

CHAPTER 1

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The Interdisciplinary Design Science

تخصصات علوم التصميم

Psychologists (incl. Experimental, Educational, Social and Industrial Psychologists)

Computer Scientists

Instructional and Graphic Designers

Technical Writers

Human Factors and Ergonomics Experts

Anthropologists and Sociologists

What are the Ramifications?

ما هي التداعيات أو التشعبات؟

Success Stories: Microsoft, Linux, Amazon.com, Google

Competition: Firefox vs. Internet Explorer

Copyright Infringement Suits - Apple vs. Microsoft (Windows) and Napster vs. The music industry

Mergers: AOL and Time Warner

Corporate Takeovers: IBM's seizure of Lotus

Privacy and Security issues: identification theft, medical information, viruses, spam, pornography, national security

Individual User Level

مستوي المستخدم الفردي

Routine processes:
tax return preparation

Decision support:
a doctor's diagnosis and treatment

Education and training: encyclopedias,
drill-and-practice exercises, simulations

Leisure:
music and sports information

User generated content: social
networking web sites, photo and video
share sites, user communities

Internet-enabled devices and
communication

Communities

المجتمعات

Business use:
financial planning, publishing applications

Industries and professions: web resources
for journals, and career opportunities

Family use:
entertainment, games and communication

Globalization: language and culture

Usability requirements

متطلبات قابليه الاستخدام

Synonyms for “user-friendly” in Microsoft Word 2002 are easy to use; accessible; comprehensible; intelligible; idiot proof; available; and ready

But a “friend” also seeks to help and be valuable. A friend is not only understandable, but understands. A friend is reliable and doesn’t hurt. A friend is pleasant to be with.

These measures are still subjective and vague, so a systematic process is necessary to develop usable systems for specific users in a specific context

The *U.S. Human Engineering Design Criteria for Military Systems (1999)* states these purposes:

- Achieve required performance by operator, control, and maintenance personnel
 - Minimize skill and personnel requirements and training time
- Achieve required reliability of personnel-equipment/software combinations
 - Foster design standardization within and among systems

Should improving the user’s quality of life and the community also be objectives?

Usability requires project management and careful attention to requirements analysis and testing for clearly defined objectives

Goals for requirements analysis

أهداف تحليل الاحتياجات

Complete projects on time and within budget

Late or over budget products can create serious pressure within a company and potentially mean dissatisfied customers and loss of business to competitors

Promote standardization, integration, consistency, and portability

1- **Standardization:** use pre-existing industry standards where they exist to aid learning and avoid errors (e.g. the W3C and ISO standards)

2- **Integration:** the product should be able to run across different software tools and packages (e.g. Unix)

3- Consistency:

- compatibility across different product versions
- compatibility with related paper and other non-computer based systems
- use common action sequences, terms, units, colors, etc. within the program

4- **Portability:** allow for the user to convert data across multiple software and hardware environments

Ensure reliability

- 1- Actions must function as specified
- 2- Database data displayed must reflect the actual database
- 3- Appease the user's sense of mistrust
- 4- The system should be available as often as possible
- 5- The system must not introduce errors
- 6- Ensure the user's privacy and data security by protecting against unwarranted access, destruction of data, and malicious tampering

Ascertain the user's needs

- 1- Determine what tasks and subtasks must be carried out
- 2- Include tasks which are only performed occasionally. Common tasks are easy to identify.
- 3- Functionality must match need or else users will reject or underutilize the product

Usability measures

قابلية القياس

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Define the target user community and class of tasks associated with the interface

Communities evolve and change (e.g. the interface to information services for the U.S. Library of Congress)

5 human factors central to community evaluation:

Time to learn: How long does it take for typical members of the community to learn relevant task?

Speed of performance : How long does it take to perform relevant benchmarks?

Rate of errors by users : How many and what kinds of errors are made during benchmark tasks?

Retention over time : Frequency of use and ease of learning help make for better user retention

Subjective satisfaction : Allow for user feedback via interviews, free-form comments and satisfaction scales

Trade-offs in design options frequently occur.

Changes to the interface in a new version may create consistency problems with the previous version, but the changes may improve the interface in other ways or introduce new needed functionality.

Design alternatives can be evaluated by designers and users via mockups or high-fidelity prototypes.

The basic tradeoff is getting feedback early and perhaps less expensively in the development process versus having a more authentic interface evaluated

Usability motivations

دوافع الاستخدام

Life-critical systems

- Air traffic control, nuclear reactors, power utilities, police & fire dispatch systems, medical equipment
- High costs, reliability and effectiveness are expected
- Length training periods are acceptable despite the financial cost to provide error-free performance and avoid the low frequency but high cost errors
- Subject satisfaction is less an issue due to well motivated users

Industrial and commercial uses

- Banking, insurance, order entry, inventory management, reservation, billing, and point-of-sales systems
- Ease of learning is important to reduce training costs
- Speed and error rates are relative to cost
- Speed of performance is important because of the number of transactions
- Subjective satisfaction is fairly important to limit operator burnout

Office, home, and entertainment applications

- Word processing, electronic mail, computer conferencing, and video game systems, educational packages, search engines, mobile device, etc.
- Ease of learning, low error rates, and subjective satisfaction are paramount due to use is often discretionary and competition fierce
- Infrequent use of some applications means interfaces must be intuitive and easy to use online help is important
- Choosing functionality is difficult because the population has a wide range of both novice and expert users
- Competition cause the need for low cost
- New games and gaming devices!
 - **For example**, Nintendo Wii

Exploratory, creative, and cooperative systems

- Web browsing, search engines, artist toolkits, architectural design, software development, music composition, and scientific modeling systems
- Collaborative work
- Benchmarks are hard to describe for exploratory tasks and device users
- With these applications, the computer should be transparent so that the user can be absorbed in their task domain

Social-technical systems

- Complex systems that involve many people over long time periods
- Voting, health support, identity verification, crime reporting
- Trust, privacy, responsibility, and security are issues
- Verifiable sources and status feedback are important
- Ease of learning for novices and feedback to build trust
- Administrators need tools to detect unusual patterns of usage

Physical abilities and physical workplaces

- Basic data about human dimensions comes from research in *anthropometry*
- There is no average user, either compromises must be made or multiple versions of a system must be created
- Physical measurement of human dimensions are not enough, take into account dynamic measures such as reach, strength or speed
- Screen-brightness preferences vary substantially, designers customarily provide a knob to enable user control
- Account for variances of the user population's sense perception
- Vision: depth, contrast, color blindness, and motion sensitivity
- Touch: keyboard and touchscreen sensitivity
- Hearing: audio clues must be distinct
- Workplace design can both help and hinder work performance

The standard *ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations (2007)* lists these concerns

- Work-surface and display-support height
- Clearance under work surface for legs
- Work-surface width and depth
- Adjustability of heights and angles for chairs and work surfaces
- Posture - seating depth and angle; back-rest height and lumbar support
- Availability of armrests, footrests, and palmrests

Cognitive and perceptual abilities

- **The human ability to interpret sensory input rapidly and to initiate complex actions makes modern computer systems possible**
- **The journal *Ergonomics Abstracts* offers this classification of human cognitive processes:**
 - Long-term and semantic memory
 - Short-term and working memory
 - Problem solving and reasoning
 - Decision making and risk assessment
 - Language communication and comprehension
 - Search, imagery, and sensory memory
 - Learning, skill development, knowledge acquisition, and concept attainment
- **They also suggest this set of factors affecting perceptual and motor performance:**
 - Arousal and vigilance
 - Fatigue and sleep deprivation
 - Perceptual (mental) load
 - Knowledge of results and feedback
 - Monotony and boredom
 - Sensory deprivation
 - Nutrition and diet
 - Fear, anxiety, mood, and emotion
 - Drugs, smoking, and alcohol
 - Physiological rhythms

But note, in any application, background experience and knowledge in the task domain and the interface domain play key roles in learning and performance

Physical abilities and physical workplaces

- There is no set taxonomy for identifying user personality types
- Designers must be aware that populations are subdivided and that these subdivisions have various responses to different stimuli
- Myers-Briggs Type Indicator (MBTI)
 - extroversion versus introversion
 - sensing versus intuition
 - perceptive versus judging
 - feeling versus thinking

Cultural and international diversity

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

Users with physical challenges

- Designers must plan early to accommodate users with disabilities
 - Early planning is more cost efficient than adding on later
- Businesses must comply with the "Americans With Disabilities" Act for some applications

Older Adult Users

- Including the elderly is fairly easy
 - Designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc. with less distracting animation

Goals for our profession

أهداف مهنتنا

Potential research topics

- Reducing anxiety and fear of computer usage
- Graceful evolution
- Specification and implementation of interaction
- Direct manipulation
- Social media participation
- Input devices
- Online assistance
- Information exploration

Providing tools, techniques, and knowledge for system implementers

- Rapid prototyping is easy when using contemporary tools
- Use general or self-determined guideline documents written for specific audiences
- To refine systems, use feedback from individual or groups of users

Raising the computer consciousness of the general public

- Many novice users are fearful due to experience with poor product design
- Good designs help novices through these fears by being clear, competent, and nonthreatening