

Cognitive Task Analysis for HPTers

A Panel Discussion

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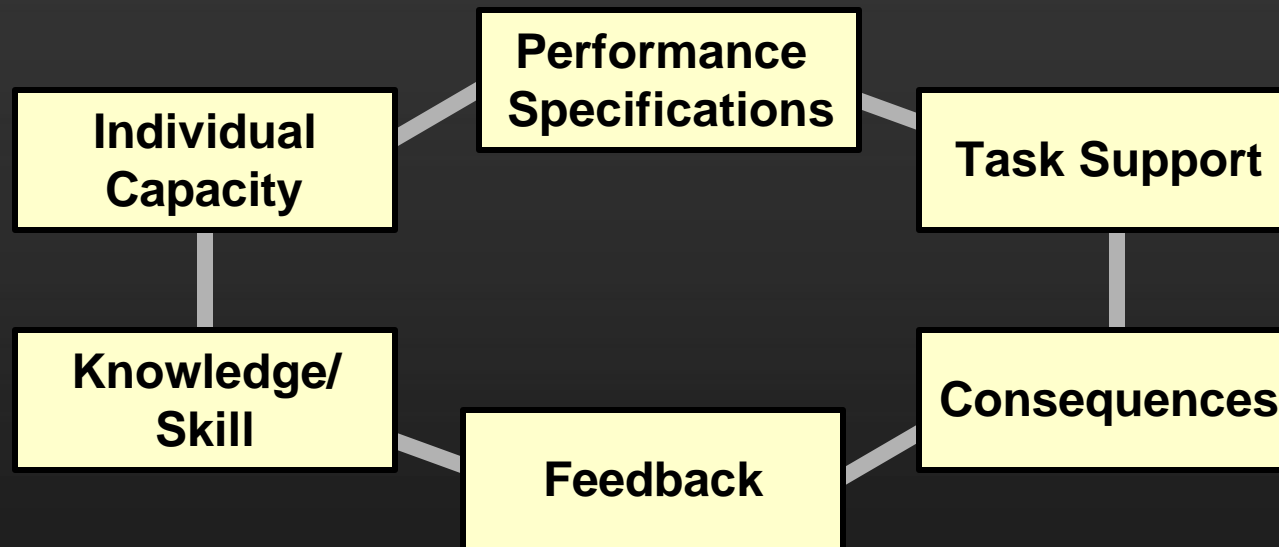
Agenda

- ⇒ Articulate when HPTers may need cognitive task analysis (CTA).
- Compare three different CTA techniques:
 - In-basket reviews.
 - Protocol analysis.
 - Facilitated case-based reasoning (F-CBR).
- Open discussion.

When to Use CTA

1. You need to conduct a task analysis.
2. The target population is either knowledge workers or people performing knowledge tasks.
3. The target population solves moderately or ill-structured problems.
4. Performance requires high-level cognitive skills.

You Need to Conduct a Task Analysis



—Adapted from Rummler-Brache (1988)

Types of Task Analysis



— *Jonassen, Tessmer, & Hannum (1999)*

The Performers Are Knowledge Workers

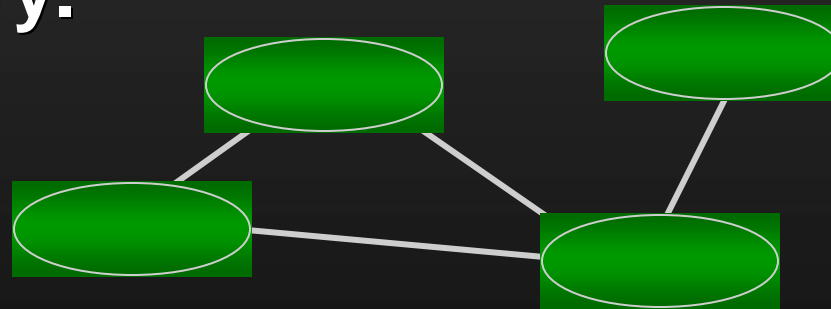
- Generate intangible outputs based on processed or enhanced information.
- Perform decision-making tasks.
- Possess complex knowledge and skills.
- Use continuously changing information.
- Encounter little repetition.
- Work in both white and blue-collar jobs.



Foundations of Knowledge Worker Performance

Declarative Knowledge

- Knowing “that,” “when” or “why.”
- “Chunks” comprised of facts, images, and episodes.
- Arranged in networks in long-term memory.

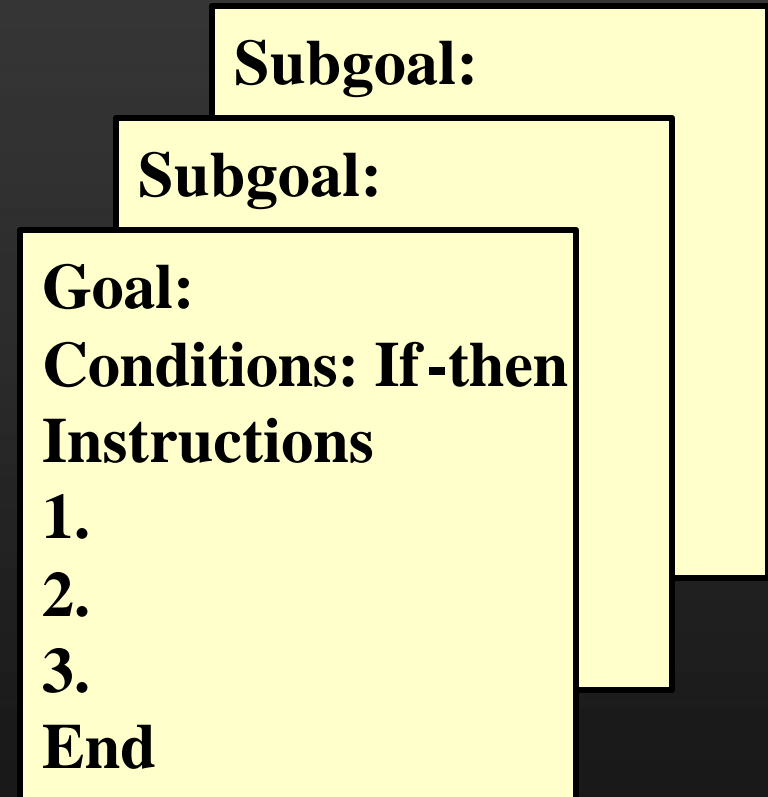


— **Anderson (1998)**

Foundations of Knowledge Worker Performance

Procedural Knowledge

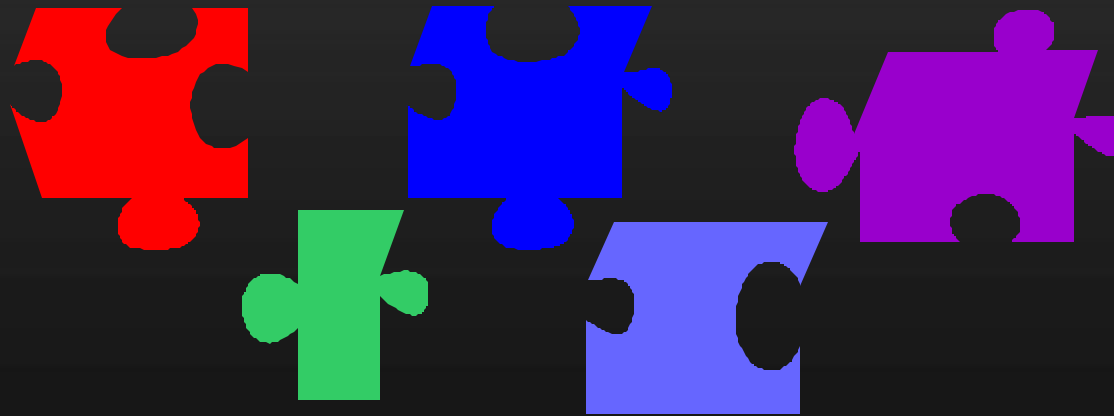
- Knowing “how.”
- Goals.
- Conditions: If-then rules.
- Instructions.
- Embedded declarative knowledge.
- Hierarchically arranged.



— *Anderson (1998)*

The Performers Must Solve Problems

- “A problem...can be characterized as the solver beginning in some initial state, traversing through some intermediate states, and arriving at a state that satisfies the goal” (*Anderson, 1993*).



The Problems Are Moderately or Ill-Structured

Well-Structured

Moderately-Structured

Ill-Structured

Well-Structured Problems

- Know where and how to start.
- Know how to solve problem.
- Know when the problem is solved.

Ill-Structured Problems

- Don't know where and how to start.
- Don't know how to solve problem.
- Don't know when the problem is solved.

Performance Requires Complex Cognitive Skills

Behavioral Skills

- Well-structured problems.
- Near transfer.
- Little or no planning.
- Algorithmic, few heuristics.
- Little or no decision-making.
- Little self-monitoring.
- There are few "red flags."
- Stable content.
- Anticipated performances.

Cognitive Skills

- Moderately or ill-structured problems.
- Far transfer.
- Lots of planning.
- Algorithms and many heuristics.
- Lots of decision-making.
- Lots of self-monitoring.
- There are many "red flags."
- Unstable content.
- Unanticipated performances.

Why CTA?

- Invisibility of cognitive performance.
- Automaticity of expert performance.
- Results of implicit knowledge.

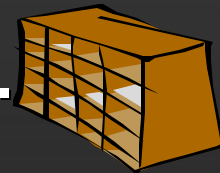
CTA Outputs



- Job processes and the mental models that underlie them.

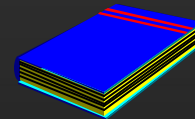


- Categorization schema for decisions.



- Best practices of experts.

- Stories and variations on a theme.



- Rules of thumb (heuristics) and procedural (algorithmic) decisions.

- Red flags (out of the ordinary).



- Hints for improving performance.



- Common problems and misconceptions.



Types of CTA

- GOMS (Goals - operators - methods - selection rules).
- PARI.
- DNA (Decompose - Network - Assess).
- In-Basket Reviews.
- Pathfinder.
- Protocol Analysis.
- Facilitated Case-Based Reasoning (F-CBR).

Agenda

- ✓ Articulate why HPTers should be familiar with cognitive task analysis (CTA).
- Compare three different CTA techniques:
 - ⇒ In-basket reviews.
 - Protocol analysis.
 - Facilitated case-based reasoning (F-CBR).
- Open discussion.

In-Basket Description

- A method to gain indirectly the features and processes of best practices for cognitive work.
- Involves asking best practitioners to identify and walk the study team through samples of the “best work” they have recently completed.
- Follow up interviews can hone in on the cues, features, and processes behind each work sample.

In-Basket Example

- **Research Analysts/ Reporters: Senior Practitioners - Community consensus.**
- **Represented 10 different analytic “groups.”**
- **Brought reports developed in past 6 months along with computer searches done and raw data selected.**
- **Described group analytic work flows and individual decisions made while preparing the report.**

In-Basket Example

Outcomes

- Process work flows for each group that participated.
- Features in common that characterize “best practices” in researching and preparing reports.
- Best-practice guidelines for research and analysis.
- A basis for selecting a test set for protocol analysis.

In-Basket Procedure

1. Identify expert practitioners.
2. Ask them to identify two recently worked cases along with all supporting data.
3. Videotape them as they walk a team through each case.
4. Analyze cases for best practices.

In-Basket Benefits

- Easy for experts to do.
- Provides real-world basis for defining judgments, identifying work processes and tools.
- Provides a set of cases which can be adapted for further study or training.
- A good starting place for PA working a new domain to get familiarity.

In-Basket Tradeoffs

- Walk-throughs are rehearsed—not dynamic.
- Metacognitive skills will probably be missed.
- Provides a macro-level picture of the job.
- Inter-rater reliability can be problematic.

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Protocol Analysis Description

- A methodology for obtaining detailed cognitive processes while solving a typical work problem.
- Involves presenting experts and novices with authentic work input data and all normal work tools. Then ask these individuals to solve the problem while talking aloud.
- Captures the actions and thoughts of knowledge workers as they solve problems.

—Ericsson & Simon (1993)

Protocol Analysis Procedure

1. Define and identify expert and nonexpert practitioners.
2. Design a moderately challenging work problem.
3. Videotape experts and nonexperts as they work the problem and talk aloud.
4. Represent the knowledge.
5. Compare work outputs and protocols to define cognitive skills.

Protocol Analysis Example

- Typical “wire-feed” data from a specific domain was identified, tested, and reduced in number and size.
- Test data included samples of high and low significance, already-reported data, and related data. In addition, reader interest surveys for that domain were provided.
- Analyst results were matched to a “best practices” solution and given accuracy scores.

Protocol Analysis Example

continued

- **Participants:** 4 domain experts, 4 non-domain experts, 2 novices.
- **Process:** Each participant was videotaped while reviewing the data, doing any additional computer searches they wished, and prioritizing the data.

Protocol Analysis Example

What We Found

- Domain-experts gave statistically more accurate sorts and prioritizations than non-domain experts.
- Errors of commission were much greater than errors of omission.
- Almost no analysts identified some data as already-reported.
- Less than half of the analysts integrated related data.

Protocol Analysis Example

What We Found

Based on our results we were able to make recommendations about:

- Software enhancements to facilitate recognition of related data and already-reported data.
- Training and processes to speed up elimination of irrelevant data.

Protocol Analysis Benefits

- Provides dynamic view of how experts solve real problems.
- Allows comparison on a common problem of different types/levels of expertise.
- Provides micro-level details.
- Allows correlations between solutions and thinking processes.

Protocol Analysis Tradeoffs

- Development and testing of the problem set is labor intensive.
- The analysis of protocols is labor-intensive.
- Matching subject solutions against a “best answer” solution provides a statistically valid way to identify best practices.

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F-CBR Description

Hybrid CTA strategy that combines:

- Case-Based Reasoning (CBR).
- Rapid Application Design (RAD).

—Schank (1990)

—Martin (1991)

Jonassen, Tessmer, & Hannum (1999)

Procedure

1.
JRP Workshop

2.
Specify Support
Components

3.
JAD Workshop

4.
Usability Test

1. Conduct a Joint Requirements Planning (JRP) workshop to:
 - a. Specify performance requirements.
 - b. Formulate a representative case study that illustrates the performance requirements in action.
 - c. Flesh out the case study using SMEs.
 - d. Write common variations to the case study.
 - e. Finalize the case study.

Procedure continued

1.
JRP Workshop

2.
Specify Support
Components

3.
JAD Workshop

4.
Usability Test

2. Specify support components for the case study that meet performance gaps.

3. Conduct a Joint Application Design (JAD) workshop to:

a. View prototypes of the interventions.

b. Determine the designs are acceptable.

c. Verify the accuracy of the performance requirements.

4. Conduct a usability test.



Example

A Day in The Life

- **Challenge:** Life insurance corporation with over 200 Managing Partners located throughout the United States.
- **Goal:** Capture and disseminate best practices by:
 - Simulating supervisory experiences MPs may encounter.
 - Letting MPs practice making real-world decisions.
 - Providing risk-free feedback and experience.
 - Granting desktop access to skills and knowledge.
- **Solution:** A Day in the Life of a Managing Partner

Example

Findings and Recommendations

- Following best practices requires decision-making in gray areas.
- Self-monitoring requires answering two ongoing questions:
 - What, if anything, is wrong?
 - What should you do next?
- Interacting with customers, agents, and other staff members requires interpersonal skills.

Example Results

Benefits

- People love to tell stories.
- Case studies and prototypes act as “inscriptions” that represent organizational knowledge and best practices.
- Synthesizes the knowledge and perspectives of the group.
- Novices and competents keep SMEs honest.
- Resolves SME disputes efficiently.
- Provides a forum for prototyping and prioritizing.
- Facilitates end-user acceptance.

Tradeoffs

- You should have a sponsor's mandate.
- Members of the JRP must be representative of the target audience and their job environs.
- You need to educate clients to do this.
- You must guard against "theorizing."
- You must be using RAD or an equivalent development methodology.
- You may have to spend more time on organizational alignment than you wanted.

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- ⇒ Open discussion.

Lessons Learned

- There are a wide variety of CTA techniques.
- Each technique has its associated benefits and tradeoffs.
- We still need to learn what techniques to use and when to use them.
- Balance the time required to do CTA with critical cognitive results.

Lessons Learned

continued

- No CTA technique truly “captures” declarative and procedural knowledge.
- You should employ converging CTA techniques.
- Performance is the gold standard. Validate your CTA results with prototypes and usability tests.

Open Discussion

Your questions and comments for the panel.

Thank You!

Behavioral versus Cognitive Task Analysis

	Behavioral	Cognitive
Inputs	Observed behaviors	Observable or cognitive performances
Processes	Observed behaviors	Observable or cognitive performances
Outputs	Observed behaviors	Behaviors, decisions, mental models, and knowledge structures

Academic versus HPT CTA

Characteristic	Academic CTA	HPT CTA
Goal	Understanding human cognition	Diagnosing and closing performance gaps
Deliverable	Representations of cognition	Performance interventions
Target Population	Experimental subjects	Job incumbents