

Full Spectrum Occupational Analysis & Applications

When a client agency requests a "job analysis," it is essential that the professional analyst determine the exact purposes of the endeavor. The term "job analysis" has been used to mean a wide-variety of expected organizational outcomes. Academics, for example, trace job analysis back to 1115 BC in China. Applicants for government jobs underwent ability and knowledge tests in the six areas of horsemanship, archery, music, writing, arithmetic, and official ceremonies. Once in office, incumbents were required to demonstrate proficiency periodically to retain the government position. While the history of job analysis is an entire semester graduate course, some highlights are in order.

Fredrick W. Taylor, in the late nineteenth century, began the movement towards the use of scientific management principles by collecting and using actual measurements of job performance time and workload in the decision making process. The early years of the twentieth century used new motion-picture technologies to enhance time-and-motion studies focusing in on very narrow aspects of job functions to increase worker productivity. By 1913, Hugo Munsterberg of Harvard had made great advances in broadening the focus of job analysis and created the discipline of Industrial-Organizational (I/O) Psychology. Munsterberg cited the job analysis as a critical step in the development of valid tests and the need to formally demonstrate test validity

By the 1930's, efforts began to create a national resource of high-level job descriptions to facilitate job changes brought about by the great depression. Various methods evolved to address different objectives and used diverse levels of analysis spanning from low-level job elements through task statements, up to personal traits or characteristics. Given this wide-range of job analysis possibilities, an in-depth review of "job analysis" is in order.

What is Job Analysis?

Job analysis is a critical first step to and serves as the foundation for many human resources functions and decisions, including recruitment, selection, job classification, performance measurement, training, promotion assessment, restructuring, and out-placement. Job analysis involves the collection and synthesis of data that describes job behaviors, attributes of workers, and characteristics of the environment in which workers perform the various activities of the job.

Why do Job Analysis?

Job analysis is required by the Federal Uniform Guidelines on Employee Selection Procedures, as well as by the American Psychological Association and Society for Industrial and Organizational Psychology professional guidelines on test use. The Federal Uniform Guidelines on Employee Selection Procedures list the following requirements for job analysis:

"A description of the method used to analyze the job should be provided (essential). The work behavior(s), the associated tasks, and, if the behavior results in a work product, the

work product should be completely described (essential). Measures of criticality and/or importance of the work behavior(s) and the method of determining these measures should be provided (essential). Where the job analysis also identifies the knowledge, skills, and abilities used in work behavior(s), an operational definition for each knowledge in terms of a body of learned information and for each skill and ability in terms of observable behaviors and outcomes, and the relationship between each knowledge, skill, or ability and each work behavior, as well as the method used to determine this relationship, should be provided (essential). The work situation should be described, including the setting in which work behavior(s) are performed, and where appropriate, the manner in which knowledge, skills, or abilities are used, and the complexity and difficulty of the knowledge, skill, or ability as used in the work behavior(s)."

Approaches and Methods of Job Analysis

A job analysis method should have as its goal the description of **observable features**, involve the description of work behavior **independent of the personal characteristics or attributes of the workers who perform the job**, and yield data that are **verifiable** and **replicable**. There are two primary approaches to job analysis--worker-oriented and job-oriented. Job-oriented approaches emphasize the conditions and/or results of work and are characterized by specific statements that focus on what is accomplished by the worker. Various methods and approaches have been developed over the past seventy years. These approaches include:

Threshold Traits Analysis (TTA)
Ability Requirements Scales (ARS)
Position Analysis Questionnaire (PAQ)
Critical Incident Technique (CIT)
Functional Job Analysis (FJA)
Job Elements Method (JEM)
Task Inventory/Comprehensive Occupational Data Analysis Programs (TI/CODAP)

Organizational Purposes for Job Analysis

In the early 1980's a team of senior job analysts under the direction of Dr. Ed Levine, undertook a project to determine the "best" job analysis method. It became clear that many different organizational purposes were being served and different methods worked better for specific purposes. This team created a survey to rate the job analysis methods identified above. This survey was completed by 90 job analysts from around the country. These methods were rated on their ability to service the 11 Organizational Purposes (see below) across a number of dimensions including validity, reliability, cost, and flexibility by sample size, etc.

11 Organizational Purposes for "Job Analysis" (*Levine, Ash, Hall, & Sistrunk, 1983)
Job Descriptions
Job Classification
Job Evaluation
Job Design

Personnel Requirements/Specifications
Performance Appraisal
Worker Training
Worker Mobility
Efficiency/safety
Manpower/workforce planning
Legal/quasi-legal requirements
<u>Evaluation of Job Analysis Methods by Experienced Job Analysts</u> , Academy of Management Journal, 1983, Vol. 26, No. 2, 339-348.

In this side-by-side comparison, TI/CODAP did very well and was considered to be the most multi-purpose method -- although the final recommendation was to employ hybrid strategies for operational projects. The shortcomings of CODAP were noted from three major sources: 1) the Levine, et al review, 2) issues raised in Frank (1981), "The Philadelphia Experience: A Critique and analysis of the applicability of the Comprehensive Occupational Data Analysis Programs (CODAP) for civilian personnel management (Draft Report for the National League of Cities Service Program on Employer-Employee Relations), and 3) the findings in Goodison (1980), "A summary of 10 cities on-site interviews and a critique of CODAP (Comprehensive Occupational Data Analysis Programs) in Report: Center for Occupational and Professional Assessment (Princeton, N.J., Educational Testing Service).

Based on the three sources above, in 1982, Sensible Systems, Inc.(SSI) began to design a new CODAP-like technology without the shortcomings noted in the literature. The result of a five-year development project was "atCODAP" which stands for "anchored to CODAP" - but not limited by it. The atCODAP technology was designed from the ground up to run 100% on PC-based platforms and to produce streamlined (i.e., operational, not research) reports directly on laser printer paper with readable type size. atCODAP is run from a menu driven system and has been used to train over 200 STUDENT job analysts at the Adult and Vocational Education Department at the Ohio State University in Columbus, Ohio.

Dr. James E. Sage was the focal point for the Ohio State University program. Dr. Sage produced an updated version of the Levine paper that includes atCODAP as well as traditional CODAP (Hutchins & Sage, "Job Analysis Validity & Workability", 1996 Academy for Human Resource Development Conference.). The Sage paper included the following table that scored job analysis methods like the Levine paper. Note that "DACUM" (a curriculum development package) and "atCODAP" have been added:

(Scoring: 5=Excellent, 0=Unacceptable)

Job Analysis Method	DACUM	CIT	FJA	PAQ	TI/CODAP	atCODAP
OA Concerns-----	(n=14)	(n=19)	(n=28)	(n=21)	(n=22)	(n=11)
Versatility/Adaptability	2.64	4.00	3.86	4.14	4.22	4.18
Acceptability	0.14	2.71	3.00	3.38	3.39	3.45
Amount of Training Required	1.86	2.57	2.68	2.81	2.13	3.36
Employee Sample Size	1.29	2.65	2.68	2.90	2.48	3.82

Reliability	1.86	2.81	2.96	3.57	4.00	4.27
Validity	1.21	1.67	2.46	2.86	4.00	4.36
Costs	4.07	2.62	2.61	2.57	1.74	3.91
Completion Time	3.86	1.86	2.61	2.57	2.00	3.64
AVERAGE SCORE	2.12	2.61	2.86	3.10	3.26	3.87

The IBM PC-based atCODAP successfully eliminated most complaints about CODAP in its mainframe versions on the Univac/Sperry/Unisys 1100, CDC-6600, IBM-360/370, IBM MVS, IBM VM, and IBM RISC. Note that DACUM's low acceptability rating is due to the fact that DACUM only produces training curriculum products (i.e., "worker training") and does not address 10 of the 11 organizational purposes.

Best approach to Job/Occupational Analysis; atCODAP. The original Levine, et al study concluded that a multi-method approach is desirable. They recommended using both TI/CODAP and Functional Job Analysis (FJA) to achieve the best coverage of organizational needs in reasonable time at reasonable cost. The atCODAP was designed to address shortcomings in main frame CODAP systems and permits rapid, multi-method approaches to be incorporated under one processing umbrella..

Occupational Analysis versus Job Analysis

The Comprehensive Occupational Data Analysis Programs (CODAP) system is a set of programs developed over the past 36 years to deliver the most flexible and valid occupational data for significant human resource management decisions. The reason CODAP is so advanced is that it evolved to meet the special and changing needs of the military personnel system. CODAP was originally developed by the United States Air Force (USAF) to produce current job descriptions needed to manage a very large workforce that spanned from raw high school graduates to retiring senior officers. The USAF training budget is enormous and the technology is always changing. CODAP grew to ensure the classification structure is reasonable for the work being done and that training courses are “on target” for real job content. CODAP later expanded again to ensure proper linkages between promotion tests and job requirements.

Over and above a large population and a changing training mandate, the military have a special problem in managing their workforce. In the civilian sector, if one needs a senior level carpenter, a new person can be recruited from the general workforce. In the military, however, all vacant positions are filled by moving or promoting people already in the service. This military personnel “pipeline” creates a level of concern about force management that is unparalleled in the private sector. Policies which cause senior people to leave the service before their scheduled 20-year term causes a rash of promotions, transfers to fill vacancies, and new demands on the training centers to fill the lower-level jobs opening up.

Because of the potential for large-scale impacts on the workforce, the CODAP system has been designed to take a look broader than just “jobs” and studies instead, “occupations” which span a person’s entire working life. CODAP’s goal is to capture, organize, analyze, and report occupational data in ways which facilitate a policy-maker’s decision process. This means data

should be able to speak to issues in recruitment, selection, classification, promotion or certification testing, training content, training schedule (within career), training evaluation, restructuring (or creation of task-force groups), and out-placement. The output data needs to be available in reports, spreadsheets, or in a form to be used by decision-support modeling systems. While the backbone of a CODAP analysis is a task list, the newer atCODAP system also permits the use of Knowledge, Skills, Abilities, and Other Characteristics (KSAO) lists, tool lists, job satisfaction lists, competency lists, -- any list of interest for given applications.

The CODAP method is based on an inventory tailor-made for the occupational job family at hand. The development of this inventory represents an upfront investment that pays off handsomely in the later stages of a project. Ratings on “validity” of method show that atCODAP is, by far, the best investment, especially if legal defensibility is of concern. When one considers the benefit of “off-the-shelf” inventories, it becomes clear that the minor savings in upfront costs is totally erased when one tries to use their data for training, certification applications, or legal defense of policy decisions. Many clients have sought out a CODAP analysis for training and other applications after having completed an “off-the-shelf” survey method like the Position Analysis Questionnaire (PAQ) which targets person-oriented traits rather than detailed job requirements.

Approach to Developing Psychologically Valid, Reliable and Legally Defensible Competency Standards

The current atCODAP system is supported by individuals each with more than 20 years experience at the forefront of research and development bringing appropriate methodologies to bear on improving operational programs for manpower, personnel, and training (MPT). AtCODAP’s applications have included projects with a focus on the organization, the employee, state certifying agencies and/or industry associations. Organizations are typically concerned about hiring practices, employee competency, getting the right person in the right job, re-organization (for up-sizing, down-sizing or improving productivity) and the cost-effective, long-term stability of a quality workforce. Employees desire a fair recognition of acquired job skills (respect in decision making, utilization of training, and compensation) and clear career paths for long-term employment, growth of competencies and organizational advancement. State agencies, acting as certifying authorities are concerned with ensuring that certified private contractors can provide competent service to the public if they “pass the test.” Similarly, industry associations are concerned both with certification standards as well as educational and training coverage for proper job performance of those in their profession.

Using A Successful Approach – An Overview of the IRS Project

A test development/validation project is an ambitious undertaking if done correctly. AtCODAP was used in such a project for the Internal Revenue Service in their Taxpayer Assistor job family. With a total of 7,000 employees, the IRS has 4,000 temporary/annual hires to be screened, trained, and certified within tight timelines. With constant changes in the tax laws and close scrutiny by the General Accounting Office (GAO), training and certification were a high priority concern, especially with the prospect of court challenges looming in the background. A

Careful job analysis was conducted (968 tasks, 900 job incumbents) covering personnel from initial job assignment through senior, supervisory positions spread all over the United States in varying work environments. The job inventory collected not only task-level performance data but also demographic data both about the job incumbent and about the work environment (i.e., size of office, walk-in or phone bank, urban or rural). A smaller group of supervisors, acting as Subject Matter Experts (SMEs), rated job inventory booklets to provide "Task Learning Difficulty" and "Training Emphasis" factors.

Determining Real Job Structures and Job Requirements

The data were submitted to the Comprehensive Occupational Data Analysis Programs (CODAP) system -- a system devised and used by the United States Air Force and spread to other services, federal agencies, allied governments and universities. The *hierarchical clustering programs* in CODAP can detect empirically defined groups of job incumbents (job types) and defensible performance dimensions (task modules). The performance dimensions were divided into two categories: 1) entry-level modules for selection, training, testing and certification (about 20 modules); and 2) advanced-level modules for promotion and continuing certification (about 10 modules).

Determining a Task's Importance in Testing and Training Programs

The corresponding SME data for Task Learning Difficulty (TD) and Training Emphasis (TE) were processed by CODAP's *inter-rater reliability program* to report reliability (KR-21 equivalent for raters rather than items), identify non-cooperative raters, and produce a mean factor vector of high stability and valid range of value. Displaying these two factors and the job incumbent data described above, reports were produced within each performance dimension. Job incumbent data (for entry level jobs) was shown with separate data columns for "under 1 year experience", "1 year to under 2 years", and "2 years to under 3 years experience". SME panels most familiar with each performance dimension generated Knowledge, Skill, Ability, and Other Characteristic (KSAO) profiles -- typically phrased in terms of appropriate training modules. (SMEs were the training managers from each of the IRS's 10 regional offices.)

Creating a Master Knowledge, Skill, Ability, and Other Characteristics List

The entire SME panel reconvened and integrated all performance-dimension KSAO profiles into a single master list. Each performance dimension was then re-visited to identify the relevance of all KSAOs to each task module. When the KSAO linkage was completed, a complete cross-reference table was created to document the Master KSAO list to the performance-dimensions relationship. Next, the SMEs identified tasks to be removed from test-development consideration (obsolete tasks, too vague, too regional) and employed the Task Learning Difficulty and Training Emphasis factors to filter-out tasks not significant enough for testing purposes (about 1/2 the tasks were eliminated in total).

Creating Test and Training Outlines with Recommended Emphasis

The reports for the performance dimensions were re-printed using only validated tasks and the consensus KSAO Master List. The "Training Emphasis" factor was used to determine "appropriate" default weight for determining the number of test items and recommended training emphasis for each empirically-defined performance dimension.

Generating New Tests or Replacement Items to Match Target Emphasis

Current test items were linked to the performance dimensions for inspection of emphasis in the existing program. Where differences arose, test developers wrote new items to build up weak areas and removed items from areas with an over-representation of emphasis. Because a performance dimension typically covered several KSAO areas, the test developers had some professional latitude in KSAO selection, but not in the job content to be tested. Test developers were allowed minor deviations from recommended allocations by documenting their rationale which included reasons such as: 1) tasks on a given sub-topic were too low a level, and therefore appear "over-emphasized"; 2) some basic topics are best emphasized in the "common" module; 3) some critical topics deserve more weight. All reasons were reviewed and agreed upon by the SME panel.

Evaluating the Focus of Current Training Programs

Current training modules were linked to the performance dimensions for inspection of emphasis in the existing program. As a new training program had just been instituted, no changes were made to the new program. Recommendations were documented for possible changes in emphasis when the next scheduled review of training content in two years.

Summary of the IRS Project

With test items linked to both training modules and performance modules, test item analysis gains in power. Poor performance of test items may now be linked not only to the wording in the stem and the quality of the distractors as in traditional item analysis, but also to the training module and the sub-specialization within the job family. Tracking the cause of item failure may actually lead to improved instruction or recognition of professional niches within the job family.

The Job-Linked Assessment Procedures (J-LAP)

The IRS project, two decades ago, was the first application of the Job-Linked Assessment Procedures (J-LAP) method. J-LAP took many-advanced research methods validated by the United States Air Force (like Automated Training Indicators – ATI) and forged them into an operational system useable outside of the military environment. The J-LAP system is described in detail in several other papers. In application, however, the J-LAP system is exactly what is needed to develop defensible certification standards for any desired set of job families and concurrently validate the job-relatedness of the associated training programs, if any.