**Applied Cognitive Task Analysis (ACTA)**

Cognitive Task Analysis (CTA) involves the use of a technique or set of methods to identify, describe and determine the cognitive skills, knowledge & strategies needed for the proficient performance of a particular task or set of tasks that are highly covert, dynamic, and involve decision-making & judgement. A major aim of many CTA methods are to help obtain valuable tacit knowledge, usually from subject matter experts (SMEs), that is often implied or not explicitly expressed.

Many CTA methods can only be effectively conducted and reported by highly trained and experienced industrial engineers, cognitive scientists or psychologists, who are typically researchers. Applied Cognitive Task Analysis (ACTA) is a set of methods that were developed by Militello et al. (Militello, Hutton, Pliske, Knight, & Klein, 1997) during a two-year project for the Navy Personnel Research and Development Center (NPRDC) in an effort to overcome the difficulty and inaccessibility associated with the utilization of many CTA methods. These methods were specifically designed and intended for use in non-research settings such as training and systems design for operations. These refined methods do not require a lot of specialized training or experience in a cognitive field (e.g., cognitive science or psychology) to effectively and efficiently utilize these techniques and analyze the data. ACTA is a structured approach used for the elicitation and analysis of cognitive skills, aspects, demands, challenges and strategies for the effective and successful performance related to a particular task or scenario(s) and their associated goals (Militello & Hutton, 1998). ACTA is a three-step method that involves three types of interviews (task diagram, knowledge audit, and simulation interview), which build on one another and are described below.

Differences in perspectives and related approaches (e.g., differences between experience levels, such as novices vs. moderately experienced workers vs. SMEs, and/or different findings among SMEs) to the simulated scenario(s) could be quite informative for future training curriculum, and design recommendations (e.g., the design or modification of an EHR’s design specifications, such as functional requirements, and/or its user interface; or changes to an organization’s system and/or department workflows, processes & policies or protocols).

There are a growing and large number of complex systems and resources (e.g., EHR) in complex & highly dynamic healthcare domains causing tasks with challenging cognitive elements to emerge. Therefore, there is definitely a need for the elicitation of the tacit knowledge, strategies & mental processes that have proven to be most effective, if not required for the successful and optimal performance and outcomes of such challenging & dynamic tasks and decisions. ACTA is a fairly comprehensive method that offers a structured approach that may effectively elicit the knowledge, decision-making processes and strategies necessary to successfully and best perform such tasks. Another advantage of ACTA is that it does not require a great deal of training in cognitive psychology or cognitive science on the part of the interviewer or analyst. Therefore, practitioners, who are interested in eliciting such valuable tacit knowledge about certain complex tasks, which are cognitively challenging, but have different educational/training backgrounds, may find ACTA to be particularly appealing and useful.

[The Militello et.al. (1997) paper describing the ACTA method can be downloaded from ResearchGate website](https://www.researchgate.net/publication/235085712_Applied_Cognitive_Task_Analysis_ACTA_Methodology)

**1st Step: Task Diagram Interview**

This initial interviewing technique is intended to generate a general overview and list of the most critical and challenging cognitive aspects of a particular task. The interviewee is typically a SME or someone with a substantial amount of experience and knowledge to draw from. The interviewer asks the interviewee to list the sequence of actions (i.e., sub-tasks) involved in a particular task. Ideally this list would include around 3-6 sub-tasks without going into much detail for efficiency and to save time for the more invasive subsequent interviewing methods. The interviewee is then asked to identify the most cognitively challenging sub-tasks or elements. Cognitively challenging sub-tasks or elements are those that require higher amounts of skill for decision-making, evaluations, and required vigilance for situation awareness. These sub-tasks and elements are then probed more extensively in the subsequent knowledge audit.

[Sample Task Diagram](https://vaww.portal2.va.gov/sites/humanfactors/BoKContent/Process%20and%20Task%20Map.pdf)

**2nd Step: Knowledge Audit**

Like some other CTA interviewing methods (e.g., the Critical Decision Method [CDM] (Crandall, Klein, & Hoffman, 2006; Hoffman, Crandall, & Shadbolt, 1998; Klein, 2017; O’Hare, Wiggins, Williams, & Wong, 2000)), the knowledge audit is an interviewing technique that utilizes a variety of probes and asks for examples, drawing from an interviewee’s personal experiences. The emphasis is on skills acquisition and how a task is performed with a high level of skill, which is why the ACTA method is often includes SME interviewees, as opposed to novice-level decision-making, actions, and behaviors characterized by inexperience or even moderate skill. Unlike some other CTA interviewing methods (e.g.., CDM (Crandall et al., 2006; Hoffman et al., 1998; Klein, 2017; O’Hare et al., 2000)), which are more in-depth and lengthy when probing specific examples, the knowledge audit is only intended to elicit enough detail to make sure that all the significant contextual details for the example were captured.

The types of probes typically used in knowledge audit interviews cover such topics as

* Perceptual skills (e.g., pattern and cue recognition)
* Problem identification, diagnosis and prediction
* Situation awareness
* Self-awareness
* Meta-cognition
* Goals and the prioritization and execution of actions
* Problem-solving and resolution
* Improvisations and adjustments
* Strategies and tricks of the trade
* Efficiency
* Atypical and unexpected events as well as potential deviations in typical event trajectories
* Equipment/technology issues (e.g., potential types of malfunctions, errors, and artifacts) and related adjustments or work-arounds

The output of knowledge audit data (see example below) includes a list of

* Aspects of expertise or skill with related examples for the particular task
* Cues, patterns and related strategies
* Challenges and potential barriers to successful, safe, and high quality performances.

[Knowledge Audit of Search and rescue procedure with Fireground Commander](https://vaww.portal2.va.gov/sites/humanfactors/BoKContent/Knowledge%20Audit%20of%20Search%20and%20rescue%20procedure%20with%20Fireground%20Commander.jpg)

**3rd Step: Simulation Interview**

The final phase of ACTA involves the simulation interview, typically intended to be challenging and require a relatively high level of skill and experience. This allows for interviewees to apply their skills while making decisions and performing related actions for a specific task in a situation of particular interest. The simulated scenario can be presented in a variety of forms, such as paper, recordings, high-fidelity environments, or computer software. The fidelity of the simulation has not been found to be an important issue (Militello & Hutton, 1998). However, it is important that the presented scenario has sufficient details and, if played out in real-time and/or videotaped with a simulator/simulation, that it is adequately executed and sufficiently realistic. One key is that the simulation presents a challenging situation in regards to the task or tasks being studied. Since the development of simulated scenarios can be time-consuming and resource-intensive, the developers of ACTA recommend the use of scenarios that have already been developed (e.g., existing training or educational videos) (Militello & Hutton, 1998). These existing scenarios can be modified to fit logistical constraints such as time allotted for each simulation session.

Once the scenario is presented, the interviewees are asked what the key events and their related decisions, evaluations and goals were, including what they would do in the presented scenario. Each key event identified is probed and discussed more deeply to elicit the significant cues, patterns, actions (i.e., sub-tasks), situation awareness (e.g., assessments and judgements), errors or mistakes that could be made at certain points, and related strategies for that event.

A useful output is a table with this information (e.g., cues, patterns, actions/sub-tasks, situation awareness, possible mistakes and related strategies) for each interview (i.e., a simulation interview table for each interview).

**Analysis and Interpretation**

Once all simulation interviews are conducted, the data from all of the interviews should be coded, analyzed and compiled into a cognitive demands table. While the developers of the ACTA method focused primarily on the cognitively difficult elements for the task of interest (and the related challenges, cues, common mistakes and strategies), it is recommended that the practitioners focus on the fundamental and long-term goals of the project when determining what specific elements to probe, code for, and compile in the table (Militello & Hutton, 1998).

[Cognitive Demands Table](https://vaww.portal2.va.gov/sites/humanfactors/BoKContent/Cognitive%20Demands%20Table.jpg)

[DJART table](https://vaww.portal2.va.gov/sites/humanfactors/_layouts/15/xlviewer.aspx?id=/sites/humanfactors/BoKContent/DJART%20table.xlsx&Source=https%3A%2F%2Fvaww%2Eportal2%2Eva%2Egov%2Fsites%2Fhumanfactors%2FBoKContent%2FForms%2FAllItems%2Easpx)

**Benefits**

* Is a fairly comprehensive method with a structured approach.
* Does not require a great deal of training and expertise in cognitive psychology.
* Reportedly easy to conduct and flexible.
* Generates useful clean data.
* Offers behavior insights within the context of users’ natural environments.
* Provides a representation of user tasks, particularly cognitive tasks, associated with a specific work domain.
* Could potentially be used to describe user needs with health IT systems, including differences in needs across users (based on context, level of experience and/or skill, and various ways to complete a behavioral task involving decision-making as well as covert tasks).
* Can be used to uncover inefficiencies in workflow and/or performance, especially those due to level of skill, experience, and/or training.

**Limitations**

* The ACTA requires the participation of experts or those with substantial experience in and knowledge of the domain of focus (not novice users), which is often limited and may be difficult to find or recruit and, consequently, may require a substantial amount of compensation or another worker to relieve him or her the ACTA session(s).
* Considerable training and experience required to effectively administer and analyze the data.
* Data analysis can be time-consuming.
* Can be difficult to assess reliability of ACTA data.
* There are potential issues with data validity, especially if small numbers of people are utilized.

**​Study Execution**

|  |  |
| --- | --- |
| **​Milestone** | **​Owner** |
| Initiate Kick-off Call | HFE |
| ​Specify study design | ​                                     HFE |
| ​Identify study location and participants | ​Business office |
| ​Recruit Participants | ​                           Business Office |
| ​Conduct Study | HFE |
| ​Analyze and summarize data | ​HFE |

**Outcomes**

* Task Diagram
* Cognitive Demands Table

Scenarios of Use

|  |  |
| --- | --- |
| **Phase of Development​** | |
| ​​ | **​Planning, Scoping & Definition** |
| ​​X | ​**Requirements Gathering** |
| **​** | **​**Early Design |
|  | **​**Detailed Design & Development |
| ​ | ​Field Testing |
| ​ | ​Deployment |
| ​ | **​Post-Deployment** |

|  |  |
| --- | --- |
| **​Related Methods ​** | |
| **Derived from** | -- |
| **​Complimentary Methods** | ​ [**--**](https://vaww.portal2.va.gov/sites/humanfactors/BoKSitePages/Methods/User%20Survey%20-%20Questionnaire.aspx) |
| **​Similar Methods** | Critical Decision Method Ethnographic Study |
| **​Follow-Up** | Interaction Design |

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| --- | --- |
| **​Lessons Learned​** | |
| [**Lessons Learned Journal**](https://vaww.portal2.va.gov/sites/humanfactors/Lists/LLJ)   |  |  |  | | --- | --- | --- | | | **Topics** | [**Title**](javascript:)  **[Open Menu](javascript:;)** | | --- | --- | |  |  | | --- | | There are no items to show in this view of the "Lessons Learned Journal" list. |  |  | | --- | |  | |  |

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