

Background for Cognitive Task Analysis Topic

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What is Task Analysis?

- “Study of what an operator (or team of operators) is required to do, in terms of actions and/or cognitive processes, to achieve a system goal” (Kirwan & Ainsworth, 1992)
- “Identify the mapping from tasks to human components and thereby to define the scope of human factors for any particular application” (Wickens, Gordon, & Liu, 1999)

Why use Task Analyses?

- Safety
 - I.d. work hazards
 - Good design for human ops.
 - Provide basis for analysis of human error in system
 - Incident/Accident investigation tool
- Productivity
- Allocation of function
- Person specification
- Staffing & Job organization
- Task & interface design
- Skills & knowledge acquisition
- Performance assurance
- Provide bases for design decisions

Categories of Task Analysis

- Instruction based TA
 - Specifies “correct” or most efficient user actions
 - Advantages: provide detailed guidance, curtailing human error
- Constraint based TA
 - Specifies only what should NOT be done
 - Advantages: more discretion is given to users, accommodates greater variability in user actions, makes fewer assumptions about the properties of the device used

Which method of Task Analysis should be used?

- Purpose
 - Task data collection
 - Task description
 - Task simulation
 - Task behavior assessment
 - Task requirement evaluation
- Design Stage
 - Conceive
 - Design
 - Implement
 - Operate

Examples of Task Analysis Methods

- Critical Incident Technique
- Hierarchical Task Analysis
- Walk-throughs
- Ergonomics Checklists

Critical Incident Technique

- Purpose: Task data collection
- Design phase: All (but generally during Operate phase after incidents have occurred)
- How (Flanagan, 1954):
 - Ask experts to recall unusual or near-catastrophic events occurring to them or co-workers
 - Gather & analyze 50-100 such events to determine what changes can be made to curb problems or capitalize on successes
- Advantages: broadly applicable, allows users to divulge otherwise overlooked information
- Disadvantages: no 1 purpose, may allow for bias & memory fallibility, too vague to be a stand-alone TA method

Hierarchical Task Analysis

- Purpose: Task description
- Design phase: All
- How:
 - Identify a goal to be achieved by the user
 - Describe the goal in terms of the tasks & plans required to achieve goal
 - Continue to break down each task until an appropriate* stopping point is reached
- Terms to understand
 - Goals
 - Tasks
 - Operations
- *Stopping ($P \times C$) rule: describing operation/task is unnecessary if the probability of inadequate performance multiplied by costs is acceptable

Hierarchical Task Analysis

- Representation
 - Tables
 - Diagrams
- Advantages:
 - Economical
 - Focus is on crucial aspects of task
 - Context for other specific approaches
- Disadvantages:
 - This method requires the researcher to be a skilled user of the technique
 - Must be carried out with cooperation of management, engineers & operating staff

Walk-throughs

- Purpose: Task simulation
- Design phase: Design
- How (Kirwan & Ainsworth, 1992):
 - Identify a desired task that the researcher would like to be walked-through
 - Perform brief, preliminary walk-through to orient the researcher to the task (especially if it is complex)
 - Gather one or more respondents with knowledge of the system
 - Notify the respondent that the walk-through is an assessment of the system NOT the respondent
 - Collect data as the respondent is performing the identified task (data sheets, written comments, audio/video recording, or data logging)
 - Debrief the respondent, clarifying any unresolved issues between one another

Walk-throughs

- Advantages: yields accurate description of task, can be “interrupted” for clarification, quickly set up & executed
- Disadvantages: data reduction & analysis is very time-consuming, requires a skilled operator for validity, poor preparation can jeopardize researcher-respondent relationship

Ergonomics Checklists

- Purpose: Task requirements evaluation
- Design phase: All
- How:
 - Identify aspects of system to be checked
 - Consult existing generalizable checklists for the task (CRT display checklists, Human engineering design checklists, MIL-STD 1472C, NUREG-0700, etc.)
 - Develop own checklists for the specific environment of your task
 - Complete the checklists selected objectively & systematically

Ergonomics Checklists

- Advantages: easy way to evaluate whether (especially physical) criteria are met
- Disadvantages: necessary to be knowledgeable about certain psych. principles before certain items can be checked, no priority to checklist failures, little account to context of task, often uni-dimensional, can be unwieldy for complex systems

Papers for February

- Applied cognitive task analysis (ACTA): a practitioner's toolkit for understanding cognitive task analysis by L. Militello & J. Hutton
- Task analysis for the investigation of human error in safety-critical software design: a convergent methods approach by N. Shrayne, et al.

References

- Kirwan, B. & Ainsworth, L. K. (eds.), 1992. *A Guide to Task Analysis*. London: Taylor & Francis, Ltd.
- Vicente, K. J. (1999). *Cognitive Work Analysis*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Wickens, C., Gordon, S., & Liu, Y. (1999) *An Introduction to Human Factors Engineering*. New York: Addison Wesley Longman, Inc.
- Harvey, C. (2001). "Cognitive Task Analysis", presentation at Wright State University.