Task Analysis: A Process Definition

What are task analysts trying to do when they examine an area of human performance? The answer to the question cuts to the heart of this definitional problem. Task analysts describe a task in terms of its component subtasks in order to make prediction about the design which will best reduce error in human performance (Davies, 1973a). Ideally, this analysis suggests both how to perform the task correctly and how to instruct a person to perform the task.

The methods applied to describe performance and instruction all use essentially the following process (Patrick & Stammers, 1978; Carlisle, 1982b, 1983):

1. Break the task, content, etc., down into constituent elements.
2. Determine the relationships among these elements.
3. Restructure in accordance with the underlying principle or optimal learning design. (Note 1)

Task analysis may be more properly defined as a process involving these three steps. Different techniques of analysis may be used in different situations for different purposes to describe or design elements of accomplishments and acquisition. These different techniques, however, either follow all or part of the task analysis process, or provide the structure necessary to initiate or complete the task analysis process. For instance, the process of recognizing a potential problem and formulating a deviation statement is one analysis technique which may initiate a task analysis. Analysis of risk may be done to indicate the completion of a task analysis step. These are decision oriented techniques which are integrated with other analysis methods to follow the complete process of task analysis. There is no single technique of task analysis; rather, there are many techniques which contribute to the complete task analysis process.

One final implication of process definition is that the task analysis is not complete until all of the steps are followed. Analysis which stops short of completion often results in bulky documents which remain unused (Carlisle, 1983). However, when all analysis steps are completed in a useable form (for example, a job aid) the results will have immediate impact on training and the work place.

It is recognized that the process definition broadens the view which some have of task analysis. Some feel that task analysis should only be used to refer to the breaking down of performances into component parts (Kaufman and Mitchell, 1982). Others refer to the restructuring step (Miller, 1962). In this sense the term "task analysis" is unfortunate (Davies, 1973b) because the three process steps previously described can be used to analyze tasks from many points of view, for example, the required content, the knowledge involved, the condition of learning, the required skills, and required algorithmic or heuristic processes (Landa, 1983). Alternatively, the broad process definition offered here might be termed something like "pre-development analysis" (Gibbons, 1980) or "training analysis" since needs analysis and goal definition are intimately involved throughout the process. For the purposes of this paper, however, the traditional term "tasks analysis" will be retained.

With this perspective in mind, we will examine how task analysis techniques might be most effectively combined and used to break the task down, examine relationships, and restructure for performance and instruction.

Step One: Breaking the Task Down

Task breakdown begins with the initial definition of the analysis situation. This definition specifies what should be analyzed, when it should be analyzed, and where it can be analyzed. The
following categories may be found in this definition:

- Deviation statement showing what should exist and what currently exists relative to the task.
- General description of the job, duty, or task to be analyzed with references to available job documentation.
- Description of the workers who will perform the task.
- Description of the expected benefits to be realized from the analysis.
- Description of maximum cost to be incurred.
- Description of the preferred format for analysis outcomes.

Once the area of analysis is defined, the analyst breaks the task down with the intention of describing current job and task performance, i.e., how the task is now performed. This breakdown begins with a listing of jobs or tasks—the job/task inventory (McCormick, 1979)—consisting of basic performance objectives for all duties of job. It is developed from available documentation as well as observations, interviews, questionnaires, or brainstorming sessions with master job performers. From this inventory it is possible to determine which duties require more detailed description by using the following questions to assess the risk of error associated with each duty:

- What is the possibility of an error resulting from this task?
- What are the consequences to safety, cost, public relations, etc., if an error does occur?

The answers to these questions make it possible to select tasks for additional description, since a task with high probability of error and high costs needs additional analysis, whereas low probability and cost mean no additional analysis is necessary. Figure 1 summarizes these decisions.

Additional information might be asked about each task to determine if more detailed description is required. These include performer’s characteristics, difficulty of performing or learning the task, importance of the task, performance frequency, number of people involved, time required to perform, where the task is learned, supervision required, and satisfaction gained during performance. This additional information is helpful during the later task analysis steps, but emphasis should be on the probability and consequence of error during task breakdown, since the most critical elements of some jobs (airplane pilots, nuclear power plant operators) are infrequently performed, require little time, and are performed by only a few individuals.

Tasks which require more detailed analysis are then subjected to hierarchical redescription. This hierarchical analysis is used to identify the specific elements underlying the job. The analyst continually iterates the question “How does one do this job?” or “What does this job consist of?” The job is broken down into related duties which are subsequently divided into related elements, and finally into specific motions or procedures. Analysis stops when the possibility and costs of an error for each task or element are acceptable, entry behaviors are identified, or the task is described sufficiently to move to the next step in the process. The technique of hierarchical redescription described by Duncan (1972) and Shepherd (1976) provides one concise format for recording this analysis. It includes the superordinate number, the task component and operation plan, and the reason for stopping analysis.

The Job Analysis Brainstorming Session (JABS) (McDermott, 1982), another method for organizing the process of creating the hierarchy, posts 3x5 cards of master performers’ job descriptions on a blank wall. The 3x5 cards show the flow of task performance identifying alternative descriptions of what is done when something goes wrong with the normal flow of performance.

The initial breakdown describing how the task is currently done may result in very specific task detailing which may be formatted as column charts (Miller, 1962), motion charts, (Seymore, 1968), or flow charts (Merrill, 1980b). Often, however, great detail is not required during this first step because the intent is to provide only enough description to determine likely performance errors and task changes needed to avoid error. Over analysis during this first step often occurs when the actual goal, to organize improved performance, is not stressed. The analyst is not interested during this first step in describing those tasks where errors are likely. The analyst should therefore move to the second task analysis step (relationship determination) as soon as possible.

**Step Two: Looking at Relationships**

The second step in the task analysis process is examining the relationship between the task as it is currently done and how it should, or could be done. The intent is to identify how the task

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![Figure 1. Decisions associated with probability and consequence of error.](image-url)
could be changed to remove performance error from the following outcome measures (Jackson and Bullock, 1983):

- Results or effects as indicated by task accomplishment and consumer satisfaction.
- Quantity as indicated by how much of the output is produced.
- Quality as indicated by how well accuracy, completeness, costs, timeliness, and safety are provided in the output.

Four approaches can be used to examine relationships. The existing task might be compared to a predetermined model of correct performance. Different methods of task performance might be compared. Portions of the task that are not affected by performance error might be compared to portions that contain error. Finally, comparisons can be made between individual task components. These approaches are often used in an iterative manner with task breakdown. For instance, a comparison with a predetermined model may indicate the need for a more detailed task breakdown, which may be followed by a comparison with different methods of task performance, which may require additional breakdown.

Behavioral analysis and vision analysis both suggest models of correct task performance for comparison with the actual task to identify performance error. Behavioral analysis is based upon the systems model or the behavioral model. The input cues encountered, operation performed, information needed, objects used, time involved, decisions required, results and feedback given, and motivations involved are recorded. This information is used to identify performance errors. Three types of error might be found (Duncan, 1972; Reason, 1977; Davies, 1981).

- **Input errors**—those resulting from failure to discriminate a signal or cue leading to an action. The outcome is inappropriate action (also called selection errors or discrimination errors). These are often caused by poor delivery systems that give the wrong information, unorganized information, or poorly timed information.

- **Process errors**—those resulting from neglecting or forgetting a goal, sequence of actions, or piece of essential information (also called response errors, storage errors, or action errors). These are often caused by poor job design, inappropriate tools and equipment, lack of knowledge, or poor motivation.

- **Feedback errors**—those resulting from a faulty verification or checkout of a process, for example, the task is terminated prematurely or continued beyond what is necessary (also called output errors or test errors). These result when consequences and feedback are inconsistent, inappropriate, partially given, incorrect, given for the wrong reason, or given at the wrong time.

The PROBE model (Gilbert, 1982a, 1982b) is probably the most detailed behavioral analysis technique. This model identifies the information, instrumentation, and motivation found in the behavioral environment and in the person's repertoire. The categories of this model are compared to actual task performance using suggested questions to identify where task errors are likely to occur. The PROBE model includes a precise theory about how to restructure the task to eliminate the identified errors.

4. Master performers fill any gaps in the scales with additional incidents. The resulting scale shows how performers with different levels of expertise might execute a given task. This scale can be important when assessing students' entry behaviors.

Problem analysis (Kepner-Tregoe, Inc., 1979) provides a third technique for analyzing relationships. To solve deviations in task performance, this technique utilized the following comparisons:

- What the deviation is versus what it could be but is not.
- Where the deviation is versus where it could occur but does not.
- What the extent of the deviation is versus how extensive it could be.

Distinctions between the "is" and "is not" categories are identified and any re-

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**Visionary analysis** (Note 1) is a recently proposed method for creating a correct model of task performance. Visionary analysis avoids focusing upon the problems in the current task by visualizing or mentally rehearsing ideal methods of task completion. Master performers write down a description of what they see, hear, feel, smell, and taste as they imagine doing this ideal task. As much detail as possible is included about who is doing what, when, where, and how. It is then determined if this description is actually what is wanted, and the description is compared with the current task to determine where modifications should occur.

Critical incident analysis is a second way of examining relationships. It is done by comparing different methods of doing the same task. The following steps are involved in this technique (Zemke, 1981):

1. Master performers select and write job incidents and results which are related to specific tasks.
2. Incidents are reviewed for consensus of the master performers, edited as needed, and labeled for ease in rating.
3. Incidents are sorted on a seven or nine point scale for favorable or unfavorable consequences.

VOL. 6, NO. 4

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puter assisted instruction where a matrix of relationships is used to call up different tasks shows great promise for the future.

In current practice, analysts often use only one method of relationship determination when analyzing an individual task. This is perhaps inappropriate. The use of various techniques combined with additional task breakdown, rather than dependence upon a single method, would give a better understanding of the relationships involved in any given task. Task analysis methodology would certainly be improved if analysts made an effort to combine these different methods before moving to task restructuring.

**Step Three:**
Reconstructing in Accordance with the Underlying Principle or Optimal Learning Design

Once the task has been sufficiently described and analyzed for relationships, restructing for correct accomplishment and learning can be done more easily and exactly. A more detailed description of the improved task should be completed using the results from the previous analysis to develop a job aid (McCormick, 1979), for example, flow chart, checklist, worksheet, decision tree, or decision table. The job aid might be used by employees during task performance, it might be used by designers to change the equipment or tools, or it might be used by management to change the work environment or incentive system. The job aid describes the plan of correct accomplishment, can actually be used in the workplace, and will either eliminate the need for training or will indicate how the training is to be done.

When training is required to effectively use the job aid, additional analysis techniques are required. The task should be analyzed for required learning strategies. Tasks include procedures describing "how" the task is done which require verbal and motor chain learning strategies. Additionally, the students must learn "what" the task is (concept learning strategy) and "why" the task is done (principle learning strategy) in order to perform correctly. The identification of correct learning strategies leads to the selection of correct teaching tactics and learning consequences as shown in figure 2. Numerous authors have discussed analysis of learning strategies (Davies, 1976b; Merrill & Tennyson, 1977; Reigeluth & Darwatz, 1982; Carlisle, 1982b).

The use of Gagne's (1977) hierarchical analysis can follow the identification of learning strategies for sequencing elements which must (because of "transfer") be presented in a specific order. One creates this hierarchy by asking the question, "What skill should the learner already know how to do and be able to recall when faced with the task of learning the new rule, the absence of which would make it impossible for him to learn the new rule?" Merrill (1960a) has shown how a rigorous hierarchy of this type can be derived when the paths identified with an information processing analysis and path analysis are carefully specified.

Once learning strategies are developed and sequenced, it is finally possible to develop specific training objectives which not only point to specific behaviors which the learners will be expected to perform, but are also actually required by the task. A master design chart (Davies, 1976), like that found in Figure 3, can be developed as a final component of the task analysis to integrate the tasks and objectives into a coordinated curriculum. This coordination is essential because even though objectives have become prominent in training, there is little doubt that these objectives are frequently not actually derived from complete task analysis or integrated into the overall training design. Objectives can be found at the beginning of lesson plans, but one seldom observes their correspondence to task listing, sources of error, important relationships, learning strategies, hierarchical sequencing, or master design charts. This state of affairs exists primarily because the process of task analysis is so often short circuited.

**Summary**

Task analysis is the key to developing the specifications for performance and instructions in instructional systems design. Task analysis, when considered as a process perspective, involves three steps, each of which can be approached with various analysis techniques. These steps and techniques can be summarized as follows.

**Step 1. Break the task, content, etc., into**

<table>
<thead>
<tr>
<th>Select Objective Which Matches Most Closely</th>
<th>Rule</th>
<th>Role</th>
<th>Learning Strategy</th>
<th>Teaching Tactic</th>
<th>Learning Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow a sequence of steps to do something (HOW)</td>
<td>2</td>
<td>1</td>
<td>Verbal Chain Learning</td>
<td>A. Give overview</td>
<td>A. Practice required</td>
</tr>
<tr>
<td>State or list HOW to do something</td>
<td>1</td>
<td>2</td>
<td>Motor Chain Learning</td>
<td>B. Memorize chain</td>
<td>B. Easily forgotten</td>
</tr>
<tr>
<td>Distinguish or classify WHAT something is</td>
<td>3</td>
<td>3</td>
<td>Concept and Multiple-discrimination Learning</td>
<td>C. Practice chain</td>
<td>C. Little transfer to job</td>
</tr>
<tr>
<td>State or define WHAT something is</td>
<td>1</td>
<td>4</td>
<td>Principle Learning</td>
<td>A. Examples, non-examples</td>
<td>A. Practice not needed</td>
</tr>
<tr>
<td>Summarize, support, or perform something based upon an understanding of relationships (WHY's) between concepts</td>
<td>4</td>
<td></td>
<td></td>
<td>B. Discriminate attributes</td>
<td>B. Resist to forgetting (except uses discrimination)</td>
</tr>
<tr>
<td>State WHY something is, or should be done</td>
<td>1</td>
<td></td>
<td></td>
<td>C. Present ex group</td>
<td>C. Transferred to job</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D. Reinforcement feedback</td>
<td>D. Verbal chain partially learned</td>
</tr>
</tbody>
</table>

![Figure 2. Learning strategy decision table.](image-url)
down into the constituent elements.

Analysis Techniques:
- Task definition
- Job/task inventory
- Risk assessment
- Hierarchical redefinition
- Task detailing

Step 2. Determine the relationship among these elements.

Analysis Techniques:
- Behavioral analysis
- Visionary analysis
- Critical incident analysis
- Problem analysis
- Network matrix analysis

Step 3. Restructure in accordance with the underlying principle or optimal learning design.

Analysis Techniques:
- Job aid development
- Learning strategy analysis
- Learning hierarchy sequencing
- Training objective development
- Master design chart development

Instruction and training are often derived using analysis techniques which follow this process in a haphazard manner. If task analysis is carefully organized and follows the proper steps, it can be used to solve many training problems—not because of some inherent magic, but because of the detailed, careful, integrated analysis involved.

Reference Note

References


Reigeluth (Cont'd from page 30.)


Winn, W. Content structure and cognition in instructional systems. Paper presented at the Annual Convention of Association for Educational Communications and Technology, Kansas City, April, 1978 (ED 151 338).