New Jersey Institute of Technology Department of Industrial and Manufacturing Engineering

IE 662 Cognitive Engineering

Harry Blanchard Adjunct Instructor, NJIT Principal Technical Staff Member AT&T Shannon Labs, Florham Park, NJ (973) 360-8095 hblanchard@research.att.com http://www.blanchard.com/

Today's Outline

- Introductions
- · Course Mechanics
- · History of Human Factors
- Definitions
 - What is Cognitive Ergonomics, User Experience?
- Observations from Don Norman's Psychology of Everyday Things
- · Usability: What Is It?
- · Importance and Impact: Examples
- Class Exercise

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Goals

- Application of human factors and cognitive psychology to user interface design of Information Technology (IT)
- IT includes, but not limited to, traditional computers – Communications, Internet, groupware, handheld devices, complex
- control systems (factories, power plants, etc.)
- Methods of User Centered Design
- Methods of Usability Testing
- Coverage of Current Technology Topics:
 - Human-Computer Interaction
 - Internet and Web Design
 - CSCW, Intelligent Agents and Intelligent Systems
 - Handheld Devices, Information Appliances
 - Telecommunications
 - Speech Technology

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History / Background of the Field (1)

- · Pre-War
 - William James: Applied Psychology
 - Gilbreth: Time and motion studies
- Post War 1945-1960
 - Late 1940s: Engineering Psychology at US Air Force and US Navy
 - Ergonomics Society 1949, Human Factors Society 1957
 - Military application dominant until 1960s

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History / Background of the Field (2)

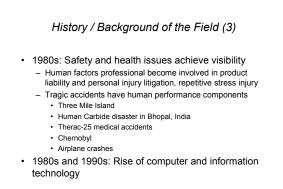
Expansion into Industry 1950s-1970s

 1951: Karlin founds User Preference Research Department at Bell Laboratories

- Began with behavioral science involvement in assessing voice quality of network
- Evolved to other applications of behavioral science (military work still formed a part)
- Example: studies to determine the impact of transition from exhange dialing to 7-digit "all number" dialing
- Other industry begin to development behavioral science groups as well: computers, automobiles, consumer products
- Late 50s early 60s: Deininger uses human performance studies to make engineering decisions on touch-tone keypads

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History / Background of the Field (4)

- 1980s 1990s Usability becomes prominent in personal computer industry
 - First Windowing systems and mouse pioneered in Xerox PARC
 - Apple launches Lisa then MacIntosh, makes reputation on usability of systems
 - MS Windows propagates throughout Industry
 - Information technology companies begin to conceive of usability as a market "differentiator"

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Definition of Terms Human Factors Ergonomics

- User Interface
- User Interface Design
- User Centered Design
- Software Ergonomics
- Cognitive Ergonomics
- · User Experience

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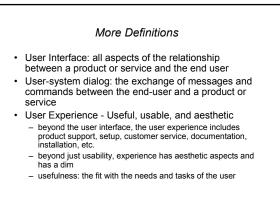
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Definitions

- Application of the knowledge concerning the characteristics of human beings to the design of systems and devices of all kinds (HFES)
- Cognitive ergonomics: Application of cognitive science and its methods to design (HEB)
- Cognitive engineering (narrow definition): "The multidisciplinary area of research that is concerned with the analysis, design, and evaluation of complex sociotechnical systems" (Vincente, 1999) a form of work analysis based on cognitive constraints

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Multidisciplinary Approach to HCI

- · Ergonomics and human factors anthropometrics, human performance
- Cognitive psychology human behavior and mental processes
- Social psychology, sociology behavior in social context, social impact and communication afforded by computer technology, CSCW
- Organizational psychology applied social psychology to business issues
- Anthropology long-term ethnographic observations of consumers
 Linguistics
- Computer science and artificial intelligence
- · Engineering and design design process, software engineering

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Observations on Technology Don Norman (1988) The psychology of everyday things. Visibility - show what part operates and how, appropriate cues and feedback Mapping - relation between controls (user actions) and results (system behavior) Atural mappings - are immediately apparent to the user Affordance - perceived and actual properties of a artifact (system, device), properties which suggest how a thing is used Conceptual model - human's mental model of a device which is used to 'simulate' the behavior of the system - problems occur when users mental models do not match the actual system

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Norman's Seven Principles

- 1. Use both knowledge in the world and knowledge in the head (models, manuals)
- 2. Simplify the structure of tasks
- 3. Make things visible: bridge the gulfs of execution and evaluation
- 4. Get the mappings right
- 5. Exploit the power of constraints, both natural and artificial
- 6. Design for error
- 7. When all else fails, standardize

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What is "Usability"?

- Usability: The degree to which a product or service is easy to use, easy to learn, and optimized for efficiency
- · ISO 9241-11 "Guidance on Usability"
 - Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction
 - Effectiveness Accuracy and completeness with which users achieve specified goals
 - Efficiency Resources expended in relation to the accuracy and completeness with which users achieve goals
 Satisfaction Freedom from discomfort, and positive attitudes towards the
 - user of the product

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