Human-Computer Interaction

Design Issues, Solutions, and Applications

Edited by
Andrew Sears
Julie A. Jacko

Human Factors and Ergonomics

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PREFACE

We are pleased to offer access to a select set of chapters from the second edition of *The Human–Computer Interaction Handbook*. Each of the four books in the set comprises select chapters that focus on specific issues including fundamentals that serve as the foundation for human–computer interactions, design issues, issues involved in designing solutions for diverse users, and the development process.

While human–computer interaction (HCI) may have emerged from within computing, significant contributions have come from a variety of fields including industrial engineering, psychology, education, and graphic design. The resulting interdisciplinary research has produced important outcomes including an improved understanding of the relationship between people and technology as well as more effective processes for utilizing this knowledge in the design and development of solutions that can increase productivity, quality of life, and competitiveness. HCI now has a home in every application, environment, and device, and is routinely used as a tool for inclusion. HCI is no longer just an area of specialization within more traditional academic disciplines, but has developed such that both undergraduate and graduate degrees are available that focus explicitly on the subject.

The HCI Handbook provides practitioners, researchers, students, and academicians with access to 67 chapters and nearly 2000 pages covering a vast array of issues that are important to the HCI community. Through four smaller books, readers can access select chapters from the Handbook. The first book, *Human–Computer Interaction: Fundamentals,* comprises 16 chapters that discuss fundamental issues about the technology involved in human–computer interactions as well as the users themselves. Examples include human information processing, motivation, emotion in HCI, sensor-based input solutions, and wearable computing. The second book, *Human–Computer Interaction: Design Issues,* also includes 16 chapters that address a variety of issues involved when designing the interactions between users and computing technologies. Example topics include adaptive interfaces, tangible interfaces, information visualization, designing for the web, and computer-supported cooperative work. The third book, *Human–Computer Interaction: Designing for Diverse Users and Domains,* includes eight chapters that address issues involved in designing solutions for diverse users including children, older adults, and individuals with physical, cognitive, visual, or hearing impairments. Five additional chapters discuss HCI in the context of specific domains including health care, games, and the aerospace industry. The final book, *Human–Computer Interaction: The Development Process,* includes fifteen chapters that address requirements specification, design and development, and testing and evaluation activities. Sample chapters address task analysis, contextual design, personas, scenario-based design, participatory design, and a variety of evaluation techniques including usability testing, inspection-based techniques, and survey design.

Andrew Sears and Julie A. Jacko

March 2008

ABOUT THE EDITORS

Andrew Sears is a Professor of Information Systems and the Chair of the Information Systems Department at UMBC. He is also the director of UMBC's Interactive Systems Research Center. Dr. Sears' research explores issues related to human-centered computing with an emphasis on accessibility. His current projects focus on accessibility, broadly defined, including the needs of individuals with physical disabilities and older users of information technologies as well as mobile computing, speech recognition, and te difficulties information technology users experience as a result of the environment in which they are working or the tasks in which they are engaged. His research projects have been supported by numerous corporations (e.g., IBM Corporation, Intel Corporation, Microsoft Corporation, Motorola), foundations (e.g., the Verizon Foundation), and government agencies (e.g., NASA, the National Institute on Disability and Rehabilitation Research, the National Science Foundation, and the State of Maryland). Dr. Sears is the author or co-author of numerous research publications including journal articles, books, book chapters, and conference proceedings. He is the Founding Co-Editor-in-Chief of the *ACM Transactions on Accessible Computing*, and serves on the editorial boards of the *International, Journal of Human–Computer Studies*, the *International Journal of Human–Computer Interaction*, the *International Journal of Mobil Human–Computer Interaction*, and *Universal Access in the Information Society*, and the advisory board of the upcoming *Universal Access Handbook*. He has served on a variety of conference committees including as Conference and Technical Program Co-Chair of the Association for Computing Machinery's Conference on Human Factors in Computing Systems (CHI 2001), Conference Chair of the ACM Conference on Accessible Computing (Assets 2005), and Program Chair for Asset 2004. He is currently Vice Chair of the ACM Special Interest Group on Accessible Computing. He earned his BS in Computer Science from Rensselaer Polytechnic Institute and his Ph.D. in Computer Science with an emphasis on Human–Computer Interaction from the University of Maryland—College Park.

Julie A. Jacko is Director of the Institute for Health Informatics at the University of Minnesota as well as a Professor in the School of Public Health and the School of Nursing. She is the author or co-author of over 120 research publications including journal articles, books, book chapters, and conference proceedings. Dr. Jacko's research activities focus on human–computer interaction, human aspects of computing, universal access to electronic information technologies, and health informatics. Her externally funded research has been supported by the Intel Corporation, Microsoft Corporation, the National Science Foundation, NASA, the Agency for Health Care Research and Quality (AHRQ), and the National Institute on Disability and Rehabilitation Research. Dr. Jacko received a National Science Foundation CAREER Award for her research titled, "Universal Access to the Graphical User Interface: Design For The Partially Sighted," and the National Science Foundation's Presidential Early Career Award for Scientists and Engineers, which is the highest honor bestowed on young scientists and engineers by the US government. She is Editor-in-Chief of the *International Journal of Human–Computer Interaction* and she is Associate Editor for the *International Journal of Human Computer Studies*. In 2001 she served as Conference and Technical Program Co-Chair for the ACM Conference on Human Factors in Computing Systems (CHI 2001). She also served as Program Chair for the Fifth ACM SIGCAPH Conference on Assistive Technologies (ASSETS 2002), and as General Conference Chair of ASSETS 2004. In 2006, Dr. Jacko was elected to serve a three-year term as President of SIGCHI. Dr. Jacko routinely provides expert consultancy for organizations and corporations on systems usability and accessibility, emphasizing human aspects of interactive systems design. She earned her Ph.D. in Industrial Engineering from Purdue University.

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VISUAL DESIGN PRINCIPLES FOR USABLE INTERFACES

Everything Is Designed: Why We Should Think Before Doing

Suzanne Watzman
Watzman Information Design

Margaret Re
UMBC

Take a moment and visualize Las Vegas at night. What kind of image does this conjure up for you? Flashing lights from all directions, a hotel's lighting display designed to outdo its neighbor as well as that of the casino signage down the street. At first glance, everything is exciting, colorful, and beautiful. Now add a fireworks display to your picture. More color, more excitement. Where do you look first? There is so much going on; it is hard to see it all, but you don't want to miss a thing. Your head turns in all directions. You look there; then, out of the corner of your eye, you see something else. Look over there! Now the fireworks are at their peak, and the noise gets even louder. Any conversation with companions is impossible, yet it is also impossible to focus on any one thing for more than a split second. You are overwhelmed and overloaded. Everything is screaming for your

attention. Can you manage to pay attention? For how long? Do you begin to shake your head in despair, and give up? Do you wish you were somewhere else—NOW?

MAKING THINGS EASIER TO USE AND UNDERSTAND: THINKING ABOUT THE USER'S EXPERIENCE

The previous description is unfortunately an accurate analogy of many users' experiences as they attempt to learn, work, play, and relax. New products, new services, and new technology with which you are unfamiliar can create confusion. Users of these new products, services, and technology are customers, electricians, grandparents, clerks, pilots, and students—you and me. And for most of us, it's a jungle out there! Las Vegas at night with fireworks, or monitors that are winking, blinking, distracting, disturbing, overwhelming—and, after a short time, visually deafening. Now add voices coming from boxes. . .! Although this may seem like an exaggeration, for many this situation is exactly their experience. User interface design focuses on designing flexible environments that have a positive impact on a user's ability to experience and interact with a product, whether that product is a mobile communication device, website, information kiosk, or appliance. It involves creating environments that include strong navigational devices that can be understood intuitively and used effortlessly. Designers have a responsibility to create user experiences that are simple and transparent. To do their job well, they must advocate on behalf of the user, ensuring that the interfaces they design are not just merely exercises in technology but that they truly assist and guide the user from task to task, enabling work to be done, and ultimately improving quality of life. When designers succeed, their products can be used effortlessly and are even pleasurable to use. Good design does not needlessly draw attention to itself. It just works. This is the role of good design.

DEFINING VISUAL DESIGN

The nautilus shell is an example of the synthesis between form and function found in nature (Fig. 1.1). Its form is the result of evolution, which is both transparent and beautiful. The nautilus shell is a perfect analogy for design and the design process because it creates valuable user experiences and usable interfaces.

The word *design* functions as both a noun and a verb. Many people use it to refer to the outward appearance or style of a product. However, design also refers to a process—that of intentionally establishing a plan or system by which a task can be accomplished or a goal reached. It includes tangible and intangible systems in which objects or processes are coherently organized to include the environments in which these objects or processes function. Design affects all people in every aspect of what they do. Good design performs for people. It is concerned with economics and the transmission of ideas. The challenge presented to a design team is to plan a

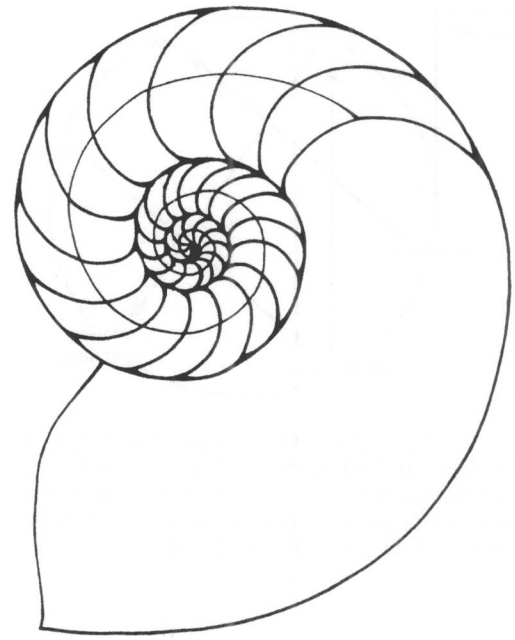

FIGURE 1.1. Nautilus Shell.

prototype with a clear purpose that is easy to use, meets user needs, addresses commercial considerations, and can be mass-produced. Its visual form, whether two- or three-dimensional, digital or analog, logically explains its purpose and efficiently leads the user through its function. Design is not a series of subjective choices based on personal preference, at best a cosmetic afterthought considered if time and money are leftover. Good design is the tangible representation of product goals. An iterative and interactive process that requires active learning, design unifies a wide range of disciplines. Good design is a significant activity that reveals multiple solutions to each problem. Design equally values different ways of thinking. It allows people with a variety of skills and learning abilities to work cooperatively to bring insights and expertise to problems and opportunities in order to better develop new and innovative solutions. Problems can be analyzed using a multitude of viewpoints and methods. Writing, drawing, statistical analysis, graphing, discussion, interviewing, personal observation, model-making, and diagramming are all legitimate methods for examination as the physical, social, and cultural contexts of possible answers are considered (Davis, Hawley, McMullan, & Spilka, 1997)

THE DESIGN PROCESS

Design as a Catalyst for Learning, a publication funded in part by the National Endowment for the Arts, argued that effective design that responds to human problems uses the following steps (Fig. 1.2):

- *Problem identification and definition:* A need or problem is identified, researched, and defined.

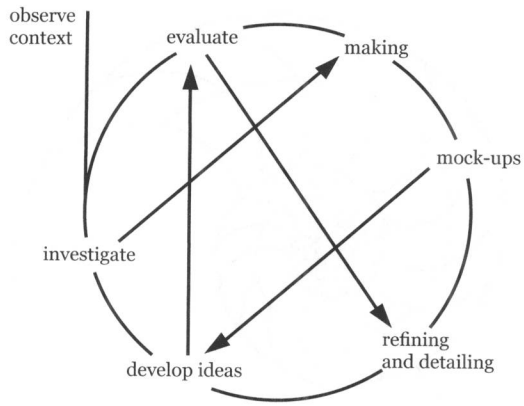

FIGURE 1.2. Interacting Design Loop. The interacting design loop developed by Richard Kimbell, founder of the Technology Education Research Unit at Goldsmiths College, and presented in *Design as a Catalyst for Learning*, captures the divergent, iterative and cyclical nature of the design process.

- *Gathering and analyzing information:* The focus is on learning what is not known. Assumptions are questioned. Wide and broad research is used to locate information and generate ideas.
- *Determining performance criteria for a successful solution:* Research continues as imagery is selected. Rules are declared and what is known is specified.
- *Generating alternative solutions and building prototypes:* Multiple solutions are generated. A variety of methods for analysis, such as drawing, interviewing, modeling or evaluating statistics, are used.
- *Implementing choices:* Project content, scope, and intent are formally established. Initial possibilities are represented and presented as prototypes.
- *Evaluating outcomes:* Prototypes are assessed, tested, evaluated, and judged. The knowledge gained is incorporated into further studies and refinements.
- *Production:* A prototype, which is a synthesis of the initial solutions made using this process, and specifications are released for making multiples to a manufacturer.

THE ROLE OF THE DESIGNER

Visual design decisions are based on project goals, user perspective, and informed decision making. While many aspects of design are quantifiable, there are visual principles that are less measurable but equally important. Even though the necessary skills to become visually literate and make competent design decisions can be learned, design involves a highly specialized knowledge base. A unique combination of creativity and skill differentiates and makes one design more attractive and desirable than another. Both education and talent are necessary to apply the principles required to present information in its most accessible, useful, and pleasing form. The role of the designer in the development of interfaces for interactive products is to understand the product goals and ensure that information is approachable, useful, and desirable. In an environment in which the interface is the only tangible representation of a product and user perception determines product success, appropriate information presentation and visual design are key. Designers understand visual principles in context, and know how to apply them appropriately to create innovative, functional and aesthetically pleasing solutions.

THE PROCESS OF GOOD DESIGN—HOW DO WE GET THERE FROM HERE?

Interface designers are responsible for defining what the experience will be like when a product is used. While print media dictates that users encounter content in a largely predetermined sequence, an interface offers the user greater flexibility over how content can be accessed based on users' needs and wants. A successful interface can be easily navigated. Interface designers define, decide, and then create the experience for users, so that an experience with a product is useful, meaningful, even pleasant and empowering. The designer must maintain an attitude of unbiased discovery and empathy for the user. The designer must develop clearly defined goals in order to create a good design that includes an evaluation process that supports and enhances these goals, and includes the flexibility to respond to changes as the process continues and products evolve.

AN INFORMATION-DESIGN PROCESS IS AN INFORMED DESIGN PROCESS

An information-design process (IDP) is a method of visually structuring and organizing information to develop effective communication. Information design is not superficial or decorative, but is rather a merging of functional, performance-based requirements with the most appropriate form to present these requirements. A thoughtful, well-designed solution will,

- *Motivate users:* It psychologically entices an audience, convincing members that information and tasks can be successfully handled.
- *Increase ease of use and accessibility:* The effort needed to comprehend information is decreased. A clear path that aids in skimming and referencing text and gives easy access is provided.
- *Increase the accuracy and retention of the information:* Users learn and retain information better when it is visually mapped and structured in obvious and intuitive ways.
- *Focus on the needs of its users:* Multiple audiences have different requirements and styles of learning. Solutions should be developed that provide alternative means of accessing information for different types of users. An information-design approach is part of a process that incorporates research, design, testing, and training to produce useful, cost-effective solutions.

Phase 1: The Audit

The goal of the audit is to create a blueprint for the project, much like architectural drawings are developed before constructing a building (Fig. 1.3). The audit process begins by asking and answering a number of questions and acknowledging ongoing change and an ever-increasing palette of products and services. Questions are asked throughout the entire product life cycle, since the answers/design solutions reflect the user/use environment and affect the ongoing usefulness and value of the product. To create an eloquent design, continually ask and answer the following questions:

Audit Questions A

- *Who* are the product users?
- *How* will this product be used?
- *When* will this product be used?
- *Why* will this product be used?
- *Where* will this product be used?
- *How* will the process evolve to support this product as it evolves?

After the first set of questions are asked and answered, a second set of questions must be asked and answered:

Audit Questions B

- What is the most efficient, effective way for a user to accomplish a set of tasks and move on to the next set of tasks?
- How can the information required for product ease of use be presented most efficiently and effectively?
- How can the design of this product be done to support ease of use and transition from task to task as a seamless, transparent, and even pleasurable experience?
- What are the technical and organizational limits and constraints?

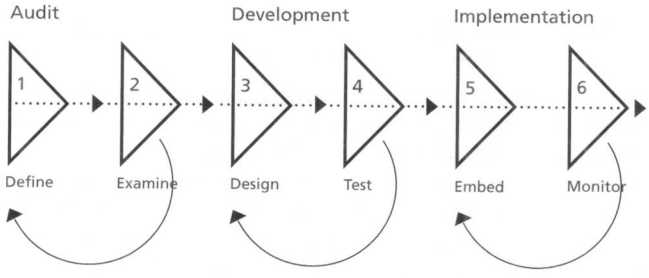

FIGURE 1.3. Information Design Process (IDP). IDP is phased to insure user and organizational needs are met. It is ongoing and iterative, throughout the lifecycle of a product. Any change can trigger a recycling of this process, to insure solutions remain appropriate and useful.

An audit focuses on discovery. Many disciplines and organizational resources must be consulted. Change is a given, since designers begin with assumptions and don't know all they need to know yet. The answers to their questions and their analysis in the context of organizational objectives provide the basis for the audit report, which serves as the guide in design development. The audit report can be as simple as a two-page list or as complex as a comprehensive hundred-page report. Since the goal is discovery, it includes every aspect of the organization concerned with the product-development cycle: project management, usability engineering, technical development, user support and documentation, visual communication and design, and content management. With these goals, the result is unbiased, accurate, comprehensive information that serves as the basis for design.

Phase 2: Design Development

The design-development phase uses the audit report as a guideline. This is an ongoing, iterative process with each iteration incorporating user test results to make the product appropriate to the particular set of needs. In reality, the length of this process is often defined and limited by real-world deadlines such as product release dates. The design-development phase includes design and testing. The designer or design team creates a number of solutions based on results and objectives determined by the audit report as well as other project specifics. Initially, design ideas should be very broad, incorporating many ideas and options no matter how unrealistic or unusual. As ideas are tested, user feedback incorporated, and other parameters defined, solutions naturally become more defined. Surviving design ideas are then based on solid information derived from user feedback, providing a strong basis for final design decisions. In the beginning, the focus is on high-level concepts and navigation. How will the product work? What will it feel like to use? As initial concepts are refined, design details become more specific. When the conceptual model and organizational framework are approved, the design of the look or product package begins. By the end of this phase, a prototype design to be carried out in implementation and monitoring is tested, approved, and specified.

Phase 3: Implementation and Monitoring

The implementation phase focuses on delivering what has been defined, designed, and documented in the preceding phases. It is the final part of a *holistic* process that defines everything necessary to make a product succeed on an ongoing basis. This includes not only the implementation of the design within the technology, but also any additional support such as the creation of training materials and other reinforcements that enhance use and productivity. Continuous monitoring is key to sustained success, because a successful product responds to evolving technology and user needs. This last phase is mostly consultative and ongoing throughout the product lifecycle in order to ensure that changes such as new technology and product developments are reflected in the product itself. These may in fact trigger another audit/design/testing cycle, although usually less extensive than the initial process. Though the implementation

phase is called "the last phase," it reveals the evolutionary process of design and development. The goal of ongoing monitoring of solutions is to be aware of changes in user needs, technology, and competition that impact user acceptance and satisfaction. Changes here often result in the need to reevaluate and redesign to incorporate this new knowledge gained.

VISUAL DESIGN PRINCIPLES

Interaction design bridges many worlds: that of visual design, information presentation, and usability with aesthetics. Donis A. Donis (1973a), in *A Primer of Visual Literacy,* argued that art and its meaning have dramatically changed in contemporary times from one that involved a concern with function to one that views the process of creating art as that of making emotional maps that spring from the province of the intuitive and subjective. This argument extends to design. To someone unskilled in creating effective communications, visual design is often understood as personal preference limited to style or appearance. However, any form of effective design is a result of rigorous study, a concern for organization and usability combined with knowledge of the basic design principles of harmony, balance, and simplicity. Visual design is in fact a form of literacy.

UNIVERSAL PRINCIPLES OF VISUAL COMMUNICATION AND ORGANIZATION

The principles of harmony, balance, and simplicity are related yet distinct in meaning and application. *Harmony* is the grouping of related parts, so that all elements combine logically to make a unified whole. In interface design, as with other categories of design, this is achieved when all design elements work in unity. Transitions from place to place are effortless and the techniques used to achieve this harmony are unnoticed by the user. Visual harmony achieves the same goal as musical harmony in which notes combine to create a chord. The golden section, also known as the "golden mean" or "golden rectangle," is one of the most widely used methods for creating harmony. Architects, artists, musicians, mathematicians, and designers have used the golden section extensively for centuries to create proportional relationships (Fig. 1.4).

Balance offers equilibrium or rest. Donis stated that equilibrium is the strongest visual reference (Donis, 1973b). It provides the equivalent of a center of gravity that grounds the page. Without balance, the page collapses, all elements are seen as dispersed, and content is lost. Balance requires continual modification from page to page because while each page is part of a greater system, elements can vary and all have visual weight. In the same way that a clown balancing on a ball while juggling objects of different weights must continually make adjustments for actions that are occurring, visual balance requires the same concerns and adjustments as in the physical world. Regardless of how a design is organized, it must achieve stability and unity in order for a user to feel comfortable with the solution. Balance can be

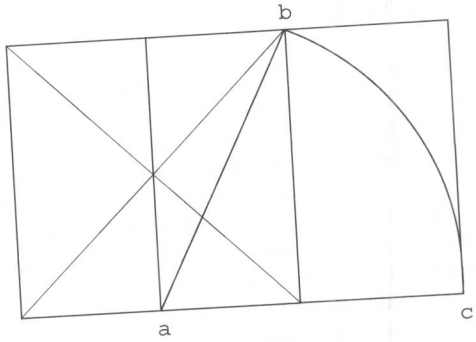

FIGURE 1.4. The Golden Rectangle. Divide a square to find the center point (a) from which length (ab) is found. From point (a) the length (ab) is swung as an arc to point (c) to create a rectangle that uses the proportions of the golden section.

achieved a number of ways. One obvious method uses *symmetry,* such as found on a page with text and image aligned on a centered axis. Deceptively simple, symmetry form is often considered easy to make; however, unless handled carefully a symmetrical composition can be predictable, boring, and static. *Asymmetry* employs nonaxial balance and uses contrast between elements such as weight, form, and color to create visual tension and drama. Both are valid approaches and require skill and knowledge of complex visual interaction to achieve.

Simplicity is the embodiment of clarity, elegance, and economy. A solution that offers simplicity is unambiguous and easily understood. It offers clarity working effortlessly devoid of unnecessary decoration. It appears deceivingly easy, accessible, and approachable, even though it may be conceptually rich. Simplicity involves distillation—every element is indispensable, if an element is removed, the composition falls apart. Achieving simplicity is no easy task. Two guidelines for creating simple design solutions are (a) "Less is more!" (attributed to Mies van der Rohe) and (b) "When in doubt, leave it out!" (Anonymous). The most refined design is direct and includes only essential elements. Removing any element breaks the composition rendering it unintelligible or radically different.

VISUAL DESIGN TOOLS AND TECHNIQUES

New technologies are rapidly being created that extend past the simple automation of tasks and communication; they are revolutionizing processes and the resulting products. Before the revolution brought about by electronic publishing technology, many disciplines such as writing, editing, design, publishing, and programming were discrete units that handled a defined step within a larger process. Today's new publishing environments encourage the possibility of a *renaissance* publisher—a person who can create, design, publish, and distribute. Yet the process used to arrive at successful solutions is very complex and extends past technical knowledge to include a mastery of visual and verbal language in order to build effective

communication. Focus must be placed on the factors that determine success with constant evaluation and adjustment of these factors in light of new developments.

The Five Criteria for Good Design

Before any work begins, all participants in the process should have a clear understanding of the criteria for good design. The following questions are guidelines for evaluation of design solutions before, during, and after the process to ensure that all solutions remain valid as products, technology, and user needs evolve.

- ***Is it appropriate?*** Is the solution appropriate for the particular audience, environment, technology, and/or culture?
- ***Is it durable?*** Will the solution be useful over time? Can it be refined and transitioned as the product evolves and is redefined?
- ***Is it verifiable?*** Has the design been tested by typical users in the environment that it will be used in? Has feedback been properly evaluated and used to improve the product?
- ***Does it have impact?*** Does the design solution not only solve the problem, but also impact the look and feel, so that the user finds the product experience comfortable, useful, and desirable?
- ***Is it cost effective?*** Can the solution be implemented and maintained? Are individuals with the necessary skills and understanding to create, refine, and maintain the design available throughout the product's life? The cost of any design begins with the audit and design phases, but continues after the implementation phase to insure that it remains advantageous and cost-effective. The hard and soft costs of delivering the solution plus ongoing maintenance add up to the real design costs.

Visual Design Principles at Work

The following sections outline the disciplines and principles used to create quality design solutions. Each topic is worthy of extended study, because there is much to understand when evaluating how to effectively present information. As the design process evolves, insights and information are discovered that impact a solution. It is optimistic to base solutions on an initial exercise because the very nature of process means discovering what is unknown yet critical. Therefore, all members involved in the design process must remain open and ready to incorporate new information, which may change or delay results, but more accurately reflect user needs.

For example, if a new feature is developed that changes a product's target audience from mid-level managerial to executive users, most methods for critical interaction and content delivery should be reconsidered. Executives have less time and need different information. The result might be a simpler interface with streamlined content that uses a larger typeface and a more conservative visual language. The most important principle to remember when thinking about design is that there are no rules, only guidelines. Everything is context sensitive. Always consider and respect the users.

Typography

In *The Elements of Typographic Style*, the poet and typographer Robert Bringhurst (2005) described typography as frozen language. *Typography* is the visual representation of spoken and unspoken thought that allows an idea to be shared across time and distance independent of its creator. A functional and expressive art that shares many of the same concerns as writing and editing, typography involves organizing text so that its meaning is communicated according to an author's intent. In design, a literacy that provides an understanding of typography and how text can be structured in space is as important as a literacy that understands how to structure grammar in order to explicate content.

Typography is made from type, individual characters organized by visual characteristics into typefaces. Type is the smallest definable part of a design, much like a pixel is to a screen display. James Felici (2003), who has worked through evolutions in typesetting technologies in *The Complete Manual of Typography*, defined a font as the electronic file that contains the programming code needed to make the characters found in a typeface. Historically, a typeface consists of all the individual characters or glyphs at a given size: letterforms, punctuation, numbers, mathematical symbols, diacritical marks, and other accessory characters needed to fully compose a text. This definition serves as a reminder to read a text carefully and consider all needs before selecting a typeface and developing a presentation form (Fig. 1.5).

Effective typography is rational. It is concerned with clarity and comprehension; the ease in which characters and word shapes are recognized in reading environments and the ease in which they can be used. It extends past the shapes of individual letters and their potential combinations to include the relationships found between word and interword shapes, functional groupings that ultimately progress into issues of type weight, slope, width and scale, characteristics that act as interpretative devices in order to create influential and

FIGURE 1.5. Type Family. A type family is built around four core members: roman, bold, italic, and bold italic. Additional members may include typefaces whose weight and width are variants of the core group. A family can also contain expert sets that offer additional or alternate characters such as small caps, fractions and non-aligning numbers.

persuasive form. If the principles of good typography can be understood and applied, then these same principles can be extended to more complex issues that follow such as page and product design. Typographic choice affects legibility and readability, the ability to easily see and understand what is on the page, in all media. Walter Tracy (1986), in *Letters of Credit: A View of Type Design,* offered the most useful definitions for legibility and readability. *Legibility,* the speed at which letters and the words built from them can be recognized, refers to perception. *Readability*, the facility and ease with which text can be read, refers to comprehension. Legibility and readability are related. Regardless of media, legibility and readability are determined by variables such as point size, letter pairing, word spacing, line length and leading, resolution, color, and organizational strategies such as text clustering. Together, legibility and readability comprise typography's functional aspects. Good typography, like good design, is invisible to the user—it just works (Fig. 1.6).

Selecting an appropriate typeface for a specific purpose and context requires experience and understanding (Fig. 1.7). With thousands of typefaces to choose from and numerous ways to manipulate them, finding the typeface best suited for an audience is not easy. With its lack of control, multiple media, and varied viewing contexts the current publishing environment makes this a complex task.

Typeface choice impacts whether and how a communication is read. Distinct typefaces and typographic styles create environments that influence a user's perception of text. The physical nature of the presentation itself helps determine content and acceptance. A typeface with extremely thick and thin strokes may appear sophisticated and readable in print but may look naïve and render text unreadable in a digital environment. Typefaces are frequently designed to solve issues of legibility and readability created by a technology. A typeface made for online use can increase page legibility, as well as the overall perception of approachability, quality of an interface, and ultimately product acceptance (Fig. 1.8, 1.9, & 1.10).

An informed selection can make reading enjoyable and effortless rather than frustrating and fatiguing. Though typography might seem to be an insignificant issue to a non-designer, it affects overall usability. A clear understanding of the concepts and principles that affect legibility and readability is crucial to determining effective typography.

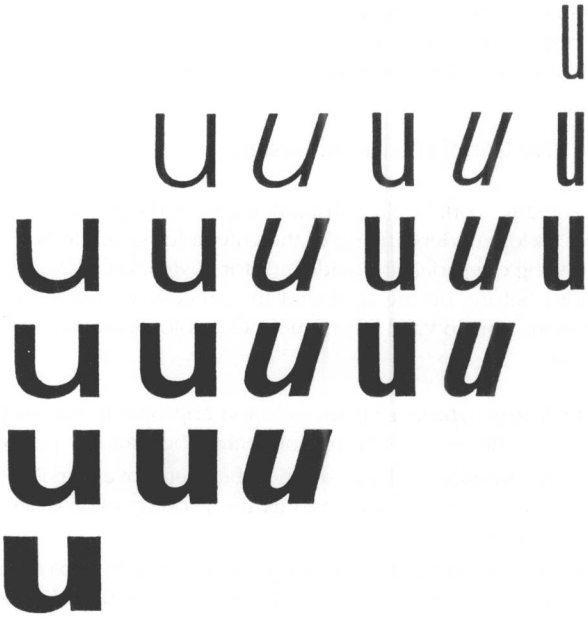

FIGURE 1.7. Univers "U". Univers, a type family designed by Adrian Frutiger and released for commercial use in 1954, is composed of twenty-one fonts that together offer a wide range of weights, widths and slopes that allows a text to be organized so that its form is visually coherent and easily read.

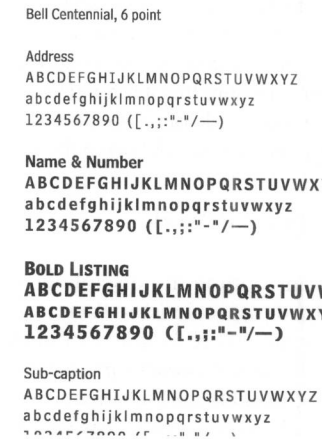

FIGURE 1.8. Bell Centennial: Technology-specific typefaces. AT&T commissioned Bell Centennial, a typeface designed at a very small size, for telephone directory use, in order to solve an industrial problem created by changing typesetting and printing technologies. The resulting type family designed for maximum legibility, readability and spatial efficiency provided the user with a clear information hierarchy. It reduced paper use and directory assistance calls. Here, Bell Centennial is shown at six point, the size at which it was intended to function.

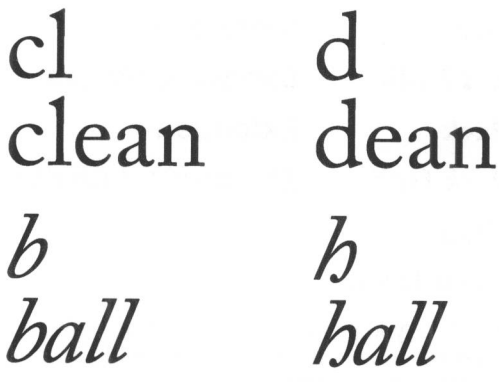

FIGURE 1.6. Legibility and Readability. The letters, letter pairs and words shown above are examples of what can happen if the designer is not sensitive to issues of legibility and readability.