

Chapter 3

Design and Evaluation Methods

Overview of design and evaluation

- Consideration of human factors into a product design should be as early as possible
- Human factor experts may be asked to justify that the benefits of human factors effort is larger than its cost in monetary term
- It is more difficult to estimate benefits than costs

Overview of design and evaluation

- Human factors in the product design include:
 - Front end analysis
 - Iterative design and test
 - System production
 - Implementation and evaluation
 - System operation and maintenance
 - System disposal
- User-Centered design: to center the design process around the user

Overview of design and evaluation

- Sources of information to guide human factors specialists' involvement in the design process include:
 - Previous published research
 - Data compendiums (e.g., tables and formulas of human capacities)
 - Human factors design standards (e.g., controls design should be frequent-based/importance-based)
 - Human factors principles and guidelines (e.g., NOISH lifting guidelines)

Front-end analysis

- Front-end analysis: to understand the users, their needs, and the demands of the work situation
- Designers should be able to answer the following questions before design solutions are generated:
 - Problem 1: who are the users?
 - Problem 2: what are the major functions to be performed by the system, whether by person or machine?
 - Problem 3: what are the environmental conditions under which the system/product will be used
 - Problem 4: what are the user's preferences or requirements for the product

Front-end analysis

- User analysis aims to solve problem 1 (“who are the product/system users)
- It is important to create a complete description of the potential user population (e.g., age, gender, education level, physical disabilities, etc.)
- For a existing system, designers could sample existing users and describe the characteristics of them (but not applicable sometimes)
- Consider use *personas* to represent the user characteristics

Front-end analysis

- Environment analysis aims to answer problem 3 (“What are the environmental conditions under which the system/product will be used?”)
- This analysis can be performed concurrently with the user and task analysis

Front-end analysis

- Function and task analysis aims to solve problem 2. It can be divided into
 - Function analysis: list the general categories of functions served by system
 - Task analysis: describe the detailed activities users will be doing in the system
- Goals, functions, are tasks are often confused but not the same
 - Goals are not dependent on technologies
 - Compared to function list, task list have more details of the activities

Front-end analysis

- Task analysis includes four steps:
 - Define the analysis purpose and identify the type of data required
 - Collect task data
 - Summarize task data
 - Analyze task data

Front-end analysis

- Define purpose and required data is to determine what design considerations the task analysis is to address
- Tasks can be described by several type,
 - Hierarchical relationships
 - Information flow
 - Task sequence
 - Location and environmental conditions

Front-end analysis

- Collect task data methods include:
 - Observation
 - Think-Aloud verbal protocol (concurrently, retrospectively, or prospectively)
 - Task performance with questioning
 - Unstructured and structured interviews
- After finishing collecting task-related information, data can be documented or presented in several types
 - Lists, outlines, and matrices
 - Hierarchies
 - Flow charts, timelines, and maps

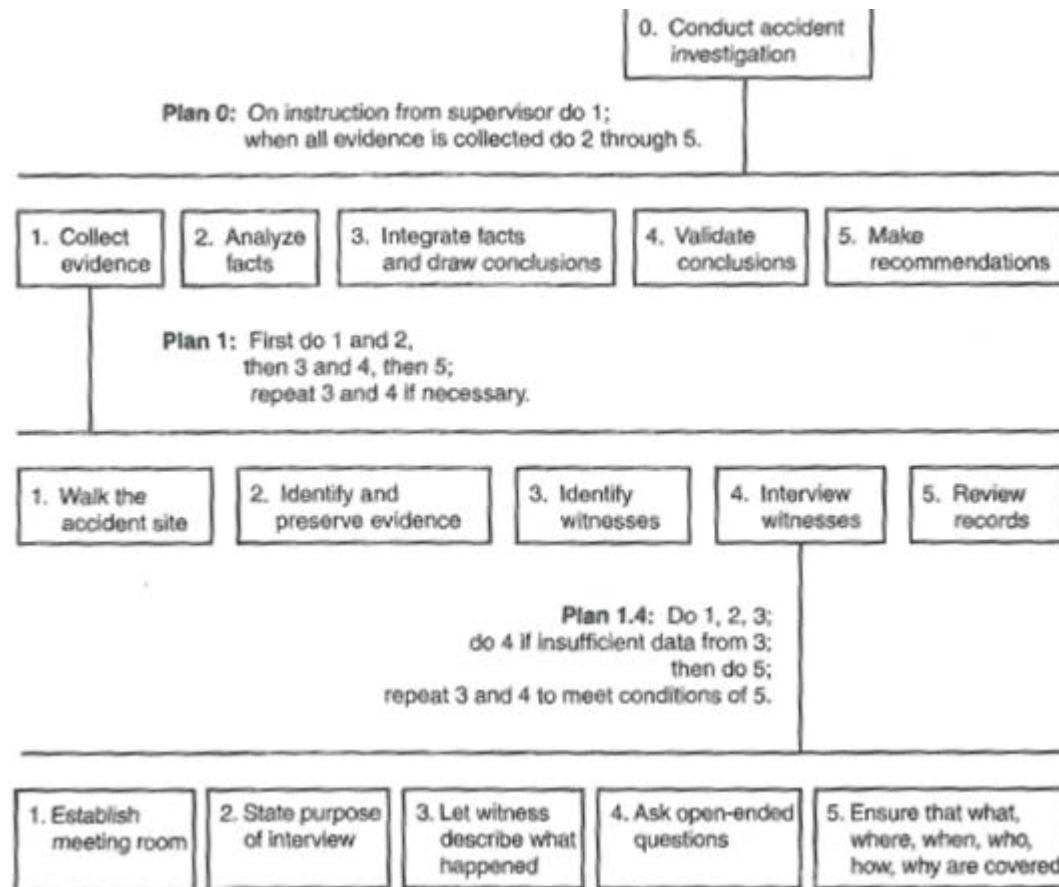


Figure 3.1, Wickens et.al (1998); Introduction to Human Factors Engineering

Front-end analysis

- Analyze data include intuitive inspection
- Quantitative ways to analyze data include:
 - Network analysis (Matrix analysis)
 - Workload analysis
 - Simulation and modeling
 - Safety analysis
 - Scenario specification (popular in software design)
- Identifying user preferences and requirements is a logical extension of the task analysis

Iterative design and testing

- Iterative evaluation starts once the front-end design has been performed
- The object of this design stage is to identify and evaluate how technologies meet users' need and address the work demands

Iterative design and testing

- The questions are going to be answered in this stage are
 - Do the identified features and functions match user preferences and meet user requirement
 - Are there any existing constraints with respect to design of the system
 - What are the human factors criteria for design solutions
 - Which design alternatives best accommodate human limits

Iterative design and testing

- Provide input for system specifications, with respect to users' characteristics, basic tasks or activities, the environment, and user requirements
- The specifications start out vague but become progressively more specific
- System specifications usually include
 - Overall objectives the system support
 - Performance requirements and features
 - Design constraints

Iterative design and testing

- There are several tools that facilitate designers to develop design approach and are listed below:
 - Quality Function Deployment (a decision matrix)
 - Cost/Benefit Analysis
 - Tradeoff Analysis (list advantages and disadvantages)
 - Human Factors Criteria Identification
 - Functional Allocation (machine, human, combination)
 - Support Materials Development
- Organization design, prototypes (mock-ups), heuristic evaluation, and usability testing were also within the iterative design and testing stage

Iterative design and testing

- Organization design concerns the training, procedure, and staffing changes
 - training
 - changes to existing equipment's
 - equipment redesign or replacement
- Prototypes: to support interface and interaction design, usability testing, and other human factor activities

Final test and evaluation

- Once the product has been fully developed, the final test and evaluation is going to be conducted
- It aims to determine any aspect of the system that affect human performance, safety, or the performance of the entire human-machine system
- Users should be involved in this process