UXE White Paper:

User Experience Engineering Essentials

April 15th, 2006

Howard Kiewe

User Experience Consultant
4796 rue Dagenais, Montreal
Canada H4C 1L7

hkiewe@videotron.ca

Office (514) 485-6373
Cell (514) 963-6376

Research Associate
McGill University Centre for Intelligent Machines
480 University Street, Montreal
Canada H3A 2A7

hkiewe@cim.mcgill.ca

Office (514) 398-4400 x 089888

Contents

Executive Summary

User experience engineering (UXE) is a structured research, design, and evaluation process whose goal is to make user interactions with a product or service easy, efficient, and enjoyable. It evolved from usability engineering and applies psychological principles and methodologies.

Our experience of a product can be divided into three primary levels: visceral, behavioral, and sociocultural. The visceral level is an immediate and instinctive reaction that is greatly influenced by the appearance of the product. The behavioral level develops through our interaction with a product and is greatly influenced by its usefulness and usability. The sociocultural level appeals to self-identity and personal symbolism. UXE addresses these three levels of experience in product and service development.

The user experience is engineered in five iterative phases:

1. *Business objectives for UXE*. Define the business or organizational objectives for the UXE effort, so UXE produces maximum impact.
2. *User research*. Collect targeted data on users (prospective or actual), their tasks, and their environment through observation and discussion.
3. *UX requirement analysis*. Define specific product and UX requirements for areas where business objectives and user research overlap.
4. *UX design*. Develop a series of increasing detailed models or prototypes (conceptual, architectural, interactive, aesthetic), iteratively evaluating and redesigning each type before going on to the next.
5. *UX evaluation*. Evaluate and test models and prototypes to generate new design ideas and to determine whether UX requirements have been met.

Each phase has its own work products that capture knowledge generated in that phase and help designers apply the knowledge in the next phase.

Most major technology companies including IBM, Microsoft, Samsung, eBay, Amazon, and Apple have invested heavily in UXE. UXE is also rapidly making inroads into established industries, with companies like GE Healthcare, Whirlpool, and Procter & Gamble reaping huge product successes from it. Despite this momentum, there is still room for improvement. A review of 700 corporate Web sites, gave only 3% a passing grade, and most high-tech gadgets remain too hard to use. This means UXE can still provide a competitive advantage to any company that chooses to invest in it.

Best-practice companies invest from 10% to 19% of the total product development project budget in UXE, which offers an impressive return on investment (ROI) of $2 to $100 for every $1 invested, accomplished in four main ways:

1. Increasing sales by improving product appeal, making e-commerce sites more usable, stimulating cross-channel activity, and improving customer retention.
2. Enhancing productivity by increasing employee efficiency.
3. Decreasing costs of development, maintenance, support, and training.
4. Reducing risk of project cancellation and litigation.

For maximum ROI, UXE methods must be used from the beginning of the project so project requirements are based on marketable user needs and development efforts achieve maximum efficiency. In today's networked, interconnected marketplace, consumers will shift their loyalties to the companies and brands that can provide them with the user experience that they value, so UXE methods offer a competitive advantage with immediate tactical value and long-term strategic benefits.

What is User Experience Engineering?

User experience engineering (UXE) is a structured research, design, and evaluation process whose goal is to make user interactions with a product or service easy, efficient, and enjoyable. UXE methods can be and are applied to the development of virtually any product or service, from mops [142], to surgical devices [98], to retail environments [32]. However, the term is most frequently applied to digital products such as software, Web sites, and electronic devices. This paper focuses primarily on UXE as it is applied in the digital context.

UXE has been influenced by the fields of human factors and ergonomics and is considered a practical application of research in human-computer interaction [95]. It evolved from, and shares much in common with, usability engineering [78; 86] whose central concern is product usability, defined in ISO 9241 as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction" [18]. A user's experience of a product includes its usability and extends to the user's emotional interaction with the product and the organizational channels that promote, supply, and support it. UXE addresses these additional elements. User experience professionals typically work closely with marketers, software engineers, graphic artists, industrial designers, customer support staff, and other professionals as good user experience results from a team effort.

If engineering is the application of scientific knowledge to practical problems, the science from which UXE draws most of its primary theoretical and methodological inspiration is psychology. UXE applies experimentally validated principles [22; 84; 95] from the fields of sensation, perception, and cognition [20], emotion and motivation [92],

as well as social psychology [38; 39]. UXE also adapts research methods from experimental psychology [116] and related social sciences such as anthropology and sociology [81; 140].

What are the Levels of a User's Experience?

Our experience of a product can be divided into three primary levels [92]: visceral, behavioral, and sociocultural (elsewhere referred to as reflective [92] or symbolic [107]). The visceral level of experience is an immediate and instinctive reaction that is greatly influenced by the appearance of the product. The sleek lines of a classic automobile appeal to this level of experience. The behavioral level of experience develops through our interaction with a product and is greatly influenced by its usefulness and usability. A cup holder in an automobile need not be attractive because it is useful. If you drive your car along a winding road and can drink your beverage without spilling it on yourself, it is usable. This combination of usefulness and usability appeals to the behavioral level of experience. The sociocultural level of experience appeals to self-identity and personal symbolism and is influenced by cultural norms. Driving a mini-van says something different than driving a sports car. Most importantly it says something to the driver, it is an act of self-definition [36; 108].

The visceral level

Although certain personality traits moderate visceral influences [17], the visceral level of experience is largely pre-wired and biologically determined. We have evolved visceral responses that attract us to objects and environments that provide a survival advantage and repel us from those that pose a survival risk [66]. We like flowers because

they signal forthcoming nourishment, vistas because we feel safer if we can see danger coming, and lakes and rivers because the water they contain quenches our thirst and implies additional food resources [5]. We like symmetrical features in a potential mate because they suggest health and therefore fertility [19]. We dislike dark environments and sudden loud noises because they predict danger [48]. However, we can learn to like some stimuli that are naturally aversive. For example, we can acquire a taste for bitter or spicy foods if we are regularly exposed to them and receive social reinforcement for their consumption [143].

Visceral preferences are based on our sensory impressions and are largely influenced by the aesthetic qualities of the perceived object. They are immediate, emotional, and pre-cognitive. Neurophysiological evidence shows that emotionally evocative stimuli directly impact the amygdala—the part of the brain responsible for emotional experience—without involving the higher cognitive centers of the cerebral cortex [e.g., 70]. When we see or hear something that is potentially pleasurable or threatening, we become aroused—measured as increases in heart rate, sweat, and startle responses [14]—and are either drawn to the stimulus or away from it, all this before we can consciously analyze or sometimes even notice the stimulus. Based on our first impression we either like something and want it or do not like it and want to avoid it. This first impression biases any subsequent cognitive evaluation, sometimes reducing a logical analysis of product benefits to nothing more than a justification for a preference already formed at the visceral level [143].

Since the emergence of industrial design in the early 1900s, aesthetic appeal has been used as a powerful marketing tool [35; 101]. Apple Computer's 1997 launch of the

iMac is a recent example of a successful product that relied primarily on aesthetics to drive sales. The iMac's curvy all-in-one form factor and colorful translucent casing stood in stark contrast to the bland putty-colored box-like computers available from PC manufactures, leading one reviewer to say "Wow! I gotta get me one o' those right now!" [117, p. 22]. Brisk sales in the first year increased Apple's market share by 66% (from 3.5% to 5.3%) [138], this despite the fact that iMac offered only incremental functional improvements over earlier models.

While the iMac is one of many examples in which compelling aesthetics led to a popular consumer product [35], the conventional view of the importance of the appearance in business-to-business, industrial products has been that "business products do not necessarily make anyone look or feel better, and they generally do not have significant aesthetic value" [15, p. 123]. However, this perspective has been shown to be incorrect: a study of engineering, marketing, and purchasing personnel who evaluated industrial products like motors, oscilloscopes, and pumps preferred those with attractive visual aesthetics and in some circumstances the influence of visual ascetics on purchase intentions exceeded that of product performance and price [141].

The influence of aesthetic appeal extends to Web sites and software. In a study that looked at user's first impressions of Web pages, pages high in the subjective attribute of "beauty" gave the best overall impression [118]. Another study measured how persistent users were in browsing for information and found users significantly more persistent on sites whose color scheme they rated as attractive [82]. And in several studies of software for automated teller machines [64; 128; 129], industrial control [52], and MP3 players [51], users who perceived the software as beautiful and appealing also

perceived it as useable during their initial evaluation. Perceived usability is important because software that is perceived to be usable is likely to be accepted and adopted [29; 133]. In some cases the initial perception of usability persists even after users interact with the software that is designed to be hard to use [129].

If the visceral level of experience is so compelling and colors perceptions of behavioral attributes like usability, is it the only level of experience we should be concerned with? It is true that visceral experience greatly influences our first impressions and biases our subsequent judgments. However, first impressions *do* change: for example, one study showed that users modified their original evaluation of the software usability after interacting with it, showing that the behavioral level of experience is influenced by product interaction [51].

The behavioral level

Designing for the visceral level of experience attracts attention and may motivate a customer to buy a product. But consider what can happen when the product does not deliver at the behavioral level what it implies at the visceral:

> Shortly after midnight, a resident of a small town in southern California called the police to report hearing a man inside a house nearby screaming "I'm going to kill you! I'm going to kill you!" Officers arrived on the scene and ordered the screaming man to come out of the house. The man stepped outside, wearing shorts and a Polo shirt. The officers found no victim inside the house. The man had been yelling at his computer [39, p. 89].

The description above, based on a police report from Seal Beach, California, illustrates the intensity of frustration that can develop when the behavioral level of experience is not addressed in software design. And this example is not even the most extreme: a man in Lafayette, Colorado was arrested on suspicion of felony menacing, reckless endangerment, and the prohibited use of weapons after he shot his laptop four times in a bar and hung it on the on the wall like a hunting trophy. He never explained what prompted his actions, but told police that it seemed like the right thing to do at the time [24]. These are extreme examples of what is referred to as "computer rage" [25]; computer rage is widespread, for example, 70% of computer users surveyed in the UK admitted to shouting, swearing, or being violent to their computers [16]. The cost to British industry is a staggering £25,000 ($40,000) per employee per year in lost productivity as users work to troubleshoot computer problems [25]. As astounding as this estimate is, controlled research backs it up, one study showing that 38% of computer user's time is lost to frustrating experiences [23]. Chief among these frustrations were user interface issues such as poor error messages, bad URLs, system responses that are inconsistent with user actions, and annoying, missing, or hard to find features.

For companies that use software and intranet information sources—whether externally or internally developed—this sort of frustration carries a huge cost in lost productivity and dampened employee moral. For companies that sell software and Web services, this sort of frustration provokes customer defection, damages hard-won reputations, and reduces word-of-mouth referrals, the consequences of which are well documented: reducing customer defections by 5% can boost profits by 25% to 85% [110] and retaining existing customers is six times less expensive than attracting new ones

[114]. Add to this the escalating support cost when users vent to support staff, and you begin to understand the business impact of poor behavioral design.

A positive behavioral experience results from a combination of product usefulness and usability. A product is useful when it meets the day-to-day needs of its users. In other words, most of its features are needed or wanted by most of its users. This is a delicate balancing act: missing features will frustrate users, while too many features will make the product unwieldy and cumbersome. Observational methods outlined in the *User Research* section (see p. 15) can help you discover the features that have significant user appeal and avoid investing resources to develop features that will simply clutter your product.

A product is usable when it is effective, efficient, engaging, easy to learn, and error tolerant [106]. These "Five Es" of usability are explained below:

- *Effective*. Affords goal accomplishment with minimum effort.
- *Efficient*. Allows rapid task completion with few errors.
- *Engaging*. Offers enjoyable day-to-day operation.
- *Easy to learn*. Supports rapid initial skill acquisition and expanded skill development with experience.
- *Error tolerant*. Prevents errors and supports error recovery.

A product with good usability will have all the above attributes. Combined with usefulness, usability provides a consistently positive behavioral experience that inspires high-levels of product loyalty. Behavioral and visceral appeal together create a product experience that is attractive on first impression and remains enjoyable over the long haul,

making a compelling product offering. However, there is one more level of experience to consider during product development, the sociocultural level.

The sociocultural level

We are social animals, and the sociocultural level of our experience influences our product preferences and interaction styles. We need to identify with a social group, and we use that group identification as a method of self-definition [131]. Our product choices are influenced by the preferences of our group [7; 36] and we use product preferences to communicate our group affiliation and self-identity both to others and ourselves. Even those who specifically reject making a fashion statement make the statement (to themselves and perhaps to others) that they are too practical to be influenced by the whims of fashion.

Tapping into group identification may be as basic as the Betty Crocker Company appealing to a "good homemaker" identity, or it can reach extremes. Schouten and McAlexander described the Harley-Davidson brand as "in effect, a religious icon, around which an entire ideology of consumption is articulated" [119, p. 50]. In the words of one owner, "I can tell you that owning a Harley is like being in a brotherhood. Everyone that has one feels a sense of kinship with other Harley owners" [103, p. 21]. Perhaps it is not surprising that 94% of Harley-Davidson owners would buy one again [99]. Harley-Davidson consumer loyalty illustrates that group identity influences are "sticky," meaning once they are established they are very difficult to change with feature-based analysis or counterfactual reasoning [11].

The applications of group and self-identity principles have been considered by marketing professionals [108]. Additionally, human-computer interaction researchers

have shown that when we interact with cognitively complex products like computers, group identity dynamics can make us feel like the computer is part of our team. In one study, participants who interacted with a computer designed to evoke group affiliation responses “perceived the computer to be more similar to themselves, saw themselves as more cooperative, were more open to influence from the computer, thought the information from the computer was of higher quality, found the information from the computer friendlier” [83, p. 669] when compared to participants in the control condition.

Group affiliation is only one social psychological principle that humans demonstrate when interacting with computers [39; 109]. When computers flatter us, we feel better about ourselves and our performance, and we like the computer more [40]. When computers help us, we are willing to help them back, a principle referred to as reciprocity [38]. When a computer listens empathetically, programmed with active listening skills, we feel less frustrated [63]. And when we interact with a computer that is designed to establish and maintain long-term social-emotional relationships, we respect it more, like it more, trust it more, and want to continue interacting with it more than the ordinary model [9]. We do this because our brains have not evolved to deal with cognitively complex technology like computers, so we treat computers like what they resemble most from our evolutionary history, another person. And we do this even if our only interaction is through text, even if we are computer savvy, and even if we do not think we will [109].

In human-human interactions, developing long-term social relationships has many benefits. In helping professions—like counseling and coaching—it is associated with successful outcomes [94]. In education, it predicts students’ cognitive, behavioral, and

emotional engagement [123]. In business, it correlates with managerial effectiveness, employee productivity [41], and marketing persuasiveness [102]. Therefore, it is likely that attending to the social aspects of interactive technology will yield similar benefits.

Visceral appeal creates a product experience that is attractive on first impression. Good behavioral experience ensures it remains enjoyable over time. Sociocultural experience reinforces the first two levels: it influences product preferences, adding to any product appeal generated at the visceral level, and it enhances the ongoing product experience by providing a rewarding social dimension.

Now that we have reviewed the nature of user experience, let's consider how it can be engineered.

How is User Experience Engineered?

The usability engineering lifecycle is well documented [46; 78; 86; 124], and although different authors use different terminology to describe it, there is a general consensus on the lifecycle's base concepts and methodologies. While the usability engineering lifecycle focuses on the behavioral level of experience, the *user experience* engineering lifecycle described below expands that narrow focus to include the visceral and sociocultural levels. The UXE lifecycle is iterative and can be integrated with various software and product development processes including object-oriented software engineering, agile software development, and product lifecycle management. It consists of five main phases:

1. *Business objectives for UXE*. Define the business or organizational objectives for the UXE effort.

2. *User research*. Collect targeted data on users (prospective or actual), their tasks, and their environment through observation and discussion.
3. *UX requirement analysis*. Define product and UX requirements for areas where business objectives and user research overlap.
4. *UX design*. Develop a series of increasing detailed models or prototypes (conceptual, architectural, interactive, aesthetic), iteratively evaluating and redesigning each type before going on to the next.
5. *UX evaluation*. Evaluate and test models and prototypes to generate new design ideas and to determine whether UX requirements have been met.

Each phase has their own work products that capture knowledge generated in that phase and help designers apply the knowledge both in the next phase and in other projects. Effective UXE requires all five lifecycle phases; however, the methods and resource allocation within each phase can vary greatly and be scaled up or down depending on budget, project schedule, business priorities, etc. Keep this in mind as we expand on each of the five phases below.

Phase 1: Business objectives for UXE

Most organizations are in business to make money, not to make great user experiences. Even non-profit associations have organizational objectives that extend beyond providing great user experiences. Therefore, it is important to define the business or organizational objectives that are driving the UXE effort; this way your organization's investment in UXE can yield worthwhile return. Some examples of objectives include:

- An e-commerce Web site wants to reduce shopping cart abandonment rates.

- A medical device manufacturer wants to mitigate legal risks and meet FDA human factor requirements.
- A contact center wants to increase first-call resolution rates and cross-selling opportunities.
- A mobile phone manufacturer wants to break into the lucrative teen market by designing a messaging system that fits their social world.

Refining general statements like “increase sales” or “decrease costs” into specific objectives similar to those described above is the first step in a successful UXE effort. The next step is understanding the user through user research.

Work products: UXE business objective statement, a short document that defines the business objectives for the UXE effort.

Phase 2: User research

One of the most dangerous assumptions product developers can make is that their users are like them. This assumption is almost always wrong. While it may be obvious that a middle-aged product manager in a telecommunications company is not like the teenage users of the company’s mobile phone service; it may *not* be obvious that an electrical engineer developing a multimeter is *not* like the technicians who use the meter. Although the engineer and technicians have certain things in common, they differ in many critical ways. Their background and education is different. Their goals are different. The work context is different. And, inevitably, their knowledge of the product is different. The engineer has an intimate understanding of the multimeter’s specifications, its internal design, and the organizational environment that produced it. Technicians have knowledge on how to use the multimeter: in some cases this only

covers how to complete the specific tasks required in their unique work context, in others it includes a thorough knowledge of the meter's user interface, work-arounds for its limitations, and ingenious, novel applications for its use. When you consider that the multimeter has many types of users with varying backgrounds, goals, tasks, and work environments, you begin to understand the gap between product developers and product users. Closing this gap can make the difference between a modestly successful product and wildly successful one. User research helps to close the gap.

User research answers the following questions for actual or prospective users:

- *Users and customers:* Who are our users? If the user is not the product purchaser, who is? Who are our prospective users and purchaser?
- *User characteristics:* What are our users like? What is their age? Sex? Cultural background? Education? Training? Experience? Motivation? Physical limitations or disabilities?
- *User goals, tasks, and models:* What do users do with our product and what would they like to do? Are the tasks recreational or professional, easy or complex, variable or repetitive, frequent or infrequent, one at a time or multitasked, time critical or flexible, high-risk or low-risk, individual or collaborative? What mental model does the user have for their tasks and tools they use to accomplish them?
- *Physical environment*: What is the physical environment like? Noisy? Dusty? Hazardous? Dimly or brightly lit? Open or private office? Interruptions? Type of furnishings?

- *Social environment*: What is the social or organizational environment like? Social or professional peers? Work pressure? Organizational goals (explicit and implied)? Organizational structure and roles? Competitive or collaborative?
- *User support:* How available and effective is training, documentation, peer support, and technical support?

The questions above can be answered with a combination of direct field observation, indirect observation, interviews, and questionnaires. Customer support analysis and competitive analysis also provide useful data from which to develop UX requirements.

Direct field observation. One of the most reliable and effective ways to understand users is to directly observe them in the field, in other words in their work, home, or recreational environment. Field observation solves several problems inherent in other research methods: (1) Users' work processes may be so automatic and behaviorally well integrated, that they cannot describe them. (2) Users environments may be so familiar that they are simply no longer consciously considered; users have learned to accommodate it so well they can no longer describe it. Even when users *can* describe their work processes and environments, without direct experience researchers may misunderstand their description. Direct observation avoids these pitfalls because it gives the researcher direct access to the pertinent information.

Field observation techniques are adapted from ethnographic methods used by anthropologists and sociologists that were developed to put those observed at ease. In fact, when implemented properly, field studies have significant PR value because they

make users feel valued. Field observation is an excellent method to gather information on the users' behavioral and sociocultural experience that will eventually help define product features and user interface.

Indirect observation is the collection of behavioral data without the researcher being present. Specialized software is available to facilitate indirect observation of user interaction with software, Web sites, and Web applications. Client-side applications can record and aggregate keystrokes, mouse clicks, and page views. Server-side applications record IP addresses of visitors and their mouse clicks (clickstream). This information can help researchers understand how users interact with their products; however, because it is difficult to interpret the intent behind the behavior, indirect observation usually must be combined with other methods to be useful.

Interviews help researchers understand the motivation behind user actions and are usually done as part of a field observation. Interviews can also be done independently, either face-to-face or on the telephone. Although some users may offer design suggestions and ideas during an interview, the purpose of the interview is to help the researcher understand what users need and how they work, not to get them to design the product. Typically, interviews are semi-structured, meaning some standard questions are asked, but new areas of inquiry that develop during the interview can also be explored. Special techniques can be used to get maximum value for the interaction; for example, users may be asked to sort names of products written on index cards into categories they feel are related, a method called card sorting. This information can be used to design an e-commerce site with products located where users expect them. Specially structured group interviews called focus groups can also be used to collect data and gage reactions

to early prototypes. They are particularly useful to evaluate visceral responses and sociocultural influences.

Questionnaires or surveys cannot replace observation because they do not provide behavioral information, nor can they replace interviews because they are missing the rich verbal and non-verbal conversation from which much useful information is gleaned. Questionnaires can, however, collect large amounts of user background information and user-satisfaction data, and therefore are an effective complement to other research methods. Compared to mail or telephone surveys, online questionnaires are very cost effective and can be rapidly deployed. They can also be used to rapidly test visceral responses to Web sites, graphical user interfaces (GUI), and other products. Unfortunately, poorly designed questionnaires provide confusing or misleading data or suffer from poor response rates. Therefore, care must be taken to define questionnaire objectives, word questions effectively, and structure the questionnaire to maximize response rate and simplify statistical analysis.

Customer support analysis. Reviewing customer support records for UX issues and interviewing support staff is a cost-effective way to identify UX issues with existing products. For example, after usability analysts learned that Lands' End Web customers were phoning the contact center to get advice on what size clothes to buy, they added online measuring charts and instructions, which reduced call volume significantly [74].

Competitive analysis involves an in-depth deconstruction of a competing product in order to find its UX weaknesses so that you can create an attractive and usable alternative. Competitive analysis may include direct field observation, indirect

observation, interviews, and UX evaluation methods (see *How is User Experience Engineered?* on p. 13).

Data collected during the user research phase ensures that you are developing a product that meets the needs of real users. With this data in hand, the next step is to define UX requirements.

Work products: User, Task, and Environment Profiles. Notes taken during field observations and interviews together with indirect observation and questionnaire data are summarized in profiles of the various users, their tasks, and environments. These profiles can be used by product managers to help conceptualize new products or features, by product designers to make sure these features are successfully implemented, and by marketers to help target product marketing efforts. Profiles can take several forms and contain different information, depending on the particular project and design environment.

For example, a user profile may be presented as a *user persona* [26]. Here, user research data are used to construct several fictional users or "personas." Each one is given a name, a photo, and enough descriptive detail to make them seem real. Products are then designed to meet the needs of the personas. The chief benefit of the persona approach is that it makes it easier for product developers to conceptualize their users, which is especially difficult in large projects when designers are not directly involved in user researcher.

Task profiles may take the form of a *task analyses* [121]; this is a detailed description of user goals, tasks, and actions. Goals are what a user wants to accomplish, for example, find a customer's phone number. Tasks are how they plan to accomplish it,

for example, search the database. Actions are the specific steps they need to follow, for example, open the search widow, type the customer's name in the search box, and press enter. Detailed descriptions of this type can reveal opportunities to improve workflow and they can also accelerate user interface design by providing structure for design decisions.

User profiles may include a description of the *user model* [90; 91; 111]. A user model is a type of mental model—typically only partly conscious—that conceptualizes users' work and technology. It influences user behavior and considering it during product design makes a product more intuitive to use, facilitating user acceptance.

Phase 3: UX requirements

Traditional requirement specifications can be enhanced with UX information in two main ways:

- Feature requirements can be based on information collected during the user research phase. Here, user research complements market research data and other sources of product development information. Basing feature requirements on actual user data collected during research reduces the risk of investing resources in unwanted features and increases the likelihood of adding features that will drive sales.
- UX-specific requirements can be added to the requirement specification. By adding UX requirements, UX becomes a priority alongside other product attributes and UX improvements are delivered when the product ships.

The development of UX requirements begins by looking for overlap between the business objectives defined in Phase 1 and user data collected in Phase 2. For example, a

business objective for an accounts receivable contact center may be to reduce average call time by 15%. Field research at this center found that support staff spent an average of 20 seconds per call finding a customer's record. A UX requirement to reduce seek time from 20 seconds to 5 seconds per call would make a significant contribution to the business objective and may be quite realistic from a UXE perspective. If this UX requirement can be implemented within technical and project constraints, then it is added to the product specification.

UX requirements may be qualitative or quantitative. Qualitative requirements are broad statements that inform the many design decisions that are made as a project progresses. For example, "The tourist information kiosk will be easy for first-time users to learn how to use." Quantitative requirements are specific, for example, "Four out of five first-time users of the tourist information kiosk will be able to find directions to a specific restaurant within a minute" or "On first impression, users give the tourist information kiosk an average attractiveness rate of 4 on a scale of 1 to 5." These quantitative requirements are validated during UX testing.

Qualitative requirements are useful to set the overall direction of the UXE design effort; however, quantitative requirements are essential to ensure that UX remains a priority as design deadlines approach. Which lead us to our next section, UX design.

Work products: UX requirements are typically included in with other product requirements in the requirement specification.

Phase 4: UX design

UX design typically progresses in several iterations, with each iteration producing a model or prototype of increasing detail and granularity. In the simplest project, a sketch

of the product's user interface is produced and evaluated (using methods described in the next section (see p. 26). This is refined and reevaluated until it tests well. Then a more detailed physical or electronic version of the prototype is produced, evaluated, and revised until the UX requirements defined in Phase 3 are demonstrated. Finally, a full version is developed and tested.

Complex projects and products may require more levels of iteration and additional models. For example, if a new product requires a substantial change in the individual's or organization's workflow in order to realize productivity gains, work reengineering may be appropriate. Work reengineering is a re-conceptualization of work process that incorporates the (tentatively defined) new product, so that efficiencies of automation are realized, business goals are supported, and retraining is minimized. Work reengineering efforts are typically represented in a revised task profile that is validated by the users before detailed design begins.

For large, complex Web sites or applications, an information architecture blueprint is produced to represent the overall site structure without concern for the appearance of the page [115]. First, a high-level blueprint is developed, grouping areas of the site semantically. Next, task-level or page-level blueprints are developed. Users validate these before page-level design begins. The equivalent model in object-oriented software development projects is a content diagram on which the use cases that define user-system interaction are based.

Once high-level issues are resolved, detailed design can begin, typically with a low-fidelity prototype. For physical products these are constructed from foam, plastic, or wood, for software and Web sites they are often hand-drawn on paper and called

mockups or wireframes. At this level, the focus is on getting the behavioral experience right by developing the structure and user interaction; aesthetic aspects are not yet considered. The low-fidelity prototype is refined and reevaluated until it tests well, at which point a high-fidelity prototype is produced.

High-fidelity prototypes for physical products have similar production quality to the final product, while for software and Web sites they are electronic. Core features are developed and tested and the prototype is revised until the behavioral UX requirements defined in Phase 3 are demonstrated. Once the overall structure of the product is defined, various aesthetic presentations can be designed and tested for visceral and sociocultural appeal. Finally, with a prototype refined to address critical issues in hand, the rest of product can be designed and tested.

Many design choices must be made when developing a complex product. Although user research can provide guidance about what features are needed and how they can be structured, research does not offer much insight about the fine details. To fill this gap, UX design incorporates design principles based on knowledge from perceptual, cognitive, and social psychology. Here are a few examples:

- Research in perceptual psychology has shown that objects that share a contour are perceived as related and part of a whole (the Gestalt principle of good contour [61] or direction [136]). For example, separate blocks of text and graphics become associated in our perception if they are aligned along an invisible grid [76]. And the clean lines of an elegantly-designed product provide a satisfying unified appearance [68]. In fact, research shows that GUIs and Web sites with aligned text and graphics are preferred by users and easier

to read [97; 130]. Other research has demonstrated that consumer products with good contour and a unified appearance are also preferred, being described as refined, elegant, simple, and deluxe-looking [134]. So products designed with good contour in mind provide an appealing visceral and behavioral experience.

- Research in cognitive psychology has demonstrated that recall of information organized in a hierarchy is two to three times faster than information grouped in other ways [13]. This is because items on the top of the hierarchy (categories) act as recall cues for items low in the hierarchy [55]. Research has demonstrated that software [21] and Web sites [27; 67] organized hierarchically provide a better behavioral experience than those that do not.
- Research in social psychology has demonstrated that praise is a powerful persuasive tool [56; 96]. Human-computer interaction research has shown that users who worked with a computer system that praised them were left in a better mood, felt more powerful, found the interaction more engaging, and liked the computer more than those who were not praised [40]. This finding is of particular importance for designers of e-learning and e-commerce products who can enhance their user's sociocultural experience simply by including dialogue messages that contain the right kind of praise.

These are only a few examples of principles that can be used to guide design choices. There are many more, some based on psychological research and others based on design tradition and practical experience. One way to formalize design guidelines, particularly for GUIs and electronic documents, is to use a style guide. A style guide

describes design guidelines, user interface controls, as well as screen layout conventions, and is an effective way to ensure UX consistency. Platform specific style guides are available for the development of desktop software on all major platforms including Windows XP [79], Windows Vista [80], Macintosh [4], UNIX [127], and Java [125]. These form a useful base to which you must add application specific details.

With the product prototype developed, we are ready for the final step in UXE lifecycle, UX evaluation.

Work products: Prototypes are the primary deliverable from this phase. These can be low-fidelity mockups or wireframes or high-fidelity functional models that implement core features. Work reengineering models and information architecture blueprints may also be useful, especially for more complex project or products.

Phase 5: UX evaluation

Software, Web sites, and electronic products typically undergo structured quality assurance (QA) testing, since releasing a product without testing runs the risk of unhappy customers, costly returns, and damaged reputations. The need for QA testing is proportional to the complexity of the product, and modern digital products are so complex that it is impossible to anticipate all technical problems during design, so these products must be QA tested. Likewise, when designing the interaction of a complex product with a human being—who is arguably much more complex than the product—it is impossible to anticipate all the UX problems. Therefore, UX evaluation is essential. There are five primary methods of UX evaluation, (1) usability testing, (2) aesthetic testing, and (3) heuristic inspection, (4) collaborative evaluation, and (5) guideline review.

Usability testing is the evaluation of a product's usability through direct observation of user behavior during a structured task. A typical usability test requires a small number of participants (3-10) recruited from a representative sample of actual or prospective users. For some products, users are happy to volunteer to participate, for others users are paid or offered a thank you gift. A test session may take place in the development organization's offices or at the user's site and typically lasts about an hour. During this time a user is asked to complete a task associated with a UX requirement. For example, when testing an e-commerce site, participants may be asked to find and purchase a specific product. Participants are asked to "speak aloud" or verbalize their thoughts as they complete the task. The test facilitator quietly observes, noting what the participant says, non-verbal signs of emotion, as well as timing the interaction and perhaps counting mouse clicks. Sometimes specialized logging software and simple Web cam are used to record all mouse and keyboard events, screen views, audio of the participants' discussion, and video of their faces as they complete the task. This software also allows for remote testing when it is advantageous to test users from far-flung locations. After the test sessions are complete, data are analyzed, usability strengths and weakness are summarized, and possible design improvements are generated. In order to minimize development effort testing begins with a low-fidelity prototype, progresses to a high-fidelity prototype, and continues iteratively until UX requirements are met.

Aesthetic testing is the evaluation of a product's visceral appeal through the observation of user responses to various designs. It can be scheduled independently or coordinated with usability testing. During a typical aesthetic appeal test, a user is exposed to several versions of a product and asked to rate the attractiveness of each one. Open-

ended questions are also asked to get an understanding of the underlying impressions that the different designs leave. Representative Web pages, GUI screens, and photographs [53] or prototypes of physical products can be evaluated in this way. Face-to-face tests have the advantage of allowing the facilitator to follow new areas of inquiry that develop during the test; however, Web-based evaluations that allow large numbers of tests to be run economically can also be deployed.

Usability and aesthetic testing provides direct feedback on users' experience, much like direct field observation in Phase 1, except now the response is to a proposed product. This information is extremely valuable, which makes user testing a high priority. Another way to evaluate a product is through various professional inspection methods such as heuristic inspection, collaborative evaluation, and guideline review; these approaches cannot replace user testing but can act as a valuable complement to it. Professional inspection methods do not involve any users, but rather professionals who may be UX experts, product designers, or product marketers.

Heuristic inspection is an evaluation method where a UX expert compares a prototype against predefined set of heuristics, or rules of thumb, such as "The system should always keep the users informed about what is going on through appropriate feedback." [86, p. 134]. Typically, the inspector evaluates the product against a list of 10 or so heuristics, noting when they are met and when they are not met, and making suggestions for improvement. Heuristic inspection can be applied before user testing to eliminate obvious flaws that would otherwise waste precious user testing time. It can also identify subtle deficits that may not come up in user testing, but will never the less have a detrimental impact on long-term UX.

Collaborative evaluation is similar to a heuristic inspection but done in a group following a structured process. Collaborative evaluation is often completed by an interdisciplinary design team and can have a similar atmosphere to a brainstorming session. One advantage is it often creates high levels of buy-in by all team members, which facilitates product changes.

Guideline review is a thorough evaluation of a product's user interface against the guidelines described in the style guide. This is similar to what an editor and proofreader do for documentation, although here the focus is on UX issues.

Work products: Usability Test Report, Aesthetic Test Report, and Heuristic Inspection Report summarize these activities' findings and resulting recommendations. The Collaborative Evaluation Summary is a record of key action points and their rational. A Guideline Review can be a spreadsheet-like table of issues or a printout of the user interface marked up with necessary changes.

How do the five phases fit together?

Each phase feeds into the next and iterations can occur between most phases:

1. *Business objectives for UXE* leads directly into user research.
2. *User research* may lead to a redefinition of business objectives if new opportunities arise, although this is unusual. User research leads into UX requirements.
3. *UX requirement analysis* work products are sometime verified with users recruited during the user research phase. UX requirement analysis leads into UX design.

4. *UX design* occurs in several iterations, with each iteration producing a model or prototype of increasing detail and granularity. UX design leads to UX evaluations.
5. *UX evaluation* iterates back to UX design until UX requirements are met.

Now that we have considered how UX is engineered, let's consider who uses these UX methods.

Who Uses UXE?

"American industry and government will become even more productive if they take advantage of usability engineering techniques." Al Gore, 1998 [45, p. 1]

Have businesses responded to advice of the former US Vice-President? Was he correct in linking usability engineering with productivity? Business Week seems to agree, even relating usability to profitability in an article entitled, "Usability Is Next to Profitability" [10] and describing how innovative design is a key strategy for the developed world's continued prosperity in the coming "design decade" [93].

So who is taking advantage of UXE methods? In the late 1990s, Mark Thompson, Charles Schwab & Co's Senior Vice President of Customer Experience said, "usability is one of our secret weapons" [57]. The secret weapon appeared to work; in 1998 schwab.com handled more than $7 billion in securities transactions a week. In the same year, when Oracle CEO Larry Ellison learned that his sales reps were being turned away because customers could not understand how to use Oracle's products, he poured money into UXE and made sure developers knew it was a top priority [10].

Today, UXE methods are no longer a secret. Most major technology companies including IBM, Microsoft, Sun, Samsung, Motorola, and Apple have invested heavily in

UXE [71]. Successful Internet companies like Google, Yahoo!, eBay, and Amazon do as well, and UXE methods have a been a key ingredient in moving them from modest startups into the Fortune 500 [31]. UXE is also rapidly making inroads into established industries, with companies like GE Healthcare [2], Whirlpool [3], Kodak [49], and Procter & Gamble [142] reaping huge product successes that are directly attributable to UXE methods. No wonder 97% of executives in large North American companies say improving customer experience is either critical or very important [126].

Despite this momentum, there is still tremendous room for improvement. In a Forrester Research review of 700 corporate Web sites, only 3% received a passing grade [72], and on the whole, high-tech gadgets remain too hard to use [6]. This means UXE can still provide a competitive advantage to any company that chooses to invest in it. Some analysts even believe we are at the beginning of an "Experience Economy" [104] or "Design Economy" [28], in which UXE will play a central role. Whether this is true or not, the UXE business case offers the potential for immediate and continuing return on investment (ROI), which we will examine in the next section.

Why Use UXE?

Consider the example of the Swatch watch [1]. By 1983, the Swiss watchmaking industry's worldwide market share had dropped from 50% to 12%, largely due to competition from inexpensive quartz watches manufactured in Asia. Swatch saved the Swiss watchmaking industry from this crisis by developing watches that were a hit on all experience levels: they were viscerally attractive, behaviorally simple (when compared to the new digital watches [77]), and had a cult-like sociocultural appeal. Designing for the user experience was the primary ingredient in the Swatch success, but it was not the only

one. Good market research identified the right price point (under $40). Innovative engineering reduced the average number of parts from 150 to 51, which made it possible to sell a Swatch at the right price point. And creative branding and promotion tapped into a new, vibrant market. This reminds us that UXE is only one ingredient in a product's success, and for maximum impact it needs to be coordinated with appropriately resourced engineering and business activities.

What proportion of organizational resources should be allocated to UXE? Surveys of Web and software development practitioners found that an average of 10% to 19% of the total project budget is typically allotted to usability engineering among companies that implement it [89; 135]; naturally, the appropriate amount for a particular project will vary with its business objectives.

The benefit side of the UXE equation includes increased sales, enhanced productivity, decreased costs, and reduced risk. ROI for UXE activities is impressive. One software engineering textbook estimates every $1 invested in UXE returns between $2 and $100 [105]. Forrester Research ROI estimates for UXE efforts applied to corporate Web sites are similarly impressive [74]. Retailers with e-commerce sites can expect between 780% and 1,795% ROI, manufacturers who use their site to generate sales leads can expect 67% to 516%, and financial service organizations will see from 499% to 1,610% ROI. This despite conservative assumptions based on the lower end of industry benchmarks; for example, increased revenue assumes only a 10%-20% increase in conversion of site visitors to customers or sales leads and decreased cost projection is based on a 1%-10% reduction in contact-center calls.

How does UXE deliver such high returns? The details vary somewhat by industry and product:

- E-commerce sites are the easiest to analyze because their servers record the impact of UXE on all transactions including traffic, sales, and support. However, similar results have been demonstrated for Web sites that promote offline and cross-channel sales (for example, increased sales in retail outlets that follow improved information retrieval on the Web).
- Computer software and hardware producers—as well as vendors of virtually any product or service—can expect increased sales as aesthetic appeal and useful and usable features attract more interest. Development costs and time to market decrease because user research prevents wasted development effort. Support cost will also decrease because customers need less help.
- Any organization that uses customized software, whether a database, intranet, or enterprise software suite will see productivity increase and training costs decrease as easier to use software is deployed.

UXE can contribute to ROI in four main ways:

1. Increasing sales by improving product appeal, making e-commerce sites more usable, stimulating cross-channel activity, and improving customer retention.
2. Enhancing productivity.
3. Decreasing costs of development, maintenance, support, and training.
4. Reducing risk of project cancellation and litigation.

Next we will review some examples of these four ROI opportunities taken from a broad range of industries. Even if an example is not from the particular industry you work in, the underlying principles are likely to be applicable.

Increasing sales by improving product appeal

UXE methods create products with marketing appeal because customers prefer products that look good, that get the job done, that are easy to use, and that others are using. In short, customers prefer products with visceral, behavioral, and sociocultural appeal. Visceral appeal reveals itself on first impression. Behavioral and sociocultural appeal is conveyed in press reviews and by word-of-mouth. As the marketing influence of conventional mass media wanes due to increasing fragmentation, word-of-mouth becomes even more important [30]. The average customer speaks to seven other potential customers, producing a user-experience ripple effect [47]: product and services with excellent behavioral and sociocultural appeal are quickly adopted and loyally retained; those offering a frustrating user experience are spurned and the companies that produce them must invest significantly in promotional efforts to compensate for the lack of grassroots momentum. Word-of-mouth is reinforced by press reviews, and for software as much as 30% of a typical review is devoted to the product usability [85].

Here are a few examples of increasing sales by improving product appeal:

- *Whirlpool increases market share from 0% to 40%*. Using a team of usability anthropologists, human factors experts, and industrial designers, Whirlpool designed the new Duet/Dreamspace line of frontloading washers. Duet/Dreamspace looked different than anything Whirlpool had previously marketed, with a new visual brand language. They incorporated features that

customers found both useful and easy to use, giving the washer excellent behavioral appeal. The powerful visceral and behavioral appeal of this line drove Whirlpool from a 0% share of the frontloading washer market to 40% within a year [3].

- *Procter & Gamble earns $500 million annually from its Swiffer brand.* The Swiffer concept was inspired by direct field observation in customer's homes, watching them mop. With this data, Procter & Gamble developed a innovative, more usable mop and created an entirely new revenue stream [142].
- *Digital Equipment Corporation increased RALLY revenue by over 80%.* Unlike the first release of this software, the RALLY version 2 was developed with UXE methods. In a survey of users, many pointed to usability as a key motivator in buying the new version [139].

Increasing sales by making e-commerce sites more usable

The behavioral level of design is critical to e-commerce success. Users who find it hard to locate a product or complete a purchase can simply click elsewhere and they often do not give the site a second chance. When asked for the most important reason to shop on the Web, 83% chose "easy to place an order," ahead of both large selection and cheaper prices [88]. Forrester Research estimates that e-commerce sites can lose up to 50% of their potential sales if it is hard for customers to find merchandise, and 40% of users will not come back [75]. UXE methods can improve the situation significantly: a 5% improvement in usability can increase revenues by 10% to 35% [10], and simply

providing product information where customers expect, rather than buried in a site, can increase sales by as much as 225% [132].

Here are a few examples of increasing sales by making e-commerce sites more usable:

- *Dell's sales increase from $1 million to $34 million per day* over 18 months after applying UXE principles to its e-commerce Web site [112].
- *Millipore.com doubled sales and reduced customer complaints* by applying UXE methods to redesign their Web site [33].
- *Macy's increased their conversion rate by 150%* by making it easier for customers to find products they want with a more usable search engine and a restructured site [62].
- *ADC (telecommunications) increased their sales by 341%* and produced $10 million of quote requests by completely revamping their Web site using UXE methods [89].
- *IBM increased sales by 400%* in the first week after a complete redesign using UXE methods. Customer satisfaction ratings also improved [112].
- *Junior's Restaurant increased their conversion rate by 900%* and greatly reduced call center volume. Their fresh cheesecakes have rigorous shipping requirements so UXE methods were used to develop a sophisticated shopping cart that could reduce ordering complexity [89].

Increasing sales by stimulating cross-channel activity

Web sites can also support sales in other channels such as retail stores, direct sales calls, or call centers. Here ROI is more difficult to measure, but the examples below show it is still significant:

- *Major American retailer's brick-and-mortar sales increased 15%* after UXE methods were used to improve their Web site [59].
- *New York Life accomplished a 213% increase sales leads from their Web site* after a redesign using UXE methods [89].

Increasing sales by improving customer retention

Loyal customers make a significant contribution to a company's profitability. For example, while a single package from a onetime customer may generate $5.00 revenue for FedEx, the lifetime revenue from a single loyal customer has been estimated at $360,000 [100], and this figure does not include the value of word-of-mouth referrals. The same trends can be seen on the Web; for example, the average first-time purchase on an e-commerce site was $127, but repeat customers spend $251 per visit [87]. The influence of a company's Web site extends beyond the e-commerce transaction, a Forrester Research report found about half of the customers polled say their bank's Web site is important to their overall satisfaction, and these are more loyal to their banks than other customers [120]. And a Gartner Group study showed that UXE methods improve user satisfaction by 40% [43].

Consider this example of the relationship between customer retention, UXE, and increased sales:

- *Staples increases repeat e-customers by 67%* after a complete redesign of their Web site guided by UXE methods. They also reduced dropoff rate by 31%-45%, increased traffic by 80%, and increased sales by 491% [54].

Enhancing productivity

The average software application has 40 usability-related design flaws. If UXE methods are applied from the beginning of the design process, the cost of UXE returns a benefit of over 700% in efficiency improvements. [65]. Field studies have demonstrated the time required to complete common tasks on intranets with low usability scores is about double what it takes to compete the same tasks on ones with a high usability scores [89]. For a large company, improving the usability of corporate enterprise software or intranet can result in huge cost savings by saving employee's time. For enterprise software vendors, usability can be a key selling point. In fact, some customers have begun to run usability tests to help them choose between software offerings [112].

Here are some examples of how UXE methods have enhanced productivity and the resulting cost savings:

- *IBM saves $6.8 million by investing $20,700.* A $20,700 investment in UXE resulted in design changes to IBM's sign-in procedure that saved 9.6 minutes per task per employee. This yielded an internal savings of $41,700 on the first day, $6.8 million in the first year, resulting in a cost benefit ratio of $1:$100 [58].
- *State of Kansas reduces task time on Web portal by 70%.* Usability testing revealed that users were confused by the organization of the site and took an

average of 22 minutes to complete a task. By adjusting the site's information architecture, task time was reduced to 9 minutes [89].

- *NCR Corporation improves data entry by 25% and decreases errors by 25%* by redesigning data entry screens according to UXE heuristics [42].
- *Bay Networks saves $10 million per year.* A $3 million investment in an intranet developed using UXE methods saved Bay Networks an estimated $10 million per year in employee search time, while resulting in a qualitative improvement in employee's work [37].

Decreasing cost of development

Projects overruns occur in 63% of software development project, with the top four reasons usability related: (1) frequent change requests from users, (2) overlooked tasks, (3) users' do not have a clear understanding of their own requirements, and (4) poor user-analyst communication [69]. However, the UXE methods can directly address these issues and has demonstrated a reduction in the product development cycle by 33%–50% [12].

Here are a few examples of decreasing development costs with UXE:

- *Israel Aircraft Industries saved $330,000 in development costs* when producing its Mission Planning Centre software. The investment in UXE was only $22,000, providing a cost-benefit ratio of $1:$15 [8].
- *UK Inland Revenue saved $390,000 in development costs* when producing internal software. The investment in UXE was $150,000, providing a cost-benefit ratio of $1:$2.5 [8].

- *Network equipment supplier saves 30% of development time* after a usability tests demonstrated that the planned personalization features were not wanted. The personalization features were dropped and instead navigation was improved which reduced total project time and resulted in an early release [89].

Decreasing cost of maintenance

One software development management guide states, “The rule of thumb in many usability-aware organizations is that the cost-benefit ratio for usability is $1:$10-$100. Once a system is in development, correcting a problem costs 10 times as much as fixing the same problem in design. If the system has been released, it costs 100 times as much relative to fixing it in design” [44]. Another states “80% of software lifecycle costs occur during the maintenance phase. Most maintenance costs are associated with ‘unmet or unforeseen’ user requirements and other usability problems.” [105].

Here are a few examples of decreasing maintenance costs with UXE:

- *American Airlines reduced its software maintenance costs by 60-90%* by appling UXE methods that allowed the identification and correction of usability problems early in the development cycle. [50]
- *Sewing machine manufacturer saves several million dollars in maintenance costs* by redesigning state-of-art sewing machine after UXE analysis. This microprocessor-controlled machine was too complex for users to understand. They could not clear the jammed thread path and flooded the company with in-home service requests covered by their warranty, at a great cost to the manufacturer. The redesigned machine had much fewer service requests [77].

Decreasing cost of support

Providing call-center technical support for computer software is estimated to cost companies between $12 and $250 per call, depending on the organization [137]. Usability related questions compose a high proportion of these calls.

Here are a few examples of decreasing support costs with UXE:

- *ConocoPhillps reduced daily employee help desk calls from 300 to zero* through an intranet redesign that simplified online application interfaces and streamlined data entry forms [113].
- *Schneider Automation saved $2 million in call center-support costs* in 10 months by improving the user experience on its Web site [60].
- *Dell reduced call center calls by 50%* when it added “My Order Status” button to its site. This feature was developed after an analysis of call-center logs [74].

Decreasing costs of training

Training is one component of the cost of deploying information technology. Software that is easy to learn how to use reduces the cost of purchasing or developing training as well as the cost of lost employee time. Here are a few examples:

- *AT&T saved $2.5 million in training expenses* as a result of usability improvements [50].
- *IBM reduced training time from one week to one hour* for an internal system by redesigning the front-end using UXE principles [50].

Reducing risk of project cancellation

Not only can software development projects take longer than projected, 31% are cancelled before a usable product is produced [122]. Consider the following example:

- *Financial services organization scraps a custom-developed application* just before implementation when quality assurance testing found a fatal flaw in how data could be entered. The application was never implemented because it was too late to change the underlying structure. UX requirements and early prototype testing could have prevented this failure [34].

Reducing risk of litigation

US courts require that manufacturers "design for reasonable use and misuse" so the risk of litigation must be managed, especially since legal costs can easily escalate into the millions of dollars. The use of a formal, professional UXE process mitigates legal risk in two ways: (1) it increases product safety and therefore reduces legitimate claims; (2) it creates a strong, defensible legal position that acts as a deterrent to fallacious litigation [77]. Consider the unfortunate legal consequences of not using UXE methods:

- *American Airlines sues for software project failure.* American Airlines sued Budget Rent-A-Car, Marriott Corporation, and Hilton Hotels after a $165 million car rental and hotel reservation project collapsed in chaos. Causes included "an incomplete statement of requirements, lack of user involvement, and constant changing of requirements and specifications," all issues that could have been addressed with UXE methods. The case was settled out of court [122].

Now that we have considered why to use UXE methods, we will consider when to use it.

When to Use UXE?

The short answer to the question above is “early in the development project.” For maximum ROI, user research methods must be implemented at the beginning of the project so that user requirements are well defined before design begins. UX evaluation must begin with rough prototypes so that little development effort is invested until a usable and attractive design is created and verified. The earlier you begin, the greater the ROI.

Some organizations prefer to role out UXE methods incrementally, beginning with a modest investment and increasing it as they gain more confidence in their ability to benefit from the techniques. This is the approach Dell Computer took when redesigning their e-commerce infrastructure. Other organizations dive right in, completely revamping their products or services using UXE methods. This is the approach Staples.com took. Both strategies were remarkably successful, as a Forrester Research report documents [73] .

Conclusion

UXE methods offer a competitive advantage to any company that chooses to adopt them, with immediate tactical value and long-term strategic benefits. The opportunity costs of deferring UXE implementation only mount as customers seek richer user experiences. In today’s networked, interconnected marketplace, consumers will shift

their loyalties to the companies and brands that can provide them with the user experience that they value.

The only question remaining is, “*Will it be you?”*

References

1. @issue. (1997). Swatch Design Time [Electronic Version]. *@issue: The Journal of Business and Design*, 2. Retrieved April 10, 2006 from http://www.cdf.org/journal/0202_swatch.php.
2. @issue. (2005). Joseph M. Hogan on Design [Electronic Version]. *@issue: The Journal of Business and Design*, 10. Retrieved April 10, 2006 from http://www.cdf.org/journal/1001_ge.php.
3. @issue. (2006). Visual Brand Language [Electronic Version]. *@issue: The Journal of Business and Design*, 11. Retrieved April 10, 2006 from http://www.cdf.org/journal/1101_whirlpool.php.
4. Apple Computer. (2006). *Apple Human Interface Guidelines*. Retrieved April 12, 2006, from http://developer.apple.com/documentation/UserExperience/Conceptual/OSXHIGuidelines.
5. Averill, J. R., Stanat, P., & More, T. A. (1998). Aesthetics and the Environment. *Review of General Psychology, 2*(2), 153-174.
6. Baig, E. C. (2005). Why Are Tech Gizmos So Hard to Figure Out? [Electronic Version]. *USA Today*. Retrieved April 10, 2006 from http://www.usatoday.com/tech/products/2005-11-01-usability-cover_x.htm.
7. Bearden, W. O., & Etzel, M. J. (1982). Reference Group Influence on Product and Brand Purchase Decisions. *Journal of Consumer Research, 9*(2), 183-195.
8. Bevan, N. (2005). Cost-Benefit Framework and Case Studies. In R. G. Bias & D. J. Mayhew (Eds.), *Cost-Justifying Usability: An Update for the Internet Age* (pp. 575-600). Boston: Morgan Kaufmann.
9. Bickmore, T. W., & Picard, R. W. (2005). Establishing and Maintaining Long-Term Human-Computer Relationships. *ACM Transactions on Computer-Human Interaction (TOCHI), 12*(2).
10. Black, J. (2002). Usability Is Next to Profitability [Electronic Version]. *Business Week*. Retrieved April 10, 2006 from http://www.businessweek.com/technology/content/dec2002/tc2002124_2181.htm
11. Bolton, L. E., & Reed, A. (2004). Sticky Priors: The Perseverance of Identity Effects on Judgment. *Journal of Marketing Research, 41*(4), 397-410.
12. Bosert, J. L. (1991). *Quality Functional Deployment: A Practitioner's Approach*. New York: ASQC Quality Press.
13. Bower, G. H., Clark, M. C., Lesgold, A. W., & Winzenz, D. (1969). Hierarchical Retrieval Schemes in Recall of Categorized Word Lists. *Journal of Verbal Learning and Verbal Behavior, 8*, 323–343.
14. Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and Motivation I: Defensive and Appetitive Reactions in Picture Processing. *Emotion, 1*(3), 276–298.

15. Bringham, F. G., & Raffield, B. T. (1990). *Business to Business Marketing Management*. Homewood, IL: Irwin.

16. British Telecom Home Computing. (2002). Computer Users Suffer 'PC Rage' [Electronic Version]. *MORI Poll*. Retrieved April 4, 2006 from http://www.mori.com/polls/2002/bthomecomputing.shtml.

17. Brunel, F. F. (1998). The Psychology of Product Aesthetics: Antecedents and Individual Differences in Product Evaluations. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 59*(3-A).

18. BSI. (1998). *BS EN ISO 9241-11:1998 Ergonomic Requirements for Office Work with Visual Display Terminals (VDTS). Part 11: Guidance on Usability*. London: British Standards Institution.

19. Buss, D. M. (2004). *Evolutionary Psychology: The New Science of the Mind* (2nd ed.). Boston: Pearson.

20. Card, S. K., Moran, T. P., & Newell, A. (1983). *The Psychology of Human-Computer Interaction*. Hillsdale, N.J.: L. Erlbaum Associates.

21. Carroll, J. M. (1982). Learning, Using and Designing Command Paradigms. *Human Learning, 1*(1), 31–62.

22. Carroll, J. M. (1997). Human-Computer Interaction: Psychology as a Science of Design. *Annual Review of Psychology, 48*, 61–83.

23. Ceaparu, I., Lazar, J., Bessiere, K., Robinson, J., & Shneiderman, B. (2004). Determining Causes and Severity of End-User Frustration. *International Journal of Human-Computer Interaction, 77*(3), 333-356.

24. CNN. (2003). Man Walks into a Bar, Kills Computer [Electronic Version]. *CNN.com/Law Center*. Retrieved April 4, 2006 from http://www.cnn.com/2003/LAW/03/07/ctv.stupid.crimes/.

25. Compaq Computer Limited UK and Ireland. (1999). Rage against the Machine [Electronic Version]. *MORI Poll*. Retrieved April 4, 2006 from http://www.mori.com/polls/1999/rage.shtml.

26. Cooper, A. (2004). *The Inmates Are Running the Asylum*. Indianapolis, IN: Sams.

27. Czerwinski, M., Larson, K., & Robbins, D. (1998). *Designing for Navigating Personal Web Information: Retrieval Cues.* Paper presented at the 42nd Annual Meeting of the Human Factors and Ergonomics Society.

28. Dan, A. (2006). Transcend Function and Focus on the Visual. *Advertising Age, 77*(10), 6.

29. Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly, 13*(3), 319.

30. Degraffenreid, S. (2006). Beyond Advertising: Why People Are the New Media. In *Handbook of Business Strategy* (Vol. 7, pp. 81-85). London: Emerald Group.

31. Donoghue, K. (2002). Built for Use: Driving Profitability through the User Experience. from http://www.books24x7.com/marc.asp?isbn=0071383042

32. Donovan, R. J., & Rossiter, J. R. (1982). Store Atmosphere: An Experimental Psychology Approach. *Journal of Retailing, 58*(1).

33. Dorsey, M. (2005). *Millipore.Com: Redesign That Supports Customer Goals Drives up Sales and Traffic, Best Practices*. Cambridge, MA: Forrester Research.

34. Dray, S. M. (1995). The Importance of Designing Usable Systems. *Interactions, 2*(1), 17-20.

35. Dreyfuss, H. (1955). *Designing for People*. New York: Simon and Schuster.

36. Escalas, J. E., & Bettman, J. R. (2003). You Are What They Eat: The Influence of Reference Groups on Consumers' Connections to Brands. *Journal of Consumer Psychology, 13*(3), 339-348.

37. Fabris, P. (1999). You Think Tomaytoes I Think Tomahtoes [Electronic Version]. Retrieved April 10, 2006 from http://www.cio.com/archive/webbusiness/040199_nort.html.

38. Fogg, B. J. (1997). *Charismatic Computers: Creating More Likable and Persuasive Interactive Technologies by Leveraging Principles from Social Psychology.* Stanford, Dissertation Abstracts International, 58.

39. Fogg, B. J. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do*. Amsterdam: Morgan Kaufmann.

40. Fogg, B. J., & Nass, C. I. (1997). Silicon Sycophants: The Effects of Computers That Flatter. *International Journal of Human-Computer Studies, 46*, 551-561.

41. Gabarro, J. (1990). The Development of Working Relationships. In J. Galegher, R. Kraut & C. Egido (Eds.), *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work* (pp. 79–110). Hillsdale, N.J.: Lawrence Erlbaum Associates.

42. Gallaway, G. (1981). *Response Times to User Activities in Interactive Man/Machine Computer Systems* (Technical report HFP 81-25).

43. Gartner Group. (1992). *Selecting and Implementing a Systems Development Methodology*. Stamford, CT: Gartner Group.

44. Gilb, T. (1988). *Principles of Software Engineering Management*. Reading, MA: Addison-Wesley.

45. Gore, A. (1998). A Letter from Vice President Al Gore. *Common Ground, 8*(3), 1.

46. Gould, J. D., & Lewis, C. (1985). Designing for Usability: Key Principles and What Designers Think. *Communications of the ACM, 28*(3), 360-411.

47. Gremler, D. D., & Brown, S. W. (1999). The Loyalty Ripple Effect: Appreciating the Full Value of Customers *International Journal of Service Industry Management, 10*(3), 271-293

48. Grillon, C., Pellowski, M., Merikangas, K. R., & Davis, M. (1997). Darkness Facilitates the Acoustic Startle Reflex in Humans. *Biological Psychiatry, 42*(6), 453-460.

49. Hansell, S. (2004, December 27). Kodak Updates Its Brownie to Compete in a Digital Age. *The New York Times*, p. 67.

50. Harrison, M. C., Henneman, R. L., & Blatt, L. A. (1994). Design of Human Factors Cost-Justification Tool In R. G. Bias & D. J. Mayhew (Eds.), *Cost-Justifying Usability* (pp. 203-242). Boston: Academic Press.

51. Hassenzahl, M. (2004). The Interplay of Beauty, Goodness, and Usability in Interactive Products. *Human-Computer Interaction, 19,* 319–349.

52. Hassenzahl, M., Platz, A., Burmester, M., & Lehner, K. (2000, April 1-6). *Hedonic and Ergonomic Quality Aspects Determine Software's Appeal.* Paper presented at the SIGCHI conference on Human factors in computing systems (CHI 2000), The Hague, The Netherlands.

53. Holbrook, M. B., & Moore, W. L. (1981). Feature Interactions in Consumer Judgments of Verbal Versus Pictorial Presentations. *Journal of Consumer Research, 8*(1), 103.

54. Human Factors International. (2001). HFI Helps Staples.Com Boost Repeat Customers by 67% [Electronic Version]. *Case Studies*. Retrieved April 10, 2006 from https://www.humanfactors.com/about/staples.asp.

55. Johnson-Laird, P. N. (1988). *The Computer and the Mind: An Introduction to Cognitive Science*. Cambridge, MA: Harvard University Press.

56. Jones, E. E. (1990). *Interpersonal Perception*. New York: W.H. Freeman.

57. Kalin, S. (1999). Cio Web Business Magazine [Electronic Version]. Retrieved April 10, 2006 from http://www.cio.com/archive/webbusiness/040199_use.html.

58. Karat, C.-M. (1990). *Cost-Benefit Analysis of Usability Engineering Techniques.* Paper presented at the Conference of the Human Factors Society 34th Annual Meeting, Orlando, FL.

59. Karat, C.-M. (2005). A Business Case Approach to Usability Cost Justification for the Web. In R. G. Bias & D. J. Mayhew (Eds.), *Cost-Justifying Usability: An Update for the Internet Age* (pp. 103-142). Boston: Morgan Kaufmann.

60. Karat, C.-M., & Lund, A. (2005). The Return on Investment in Usability of Web Applications In R. G. Bias & D. J. Mayhew (Eds.), *Cost-Justifying Usability: An Update for the Internet Age* (pp. 297-316). Boston: Morgan Kaufmann.

61. Katz, D. (1950). *Gestalt Psychology: Its Nature and Significance*. New York: Ronald Press Co.

62. Kemp, T. (2001). Macy's Doubles Conversion Rate [Electronic Version]. *Internet Week* from http://internetweek.cmp.com/showArticle.jhtml?articleID=6402624.

63. Klein, J., Moon, Y., & Pieard, R. W. (1999, May 15-20). *This Computer Responds to User Frustration.* Paper presented at the SIGCHI conference on Human factors in computing systems (CHI 99), Pittsburgh, Pennsylvania.

64. Kurosu, M., & Kashimura, K. (1995, May 7-11). *Apparent Usability Vs. Inherent Usability: Experimental Analysis on the Determinants of the Apparent Usability.*

Paper presented at the SIGCHI conference on Human factors in computing systems (CHI 95), Denver, Colorado.

65. Landauer, T. K. (1995). *The Trouble with Computers: Usefulness, Usability, and Productivity*. Cambridge, MA: MIT Press.

66. Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). Motivated Attention: Affect, Activation, and Action. In P. J. Lang, R. F. Simons & M. T. Balaban (Eds.), *Attention and Orienting: Sensory and Motivational Processes* (pp. 97–135). Hillsdale, NJ: Erlbaum.

67. Larson, K., & Czerwinski, M. (1998, April 18-23). *Web Page Design: Implication of Memory, Structure and Scent for Information Retrieval.* Paper presented at the SIGCHI conference on Human factors in computing systems (CHI 98), Los Angeles, CA.

68. Lauer, D. A. (1979). *Design Basics* New York: Holt, Rinehart, and Winston.

69. Lederer, A. L., & Prasad, J. (1992). Nine Management Guidelines for Better Cost Estimating. *Communications of the ACM, 35*(2), 51-59.

70. LeDoux, J. E. (1994). Emotion, Memory and the Brain. *Scientific American, 270*(6), 50a.

71. Madsen, K. H. (1999). The Diversity of Usability Practices. *Communications of the ACM*(42), 5.

72. Manning, H. (2005). *Executive Q&A: Web Site Reviews*. Cambridge, MA: Forrester Research.

73. Manning, H. (2006). *Managing the Risk of Web Site Redesigns*. Cambridge, MA: Forrester Research.

74. Manning, H. (2006). *The Roi of Web Redesigns Made Simple*. Cambridge, MA: Forrester Research.

75. Manning, H., McCarthy, J. C., & Souza, R. K. (1998). *Why Most Web Sites Fail* (No. 3-7). Cambridge, MA: Forrester Research.

76. Marcus, A. (1992). *Graphic Design for Electronic Documents and User Interfaces*. New York: ACM Press.

77. Mauro, C. L. (2005). Usability Science: Tactical and Strategic Cost Justifications in Large Corporate Applications. In R. G. Bias & D. J. Mayhew (Eds.), *Cost-Justifying Usability: An Update for the Internet Age* (pp. 265-296). Boston: Morgan Kaufmann.

78. Mayhew, D. J. (1999). *The Usability Engineering Lifecycle: A Practitioner's Handbook for User Interface Design* San Diego: Morgan Kaufmann.

79. Microsoft. (2002). *Windows XP Visual Guidelines*. Retrieved April 12, 2006.

80. Microsoft. (2006). *Windows Vista User Experience Guidelines*. Retrieved April 12, 2006, from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/UxGuide/UXGuide/Home.asp.

81. Millen, D. R. (2000). Rapid Ethnography: Time Deepening Strategies for HCI Field Research. *Proceedings of the Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, 280-286.

82. Nakarada-Kordic, I., & Lobb, B. (2005, July 6-8). *Effect of Perceived Attractiveness of Web Interface Design on Visual Search of Web Sites.* Paper presented at the Conference of SIGCHI New Zealand (CHINZ 05), Auckland, NZ.

83. Nass, C., Fogg, B. J., & Moon, Y. (1996). Can Computers Be Teammates? *International Journal of Human-Computer Studies, 45*(6), 669-678.

84. NCI. (2006). Research-Based Web Design & Usability Guidelines. Retrieved March 25, 2006, from http://usability.gov/guidelines/

85. Nielsen, J. (1993). Is Usability Engineering Really Worth It? *IEEE Software, 10*(6), 90–92.

86. Nielsen, J. (1994). *Usability Engineering*. San Diego: Morgan Kaufmann.

87. Nielsen, J. (1997). Loyalty on the Web [Electronic Version]. *Alertbox*. Retrieved April 10, 2006 from http://www.useit.com/alertbox/9708a.html. See also a press release describing the Binary Compass report that this Alertbox column is based on at http://merchant.bizrate.com/oa/general/press/release.xpml?rel=7.

88. Nielsen, J. (1999). Why People Shop on the Web [Electronic Version]. *Alertbox*. Retrieved April 10, 2006 from http://www.useit.com/alertbox/990207.html.

89. Nielsen, J., & Gilutz, S. (2003). *Usability Return on Investment.* Nielsen Norman Group, Fremont, CA.

90. Norman, D. A. (1987). Some Observations on Mental Models. In R. M. Baecker & W. A. S. Buxton (Eds.), *Readings in Human-Computer Interaction: A Multidisciplinary Approach*. San Mateo, CA: Morgan Kaufmann.

91. Norman, D. A. (1990). *The Design of Everyday Things* (1st Doubleday/Currency ed.). New York: Doubleday.

92. Norman, D. A. (2004). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Books.

93. Nussbaum, B. (2005). Getting Schooled in Innovation [Electronic Version]. *Business Week*. Retrieved April 10, 2006 from http://businessweek.com/bwdaily/dnflash/jan2005/nf2005013_8303.htm.

94. Okun, B. F. (2002). *Effective Helping: Interviewing and Counseling Techniques* (6th ed.). Pacific Grove, CA: Brooks/Cole-Thomson Learning.

95. Olson, G. M., & Olson, J. S. (2003). Human-Computer Interaction: Psychological Aspects of the Human Use of Computing. *Annual Review of Psychology, 54*, 491-516

96. Pandey, J., & Singh, P. (1987). Effects of Machiavellianism, Other-Enhancement, and Power-Position on Affect, Power Feeling, and Evaluation of the Ingratiator. *Journal of Psychology: Interdisciplinary and Applied, 121*(3), 287-300.

97. Parush, A., Nadir, R., & Shtub, A. (1998). Evaluating the Layout of Graphical User Interface Screens: Validation of a Numerical Computerized Model. *International Journal of Human-Computer Interaction, 10*(4), 343-360.

98. Patterson, P. A., & North, R. A. (2006). Fitting Human Factors in the Product Development Process [Electronic Version]. *Medical Device & Diagnostic Industry Magazine*. Retrieved April 19, 2006 from http://www.devicelink.com/mddi/archive/06/01/007.html.

99. Peter, J. P., & Olson, J. C. (1993). *Consumer Behavior and Marketing Strategy*. Homewood, IL: Richard D. Irwin.

100. Peters, T. J. (1987). *Thriving on Chaos: Handbook for a Management Revolution*. New York: Harper & Row.

101. Petroski, H. (1993). *The Evolution of Useful Things*. New York: Alfred A. Knopf.

102. Petty, R., & Wegener, D. (1998). Attitude Change: Multiple Roles for Persuasion Variables. In D. T. Gilbert, S. T. Fiske & G. Lindzey (Eds.), *The Handbook of Social Psychology* (4th ed., pp. 323–390). New York: McGraw-Hill.

103. Pimentel, R. W., & Reynolds, K. E. (2004). A Model for Consumer Devotion: Affective Commitment with Proactive Sustaining Behaviors. *Academy of Marketing Science Review, 2004*.

104. Pine, B. J., & Gilmore, J. H. (1999). *The Experience Economy: Work Is Theatre & Every Business a Stage*. Boston: Harvard Business School Press.

105. Pressman, R. S. (2005). *Software Engineering: A Practitioner's Approach* (International ed.). Boston: McGraw-Hill Higher Education.

106. Quesenbery, W. (2003). The Five Dimensions of Usability. In M. J. Albers & B. Mazur (Eds.), *Content and Complexity: Information Design in Technical Communication*. Mahwah, NJ: Lawrence Erlbaum Associates.

107. Rafaeli, A., & Vilnai-Yavetz, I. (2004). Relating Instrumentality, Aesthetics, and Symbolism of Physical Artifacts to Emotions. *Theoretical Issues in Ergonomics Science, 5*(1), 91–112.

108. Reed, A. (2002). Social Identity as a Useful Perspective for Self-Concept-Based Consumer Research. *Psychology & Marketing, 19*(3), 235.

109. Reeves, B., & Nass, C. I. (1996). *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places*. New York: Cambridge University Press.

110. Reicheld, F. F., & Sasse, W. E. J. (1990). Zero, Defections: Quality Comes to Services. *Harvard Business Review, 68*(September/October), 105-111.

111. Rogers, Y., Rutherford, A., & Bibby, P. (Eds.). (1992). *Models in the Mind: Theory, Perspective and Application*. London: Academic Press.

112. Rohn, J. A. (2005). Cost-Justifying Usability in Vendor Companies In R. G. Bias & D. J. Mayhew (Eds.), *Cost-Justifying Usability: An Update for the Internet Age* (pp. 185-213). Boston: Morgan Kaufmann.

113. Root, N. L. (2005). *Learning the Value of Effective Site Design*. Cambridge, MA: Forrester Research.

114. Rosenberg, L. J., & Czepiel, J. A. (1984). A Marketing Approach to Customer Retention. *Journal of Consumer Marketing*(Spring), 45-51.

115. Rosenfeld, L., & Morville, P. (2002). *Information Architecture for the World Wide Web* (2nd ed.). Cambridge, Mass: O'Reilly.

116. Rubin, J. (1994). *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests*. New York: Wiley.

117. Russell, B., & Novosedlik, W. (1998). Design Matters: New iMac Apotheosis of Lateral Thinking. *Strategy, 9*(19), 22–23.

118. Schenkman, B. N., & Jönsson, F. U. (2000). Aesthetics and Preferences of Web Pages. *Behaviour & Information Technology, 19*(5), 367–377.

119. Schouten, J. W., & McAlexander, J. (1995). Subcultures of Consumption: An Ethnography of the New Bikers. *Journal of Consumer Research, 22* (June), 43-61.

120. Shevlin, R. (2006). *Bank Web Sites Impact Customer Relationships*. Cambridge, MA: Forrester Research.

121. Special Issue on Task Analysis. (1998). *Ergonomics, 41*(11), 1537-1756.

122. Standish Group. (1995). *The Chaos Report*. West Yarmouth, MA: Standish Group.

123. Stipek, D. (1996). Motivation and Instruction. In Berliner & Calfee (Eds.), *Handbook of Educational Psychology* (pp. 85–113). New York: Macmillan.

124. Stone, D. L., Jarrett, C., Woodroffe, M., & Minocha, S. (2005). *User Interface Design and Evaluation*. San Francisco, CA: Elsevier/Morgan Kaufmann.

125. Sun Microsystems. (2001). *Java Look and Feel Design Guidelines*. Retrieved April 12, 2006, from http://java.sun.com/products/jlf/ed2/book/HIGTitle.html.

126. Temkin, B. D. (2005). *The Customer Experience Value Chain*. Cambridge, MA: Forrester Research.

127. The Open Group. (1997). *CDE 2.1/Motif 2.1 - Style Guide and Glossary*. from http://www.opengroup.org/public/pubs/catalog/m027.htm.

128. Tractinsky, N. (1997, March 22-27). *Aesthetics and Apparent Usability: Empirically Assessing Cultural and Methodological Issues.* Paper presented at the SIGCHI conference on Human factors in computing systems (CHI 97), Atlanta, Georgia.

129. Tractinsky, N., Katz, A. S., & Ikar, D. (2000). What Is Beautiful Is Usable. *Interacting with Computers, 13* 127-145.

130. Tullis, T. S. (1983). The Formatting of Alphanumeric Displays: A Review and Analysis. *Human Factors, 25*(6), 657-682.

131. Turner, J. C. (1985). Social Categorization and the Self-Concept: A Social Cognitive Theory of Group Behavior. In E. J. Lawler (Ed.), *Advances in Group Processes: Theory and Research* (Vol. 2, pp. 77–121). Greenwich , CT: JAI Press.

132. User Interface Engineering. (2001). *Are the Product Lists on Your Site Reducing Sales?* Bradford, MA: User Interface Engineering.

133. van der Heijden, H. (2003). Factors Influencing the Usage of Websites: The Case of a Generic Portal in the Netherlands. *Information & Management, 40*(6), 541-549.

134. Veryzer Jr., R. W. (1993). Aesthetic Response and the Influence of Design Principles on Product Preferences. *Advances in Consumer Research, 20*(1), 219-223.

135. Vredenburg, K., Mao, J.-Y., Smith, P. W., & Carey, T. (2002). *A Survey of User-Centered Design Practice.* Paper presented at the SIGCHI conference on Human factors in computing systems (CHI 02), Minneapolis, Minnesota.

136. Wertheimer, M. (1938). Laws of Organization in Perceptual Forms. In W. D. Ellis (Ed.), *Source Book of Gestalt Psychology* (pp. 71-88). London: Kegan Paul.

137. Wiklund, M. E. (1994). *Usability in Practice: How Companies Develop User-Friendly Products*. Boston, MA: Academic Press.

138. Wildstrom, S. (1998, September 7). Is Apple's iMac for You? *Business Week, 18*.

139. Wixon, D., & Jones, S. (1996). Usability for Fun and Profit: A Case Study of the Design of Dec Rally, Version 2. In M. Rudisill & C. Lewis (Eds.), *Human-Computer Interface Design: Success Stories, Emerging Methods, and Real-World Contex* (pp. 3-35). San Francisco: Morgan Kaufman.

140. Wixon, D., & Ramey, J. (Eds.). (1996). *Field Methods Casebook for Software Design*. New York: John Wiley & Sons.

141. Yamamoto, M., & Lambert, D. R. (1994). The Impact of Product Aesthetics on the Evaluation of Industrial Products. *Journal of Product Innovation Management, 11*, 309–324.

142. Zaccai, G. (2005). Designed for Loving [Electronic Version]. *Business Week.* Retrieved April 10, 2006 from http://www.businessweek.com/innovate/content/jul2005/di20050721_304729.htm .

143. Zajonc, R. B., & Markus, H. (1982). Affective and Cognitive Factors in Preferences. *Journal of Consumer Research, 9*(2), 123–132.