Human Factors: Interactive Software

• Organization of information
• Real impact on lives of people
• Human factors issues emerging relatively recently
• Interactive capability is crux
Why Consider Human Factors?

• Post-Phone-Company economy:
  – we’re the phone company; we can do anything we want
  – new era: user/consumer drives design

• Life-critical applications: serious situations are now software-controlled
  – air traffic control
  – medical applications
  – space flight; navigation/transportation
Motivations for Human Factors

• Industrial/economic competition in a global economy
• Creative applications
• The personal computer/home/office environment
System Engineering Goals

• “Make system user-friendly”: too vague
  – Achieve required performance by operator/controller personnel
  – Minimize skill requirements/training time of users
  – Achieve required reliability of use
  – Promote standardized design criteria within/among related systems
Expressing Functional Requirements

• Task analysis:
  – avoid under-utilization of resources/attention
  – avoid inadequate or incorrect functionality

• Explore exceptional/emergency conditions:
  – difficult to predict boundary conditions
  – error recovery, catastrophic failure avoidance are critical
Reliability and Consistency

• Reliability:
  – user trust depends upon reliable and consistent data management
  – functional goals are jeopardized without reliability

• Security and privacy:
  – data availability and protection important for user trust
  – privacy issues must be considered early in design phase
Standardization

• User expectation:
  – pressure exerted on design by existing tools and user expectations
  – often design standardization competes with business goals in design stage

• Consistency and portability:
  – version consistency at a minimum is strongly expected by users
  – portability can affect size of user community as well as performance of system
Business Issues

• Human factors of human factors:
  – budgets, motivation, time-critical deadlines to market
  – interaction with non-technical design partners

• Management
  – product profitability
  – proper pre-release (pre-implementation?) testing cycle
GUI Design Goals

• Graphical User Interface (GUI) - central evaluative human factors:
  – Time to learn
  – Speed of performance
  – Error rate
  – Retention over many sessions
  – User satisfaction (“how does it make you feel?”)
Tradeoffs in Design Goals

• Many pressures and competing constraints must be resolved during design phase:
  – need for “quick and dirty”: fast learning versus low satisfaction and reduced functionality
  – need for high user satisfaction: ease of installation, low cost, consistent interface

• Managers make decisions:
  – consider tradeoffs; use mock-ups
  – rely on design engineers for critical information
Diversity Delimits Design

• One size does not fit all
  – design challenges abound when accommodating human diversity

• Physical diversity
  – space, size, shape, dynamics
  – perceptual differences: color, brightness, contrast, motion
  – *Ergonomics* of hardware, interfaces, workspaces
Cognitive Abilities

• Memory and learning techniques
• Problem solving skills
• Attention span
• Search and scanning ability
• Perception of time
Factors Affecting Cognitive Performance

- Fatigue
- Enthusiasm and tenacity
- Mental load
- General knowledge of results
- Monotony and boredom
- Sensory/sleep deprivation
- Anxiety, fear, isolation
- Aging, drugs, alcohol, ...
Personality Differences

Myers-Briggs Type Indicator (MBTI):

- Extroversion versus introversion
- Sensing versus intuition
- Perceptive versus judging
- Feeling versus thinking

Add risk-taking, controlling, impulsive, ...
Cultural Differences

- Character/language variation
- Date and time formats
- Number formats
- Weights and measures
- Sorting orders
- Icon colors, styles, buttons
- Etiquette, policies, metaphors
Disabilities and the Elderly

- Avoid designs which marginalize groups with special needs
- Explore versions substantially designed to overcome shortcomings of a group
Professional Goals

• Make computers accessible: reduce fear and anxiety
• Evolve designs gracefully
• Precisely specify and implement designs (nothing by accident)
• Direct manipulation
• Refine input devices
• Provide for better “help” (on-line?)
• Enable information exploration and organization
General Principles
Interface Design

• Informative feedback
• Error prevention and simple error handling
• Obvious focus of control
• Reduce short-term memory load
• Transparent state
• Support user diversity
Informative Feedback

• Feedback to the user to be provided to avoid the *divided states problem*
  – If asked the user should be able to describe the state of the system

• Feedback must be consice and not misleading or ambiguous
Error Prevention / Control

• Prevent errors whenever possible
  – If possible do not report prevented errors to user
  – Prevention should be transparent to the user

• Control user behaviors prior to errors occurring
  – Warnings, etc.
Obvious Focus of Control

• Actions performed must be applied to focus of control

• User must be made aware of focus of control at all times

• Examples: mouse pointer, active buttons, active image.
Reduce Short-Term Memory Load

• Users should be assisted, not burdened by your interface

• Do not expect users to recall more than one or two items in history

• Dependencies (spatial/temporal) must be made explicit
  – Example: heirarchical menus
Some Specific Examples

• Next several sides show good and bad examples

• These examples are anecdotal but can teach us valuable design principles

• Make sure your program does not become next year’s “bad” example!
Use of Color

- Hardcoded color scheme: difficult and irritating to the user
- Colors should support the user interface without being intrusive
Use of Color

• This program has two possible states; success or failure

• Color and layout should help differentiate these for the user, not confuse the user
Use of Metaphor

• Graphical User Interfaces are inherently a metaphor
  – Images, mouse clicks, etc. are visual and action metaphor representing machine code state and operations

• The user interface designer should be aware of the metaphor being conveyed to the user
Misleading Metaphor

• A control dialog box that uses a VCR metaphor for control of a printer

• Metaphor should not supplant existing models of how things behave
Confusing Metaphor (stoplights?)

- Stoplights denote user entry progress per tab
  - Too much information
  - Conflicting Messages
  - Labeling and placement of stoplights
Terminology and Preciseness

- Error generated when user attempts to view a folder for which she/he does not have permission (Outlook ‘98)

- Error produced implies that there is something wrong with the users settings or installation
• IBM’s Audiostation player

• Mode button is ambiguous and only after selecting mode several times (and carefully watching the system change) does the user learn the purpose of the button
Information, not Clutter

• Icon next to each file name in dialog window conveys filetype to user in concise manner
Tabbed Hall of Shame