artist or programmer workstations, and music-composition systems.

Collaborative interfaces enable two or more people to work together, even if the users are separated by time and space, through use of electronic text, voice, and video mail; through electronic meeting systems that facilitate face-to-face meetings; or through groupware that enables remote collaborators to work concurrently on a document, map, spreadsheet, or image.

5 Sociotechnical systems

A growing domain for usability is in complex systems that involve many people over long time periods, such as systems for voting, health support, identity verification, and crime reporting. Interfaces for these systems, often created by governmental organizations, have to deal with trust, privacy, and responsibility, as well as limiting the harmful effects of malicious tampering, deception, and incorrect information. Users want access to verifiable sources, adequate feedback about their actions, and ways of easily checking status. They will want to know who to tum to when things go wrong, and maybe who to thank when things go right. For example, in electronic voting systems (Bederson et al., 2003) citizens need to have reassuring feedback that their votes were correctly recorded, possibly by having a printed receipt.

In addition, government officials and professional observers from opposing parties need to have ways of verifying that the votes from each district and regional aggregations are correctly reported. If complaints are registered, investigators need tools to review procedures at every stage.

Designers of sociotechnical systems have to take into consideration the diverse levels of expertise that users with different roles have. Successful designs for the large number of novice and first-time users emphasize ease of learning and provide the feedback that builds trust. Designs for the professional administrators and the seasoned investigators will enable rapid performance of complex procedures with visualization tools to spot unusual patterns or detect fraud in usage logs.

Universal Usability

The remarkable diversity of human abilities, backgrounds, motivations, personalities, cultures, and work styles challenges interface designers. As a profession, we will be remembered for how well we meet our users' needs. That's the ultimate goal-addressing the needs of all users.

The important issues of different usage profiles (novice, intermittent, and expert users), wide-ranging task profiles, and multiple interaction styles are covered in Section 2.3.3. As interest grows in ubiquitous or pervasive computing and as market forces push towards broad consumer appeal, the pressure for designs that are universally usable will rise.

1 Variations in physical abilities and physical workplaces

Accommodating diverse human perceptual, cognitive, and motor abilities is a challenge to every designer. Fortunately, there is much research and experience from design projects with automobiles, aircraft, typewriters, home appliances, and so on that can be applied to the design of interactive computer systems.

The choice of keyboard design parameters--in terms of distance between keys, size of keys, and required pressure evolved to accommodate the differences between the physical abilities of users.

These physical abilities influence elements of the interactive-system design. They also play a prominent role in the design of the workplace or workstation (or play station). The draft standard *Human Factors Engineering of Computer Workstations*
(2002) lists these concerns:

• Work-surface and display-support height
• Clearance under work surface for legs
• Work-surface \vidth and depth
• Adjustability of heights and angles for chairs and work surfaces
• Posture-seating depth and angle; back-rest height and lumbar support
• Availability of armrests, footrests, and palmrests
• LsI.' of chair casters

2 Diverse cognitive and perceptual abilities

A vital foundation for interactive-systems designers is an understanding of the cognitive and perceptual abilities of the users . The human ability to interpret sensory input rapidly and to initiate complex actions makes modern computer systems possible.

In milliseconds, users recognize slight changes on their displays and begin to issue streams of commands. The journal *Ergonomics Abstracts* offers this classification of human cognitive processes:

• Short-term and working memory
• Long-term and semantic memory
• Problem solving and reasoning
• Decision making and risk assessment
• Language communication and comprehension
• Search, imagery, and sensory memory
• Learning, skill development, knowledge acquisition, and concept Attainment

They also suggest this set of factors affecting perceptual and motor performance:

• Arousal and vigilance
• Fatigue and sleep deprivation
• Perceptual (mental) load
• Knowledge of results and feedback
• Monotony and boredom
• Sensory deprivation
• Nutrition and diet
• Fear, anxiety, mood, and emotion
• Drugs, smoking, and alcohol
• Physiological rhythms

These vital issues are not discussed in depth in this book, but they have a profound influence on the quality of the design of most interactive systems. The term *intelligence* is not included in this list, because its nature is controversial and measuring pure intelligence is difficult.

3 Personality differences

Some people dislike computers or are made anxious by them; others are attracted to or are eager to use computers. Often, members of these divergent groups disapprove or are suspicious of members of the other community. One evident difference is between men and women, but no clear pattern of gender-related preferences in interfaces has been documented.

Unfortunately, there is no simple taxonomy of user personality types. A popular, but controversial, technique is to use the Myers-Briggs Type Indicator, which is based on Carl lung's theories of personality types. lung conjectured that there were four dichotomies:

• ***Extroversion versus introversion.*** Extroverts focus on external stimuli and like variety and action, whereas introverts prefer familiar patterns, rely on their inner ideas, and work alone contentedly.

• ***Sensing versus intuition***. Sensing types are attracted to established routines, are good at precise work, and enjoy applying known skills, whereas intuitive types like solving new problems and discovering new relations but dislike taking time for precision.

• ***Perceptive versus judging.*** Perceptive types like to learn about new situations but may have trouble making decisions, whereas judging types like to make a careful plan and will seek to carry through the plan even if new facts change the goal.

• ***Feeling versus thinking***. Feeling types are aware of other people's feelings, seek to please others, and relate well to most people, whereas thinking types are unemotional, may treat people impersonally, and like to put things in logical order.

4 Cultural and international diversity

Another perspective on individual differences has to do with cultural, ethnic, racial, or linguistic background. Users who were raised learning to read Japanese or Chinese will scan a screen differently from users who were raised learning to read English or French. More and more is being learned about computer users from different cultures, but designers are still struggling to establish guidelines for designing for multiple languages and cultures. The growth of a worldwide computer market (many U.S. companies have more than half of their sales in overseas markets) means that designers must prepare for internationalization. Software architectures that facilitate customization of local versions of user interfaces should be emphasized. For example, all text (instructions, help, error messages, labels, and so on) might be stored in files, so that versions in other languages can be generated with no or little additional programming. Hardware concerns include character sets, keyboards, and special input devices. User-interface design concerns for internationalization include the following:

• Characters, numerals, special characters, and diacritical
• Left-to-right versus right-to-Left versus vertical input and reading
• Date and time formats
• Numeric and currency formats
• Weights and measures
• Telephone numbers and addresses
• Names and titles (Mr., Ms., Mme., M., Dr.)
• Social security, national identification, and passport numbers
• Capitalization and punctuation
• Sorting sequences
• Icons, buttons, and colors
• Pluralization, grammar, and spelling
• Etiquette, policies, tone, formality, and metaphors

5 Users with disabilities

The flexibility of desktop and web software makes it possible for designers to provide special services to users who have disabilities The Access Board spells out the implications for vision- impaired, hearing-impaired, and mobility-impaired users, such as keyboard or mouse alternatives, color coding, font-size settings, contrast settings, textual alternatives to images, and web features such as frames, links, and plug-ins.

Further information about accommodation in workplaces, schools, and the home is available from many sources:

• Private foundations (e.g., the American Foundation for the Blind and the National Federation of the Blind)

• Associations (e.g., the Alexander Graham Bell Association for the Deaf, the National Association for the Deaf, and the Blinded Veterans Association) Government agencies (e.g., the National Library Service for the Blind and

Physically Handicapped of the Library of Congress and the Center for Tech-nology in Human Disabilities at the Maryland Rehabilitation Center)

• University groups (e.g., the Trace Research and Development Center on Communications and the Control and Computer Access for Handicapped Individuals at the University of Wisconsin)

• Manufacturers (e.g., Apple, IBM, Microsoft, and Sun Microsystems)

Neuman's advice to designers of courseware for learning-disabled students is applicable to all users:

• Present procedures, directions, and verbal content at levels and in formats that make them accessible even to poor readers.

• Ensure that response requirements do not allow students to complete pro- grams without engaging with target concepts.

• Design feedback sequences that explain the reasons for students' errors and that lead students through the processes necessary for responding correctly.

• Incorporate reinforcement techniques that capitalize on students' sophistica-tion with out-of-school electronic materials.

The potential for benefit to people with disabilities is one of the gifts of com-puting; it brings dividends in the increased capacity for gainful employment, social participation, and community contribution. In addition, many users are temporarily disabled: they can forget their glasses, be unable to read while dri-ving, or struggle to hear in a noisy environment. The University of Wisconsin TRACE Center and the United Nations Enable web sites provide guidelines and resources for designers who are addressing universal usability.

Older adult users

There are many pleasures and satisfactions to seniority, but aging can also have negative physical, cognitive, and social consequences. Understanding the human factors of aging can lead us to computer

designs that will facilitate access by older adult users. The benefits to senior citizens include improved chances for productive employment and opportunities to use writing, accounting, and other computer tools, plus the satisfactions of education, entertainment, social interaction, and challenge

The National Research Council's report on Human Factors Research Needs for an Aging Population describes aging as A nonuniform set of progressive changes in physiological and psychological functioning .... Average visual and auditory acuity decline considerably with age, as do average strength and speed of response.... [People experienceI loss of at least some kinds of memory function, declines in perceptual flexibility, slowing of "stimulus encoding," and increased difficulty in the acquisition of complex mental skills, ... visual functions such as static visual acuity, dark adaptation, accommodation, contrast sensitivity, and peripheral vision decline, on average, with age.

As the world's population grows older, designers in many fields are adapting their work to serve older adult citizens. Larger street signs, brighter traffic lights, and better nighttime lighting can make driving safer for drivers and pedestrians.

Similarly, desktop, web, and mobile devices can be improved for all users by providing users with control over font sizes, display contrast, and audio levels.

Interfaces can also be designed with easier-to-use pointing devices, clearer navi- gation paths, consistent layouts, and simpler command languages to improve access for older adults and every user computing for older adults enables them to share in the benefits of technology and enables others to profit from their participation. For more information on this topic, check out the Human Factors & Ergonomics Society, which has an Aging Technical Group that publishes a newsletter and organizes sessions at conferences.

Designing for and with children

Another lively community of users is children, whose uses emphasize entertain- ment and education. Even pre-readers can use computer-controlled toys, music generators, and art tools are shown in below.

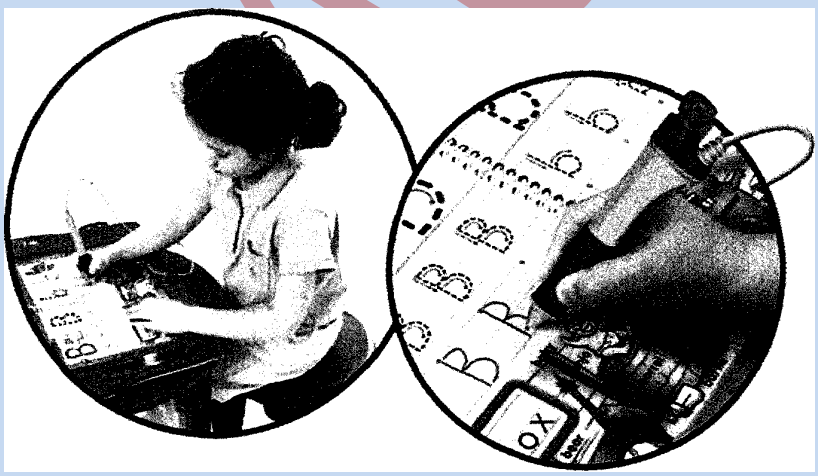


Figure: Child using an educational computer game (LeapFrog's LeapPad Learning System) which has books and a pen that children can use for learning to read, learning letter sounds, and playing games.

As they mature to begin reading and gain limited keyboard skills, they can use a wider array of portable devices, desktop applications, and web services.

Appropriate design principles for children's software recognize young peo-ple's intense desire for the kind of interactive engagement that gives them con- trol with appropriate feedback and supports their social engagement with peers.

Designing for younger children requires attention to their limitations. Their evolving dexterity means that mouse dragging, double-clicking, or small targets cannot always be used; their emerging literacy means that instructions and error messages are not effective; and their low capacity for abstraction means that complex sequences must be avoided unless an adult is involved.

Designers of children's software also have a responsibility toattend to dangers, especially in web-based environments, where parental control over access to violent, racist, or pornographic materials is unfortunately necessary. Appropriate education of children about privacy issues and threats from strangers is also a requirement.

Accommodating hardware and software diversity

In addition to accommodating different classes of users and skill levels, designers need to support a wide range of hardware and software platforms. The rapid progress of technology means that newer systems may have a hundred or a thousand times greater storage capacity, faster processors, and higher-bandwidth net-works. Designers need to accommodate older devices and deal with newer portable devices that may have low-bandwidth connections and small screens.

The challenge of accommodating diverse hardware is coupled with the need to ensure access through many generations of software. New operating systems, web browsers, e-mail clients, and application programs should provide back-ward compatibility in user-interface design and file structures.

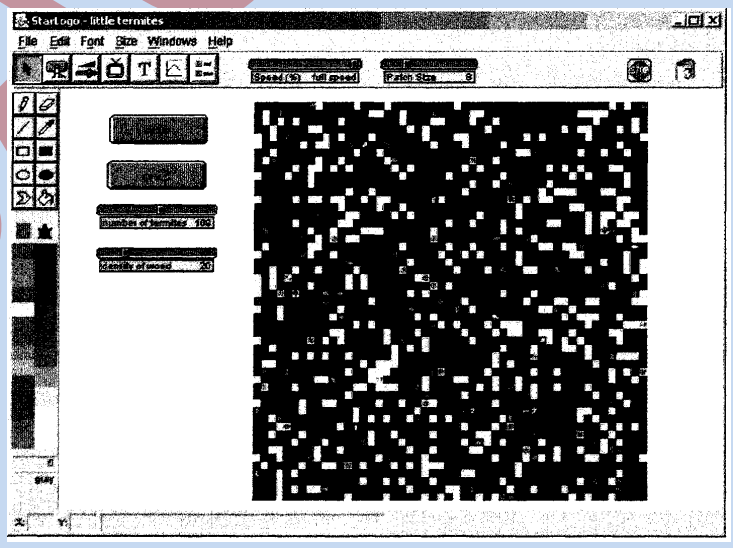


Figure: StarLogo, a programmable modeling environmentfor kids (and adults) that explores the workings of decentralized systems.

For at least the next decade, three of the main technical challenges will be:

• ***Producing satisfying and effective Internet interaction on high-speed (broadband) and slower (dial-up and some wireless) connections***. Some technology break- throughs have already been made in compression algorithms to reduce file sizes for images, music, animations, and even video, but more are needed.

• ***Enabling access to web services from large displays (1200 x 1600 pixels or larger) and smaller mobile devices (640 x 480 and smaller).*** Rewriting each web page for different display sizes may produce the best quality, but this approach is probably too costly and time-consuming for most web providers.

• ***Supporting easy maintenance of or automatic conversion to multiple languages***. Commercial operators recognize that they can expand their markets if they can provide access in multiple languages and across multiple countries.

Goals for Our Profession

Clear goals are useful not only for interface development but also for educa-tional and professional enterprises. Three broad goals seem attainable:

(1) Influencing academic and industrial researchers

(2) Providing tools, techniques, and knowledge for commercial developers and

(3) Raising the computer conscious- ness of the general public.

1 Influencing academic and industrial researchers

Early research in human-computer interaction was done largely by introspec-tion and intuition, but this approach suffered from lack of validity, generality, and precision. The techniques of psychologically oriented controlled experimentation can lead to a deeper understanding of the fundamental principles of human interaction with computers. The scientific method for interface research, which is based on controlled experimentation, has this basic outline:

• Understanding of a practical problem and related theory
• Lucid statement of a testable hypothesis
• Manipulation of a small number of independent variables
• Measurement of specific dependent variables
• Careful selection and assignment of subjects
• Control for bias in subjects, procedures, and materials
• Application of statistical tests
• Interpretation of results, refinement of theory, and guidance for experi-menters

Researchers in information science, business and management, education, sociology, anthropology, and other disciplines are benefiting and contributing by their study of human-computer interaction. There

are so many fruitful directions for research that any list can be only a provocative starting point. Here are a few:

• ***Reduced anxiety and fear of computer usage.*** Although computers are widely used, they still serve only a fraction of the population. Many otherwise com- petent people resist use of computers.

• ***Graceful evolution.*** Although novices may begin their interactions with a com- puter by using menu selection, they may wish to evolve to faster or more powerful facilities. Methods are needed to smooth the transition from novice to knowledgeable user to expert.

• ***Specification and implementation of interaction.*** User-interface building tools reduce implementation times by an order of magni-tude when they match the task. There are still many situations in which extensive coding in procedural languages must be added. Advanced research on tools to aid interactive-systems designers and implementers might have substantial payoffs in reducing costs and improving quality.

• ***Direct manipulation of.*** Visual interfaces in which users operate on a representa-tion of the objects of interest are extremely attractive.

• ***Input devices.*** The plethora of input devices presents opportunities and challenges to interface designers. There are heated discussions about the relative merits of the high-precision touchscreen; stylus, voice, eye-gaze, and gestural input; the mouse; and haptic devices. Such conflicts could be resolved through experimentation with multiple tasks and users.

• ***Online help.*** Although many interfaces offer some help or tutorial information online, we have only limited understanding of what constitutes effective design for novices, knowledgeable users, and experts.

• ***Information exploration***. As navigation, browsing, and searching of multime-dia digital libraries and the World Wide Web become more common, the pres-sure for more effective strategies and tools will increase .

2 Providing tools, techniques, and knowledge for commercial developers

User-interface design and development are hot topics, and international competition is lively. Employers, who used to see usability as a secondary topic, are increasingly hiring user-interface designers, information architects, user-interface implementers, and usability testers. These employers recognize the competitive advantage from high-quality consumer interfaces and from improving the per-formance of their employees. There is a great thirst for knowledge about soft- ware tools, design guidelines, and testing techniques. User-interface building tools (see Chapter 5) provide support for rapid prototyping and interface devel-opment while aiding design consistency, supporting universal usability, and simplifying evolutionary refinement.

Guidelines documents have been written for general and specific audiences. Many projects are taking the productive route of writing their own guidelines, which are tied to the problems of their application

environments. These guide- lines are constructed from experimental results, experience with existing inter-faces, and knowledgeable guesswork.

Iterative usability studies and acceptance testing are appropriate during interface development. Once the initial interface is available, refinements can be made on the basis of online or printed surveys, individual or group interviews, or more controlled empirical tests of novel strategies.

Goals for Our Profession

Iterative usability studies and acceptance testing are appropriate during interface development. Once the initial interface is available, refinements can be made on the basis of online or printed surveys, individual or group interviews, or more controlled empirical tests of novel strategies.

Feedback from users during the development process and for evolutionary refinement can provide useful insights and guidance. Online electronic-mail facilities allow users to send comments directly to the designers. Online user consultants and fellow users can provide prompt assistance and supportive encouragement.

Raising the computer consciousness of the general public

The media are so filled with stories about computers that raising public con-sciousness of these tools may seem unnecessary. However, many people are still uncomfortable with computers. When they do finally use a bank machine or word processor, they may be fearful of making mistakes, anxious about damaging the equipment, worried about feeling incompetent, or threatened by the computer "being smarter than I am." These fears are generated, in part, by poor designs that have complex commands, hostile and vague error messages, tortuous and unfamiliar sequences of actions, or a deceptive anthropomorphic style.

One of our goals is to encourage users to translate their internal fears into out- raged action. Instead of feeling guilty when they get a message such as SYNTAX ERROR, users should express their anger at the interface designer who was so inconsiderate and thoughtless..

Usability ultimately becomes a question of national priorities. Advocates of electronic voting and other services, promoters of e-healthcare, and visionaries of e-Iearning increasingly recognize the need to influence allocation of government resources and commercial research agendas. Policymakers and industry leaders become heroes when they facilitate access and promote quality, but they become villains when failures threaten children, disrupt travel, or menace consumers.

As examples of successful and satisfying interfaces become more visible, the crude designs will begin to appear archaic and will become commercial failures. As designers improve interactive systems, some users' fears will recede and the positive experiences of their competence, mastery, and satisfaction will flow in.

Then, the images of computer scientists and interface designers will change in the public's vie\v. The machine-oriented and technical image will give way to one of personal warmth, sensitivity, and concern for the user.

Managing Design Processes

Introduction:

With the expansion of computer use to more than just technically oriented programmers, the complex interfaces of the past are no longer accepted. The current user population are not as dedicated to the technology as they used to be. Their use of computers are tied more for their work needs and the tasks they perform, while the use of computers as entertainment has increased. Designers need to observe current user's trends to produce high-quality interfaces that accommodate the users' skills, goals, and preferences. Designers seek direct interaction with users during requirements and feature definition, the design phase, the development process, and throughout the system life-cycle through iterative design methods. Usability engineering has evolved into a recognized discipline with maturing practices and a growing set of standards.

Organizational Design:

Organizations recognize the role of usability for productivity. With the increase of novice users, products with similar functionality can succeed or fail due in part to good usability engineering. A shift in focus towards usability constitutes an organizational change to be managed. The benefits of this change are; shorter learning times, performance, error reduction. The Return on Investment (ROI) in major corporations is always questioned, the benefits must be made clear. As projects become more complex, the critical specialization in the field of usability and HCI increases. Their are interface-development activities where the ROI for usability analysis is not immediately apparent, but usability of the delivered systems crucial for success. Some industries, like aerospace, have Human Systems Integration (HSI) requirements that deal with human factors, usability, display design, navigation, and son, while meeting customer requirements. As user-interface design matures, projects grow in complexity, size, and importance where the UI designs take on new perspectives. Usability engineers and user-interface architects (UX) gain experience in managing organizational change. Design is inherently creative and unpredictable.

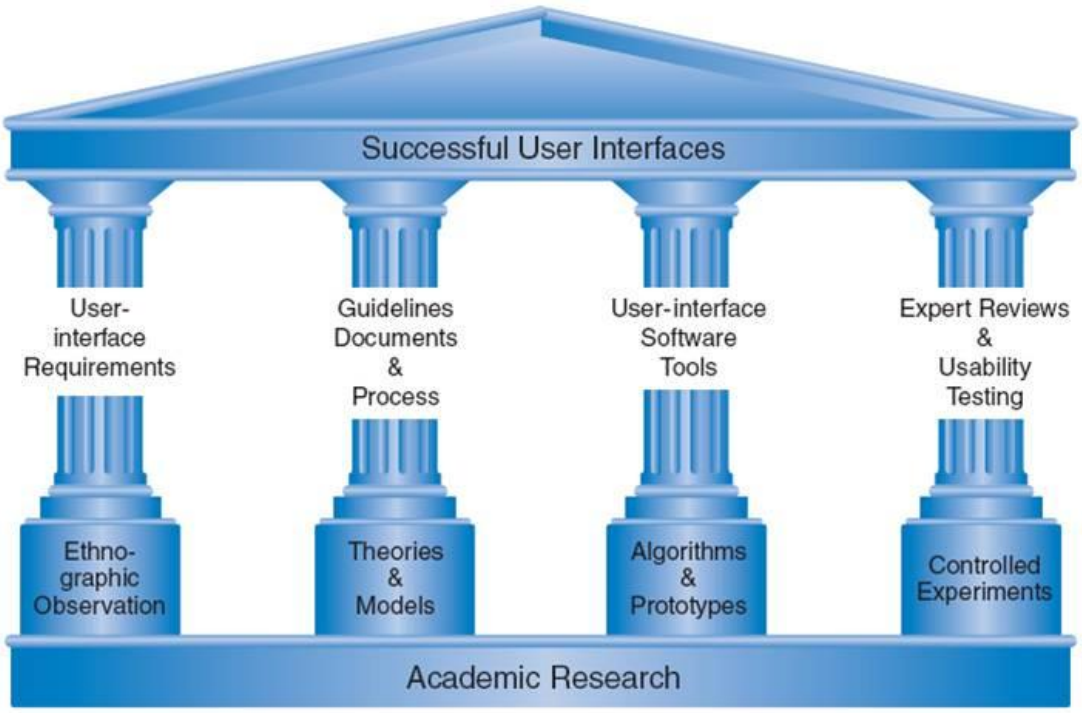
Method in Recognizing the creative and unpredictable:

- Design is a process, not an end-state and cannot be adequately represented statically
- The design process is non-hierarchical; it is neither strictly bottom-up nor top-down.
- The design process is radically transformational; involves the development of partial and interim solutions
- Design intrinsically involves the discovery of new goals.

The Four Pillars of Design:

Used to help user interface architects to turn ideas into successful systems, though not guaranteed to work flawlessly.

A set of fundamentals to assist interface designers optimize usability. These are benefits that are derived from **Academic Research** and if used properly will assist the designer in creating a **Successful Interface**.



- **Ethnographic Observation** provides **User-interface Requirements**
- **Theories and Models** provide a means of developing **Guidelines Documents & Process**
- **Algorithms and Prototypes** assist the development of **User-interface Software Tools** which can be used for Rapid-Prototyping.
- **Controlled Experimentation** provides **Expert Reviews & Usability Testing**

User Interface Requirements

For UI, the first pillar of good design is that of user interface requirements. This pillar deals with the importance of having a clear specification of the user group, and the specific tasks that the user will perform. Who will use the software, and how will they use it? You need to have a clear response to these questions if you plan on developing a useful piece of software.

This is the same in L&D. One of the first questions a trainer should ask themselves is who will be attending this training, and what are they expected to know having completed it. A successful e-learning developer will incorporate these responses into the online learning component. An e-learning project meant to teach

call reluctance and prospecting to a junior level sales team will look very different to an e-learning project meant to teach leadership development skills to a company's c-level executives.

Guidelines, Documents and Processes

An element of any good training program is a set of well-written guidelines and documents. These are written for the purpose of helping train the trainers, and it ensures that the training experience is similar no matter which instructor is chosen to lead the class. These guidelines and documents can range from a simple 10-page document that takes a maximum of one week to create, all the way up to a 300-page document that requires a solid year of work to complete. It all depends on the magnitude and importance of the training being provided. In order to create an effective training document, one should follow the "FourE's": *education*, *enforcement*, *exemption* and *enhancement*.

Education: The users of the documents (the trainers) must be provided a chance to examine and discuss the documents and guidelines. Many important questions will come up during this discussion process, and it is crucial that they are answered in order to ensure that the trainers understand the material.

Enforcement: The trainers must be evaluated on their understanding and performance of the training material. Any errors or mistakes must be corrected in order to ensure that the training matches with the guidelines.

Exemption: All trainers are different and each brings their own unique personality to the training. A rapid process for gaining exemption or approval is needed in order to allow for those spontaneous moments of training creativity. These moments are sometimes referred to as "teachable moments".

Enhancement: Training guidelines and documents must undergo a process of review, in order to correct any errors and update the material. This should be done at the very least once a year.

User-Interface Software Tools

A problem that software developers face is that clients and customers may not have a clear idea of what the final system or product will look like when it is complete. It is both difficult and costly to make sweeping changes to the software once it has already been completed. A solution to this problem is to provide the clients and customers with a realistic impression of the final product at an early stage, preferably before the development process begins.

This is something that learning and development professionals should also be doing. Training programs can be costly, both from a financial and time perspective. This is why you should always provide a clear model of what the final training program will consist of as early as possible. By using an instructional systems design model, such as ADDIE, you will ensure that you complete this important step for all of your L&D projects.

Expert Reviews & Usability Testing

Software developers perform both small and large pilot tests of different software components prior to the launch date. This is done so that they can isolate potential errors in the software, and correct them before they release the product to the market. Successful learning and development experts will do the same

with their training programs. They will ask other L&D experts to review each component of their program, including all training materials, to see if any problems exist. For large programs, especially those that will involve multiple divisions of the organization, small test-runs will be conducted to see if the program meets the learning objectives stated in the curriculum.

Development methodologies:

Many software development projects fail to achieve their goals due to poor communication between Developers and their business clients/users.

- Successful developers
  - work careful to understand the business's needs and refine their skills in eliciting accurate requirements
  - also know that careful attention to user centered design issues during software development dramatically reduces development time and cost.
  - Design methodologies include: GUIDE, STUDIO, OVID
- Rapid contextual design Examples
  - Contextual Inquiry
    - Field interviews and observation
  - Interpretation sessions and working modeling
    - Team discussions on workflow and organizational issues
  - Model consolidation and affinity diagram building
    - Synthesize observations and share with target population
  - Persona development
    - Develop fictitious characters and enact scenarios
  - Visioning
    - Walk through scenarios using the developed persona
  - Storyboarding
    - Design users tasks with visuals and sequencing
  - User environment design
    - Comprehensive and coherent representation, built from the storyboards
  - Paper prototypes and mock-up interviews
    - Testing on paper

Ethnographic Observation:

- Early stages of most methodologies include observation of users. A user group constitutes a unique culture so,

- Ethnographic methods are appropriate as they are used to observe people within their own culture
- Ethnographic methods allow for immersion by listening, observing and asking questions

- Non-traditional ethnography
  - User-interface designers observe and listen in order to create designs which improve and otherwise change the users' lives
  - User-interface designers do not have weeks and/months to observe, they must keep it short
- Intentions for observation
  - Influence design
  - Follow a valid process

Guidelines for an Ethnographic Study

- Preparation
  - Understand policies in work environments and family values in homes.
  - Familiarize yourself with the existing interface and its history.
  - Set initial goals and prepare questions
  - Gain access and permission to observe or interview.
- Field Study
  - Establish a rapport with all users
  - Observe and collect (objective/subjective, qualitative/quantitative) data
  - Follow any leads that emerge from the visits and record you visits.
- Analysis
  - Compile and organize (databases)
  - Quantify and summarize (statistics)
  - Reduce and interpret data
  - Refine and revisit goals
- Report
- Consider multiple audiences and goals
- Prepare a report and present findings

Participatory Design

Direct and collaborative involvement, including the designers and users, in designing the interfaces and organization will use. User-involvement brings richer and more accurate information. Users have an elevated sense of purpose when directly involved. Costs may increase as the project is slowed by this approach

Levels of participation

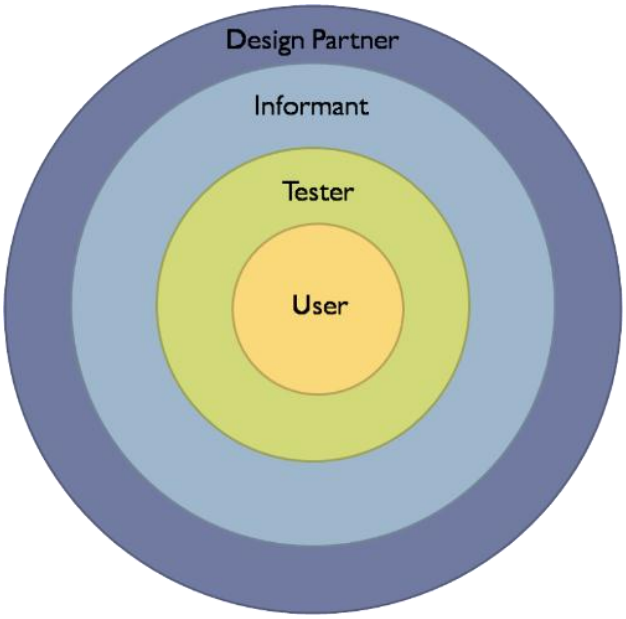


Figure: Levels of participation

Scenario Development

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

- How is the interface used?
  - What is the frequency with which each user performs each task

Scenarios

- "Day-in-the-life" helpful to characterize what happens when users perform typical tasks.
- Analogs and metaphors
- Describes novel systems
- Write scenarios of usage and then if possible, act them out as a form of theater, effective with multiple user cooperation.

Useful applications

- Control rooms, cockpits, financial trading rooms and other places where people must coordinate

Notable uses of Scenarios

Social Impacts

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 development.

* Inspired by the environmental impact statement
* Encourages early and wide discussion

Examples of a social impact statement

- **Describe the new system and it's benefits**
  - Convey the high-level goals of the new system
  - Identify the stakeholders.
  - Identify specific benefits
- **Address concerns and potential barriers**
  - Anticipate changes in job functions.
  - address security and privacy issues
  - Describe accountability and responsibility for system misuse and failure.
  - Avoid potential biases.
  - weigh individual rights
  - assess trade-offs between centralization and decentralization
  - Preserve democratic principles
  - ensure divers access
  - Promote simplicity.
- **Outline the development process**
  - Present an estimated project schedule
  - Propose a process for making decisions discuss expectations of how stake holders will be involved.
  - Recognize needs for staff, training and hardware.
  - propose a plan for backups of data
  - Outline a plan for migrating to the new system.
  - Describe a plan for measuring the success of the new system.

Legal Issues

As user interfaces have become more prominent, serious legal issues have emerged.

- Privacy

- Medical,legal, financial, an data that can be used for unapproved access illegal tampering. .
- Safety and reliability
  - User interfaces for aircraft, automobiles, medical equipment, military systems, utility control rooms anything that can effect a life or death situation.
- Patent protection for software
  - Developers who patent software who attempt to recover time and money spent on the project and make a profit.
- Piracy, P2P, file-sharing, etc.
  - Do customers have the right to store the information electronically for later use, can they share this copy, and do you own the contents of an email.
- Freedom of Speech
  - Do users have the right to make controversial or potential offensive statements through e-mail or list servers?
- Localization:
  - International, Federal, State, Municipality, etc.

Usability Testing and Laboratories

- The usability-test report provided supportive confirmation of progress and specific recommendations for changes.
- Usability testing not only sped up many projects, but also produced dramatic cost savings.
- Usability tests are designed to find flaws in user interfaces.

Usability Labs

- A typical modest usability laboratory would have two 10-by-10-foot areas, divided by a half-silvered mirror.

Step-by-Step Usability Guide

- Plan
- Analyze
- Design
- Test and Refine

Testing Considerations

- A detailed test plan is needed
- Pilot test

Handling participants and the Institutional Review Board (IRB)

- Representative samples of relevant populations
- Controls: physical, time, place, etc.
- IRB and Informed Consent
  - The IRB governs any research performed with human subjects.
- Record and annotate observations (Keystrokes, menu selections, eye-tracking)
- Participant encouragement

Techniques

- "Thinking aloud:" (Enunciating what is being done as it is being done) (Verbally evaluating on the fly)
  - often leads to many spontaneous suggestions for improvements
  - The think-aloud procedure may alter the true task time. i.e. The users may pause the task activity as they vocalize their thoughts.
- Retrospective think aloud
  - With this technique, after completing a task users are asked what they were thinking as they performed the task.
  - The drawback is that the users may not be able to wholly and accurately recall their thoughts after completing the task.

The spectrum of usability testing

Usability testing comes in many different flavors and formats. Most of the current research demonstrates the importance of testing often and at varied times during the design cycle. The purpose of the test and the type of data that is needed are important considerations. Testing can be performed using combinations of these methods as well.

Methods:

- Paper mock-ups and prototyping.
  - A test administrator plays the role of the computer by flipping the pages while asking a participant user to carry out typical tasks.
  - Inexpensive, rapid, and usually productive.
- Discount usability testing.
  - Quick and dirty approach to task analysis, prototype development, and testing
  - Widely influential because it lowers the barriers to newcomers.

    - Advocates point out that most serious problems are found with only a few participants, enabling prompt revision and repeated testing.
- Competitive usability testing.
    - Competitive testing compares a new interface to previous versions or to similar products from competitors.
- Universal usability testing.
    - This approach test interfaces with highly diverse users, hardware software platforms, and networks.
    - This will result in the creation of products that can be used by a wider variety of users.
- Field tests and portable labs.
    - This testing method puts new interfaces to work in realistic environments or in a more naturalistic environment in the field for a fixed trial period.
- Remote usability testing.
    - Since web-based applications are available internationally, it is tempting to conduct usability tests online, avoiding the complexity and cost of bringing participants to a lab.
    - This makes it possible to have larger numbers of participants with more diverse backgrounds, and it may add to the realism, since participants do their tests in their own environments and use their own equipment.
- Can-you-break-this tests.
    - Pioneered by game designers
    - Users try to find fatal flaws in the system or otherwise destroy it.

For all its success, usability testing does have at least two serious limitations: it emphasizes first-time usage and provides limited coverage of the interface features.

Usability test reports

The U.S. National Institute for Standards and Technology took a major step towards standardizing usability-test reports in '97. The Common Industry Format describes the testing environment, tasks, participants, and results in a standard way so as to enable consumers to make comparisons.