PERSONNEL PSYCHOLOGY
1979, 32

A METHODOLOGICAL APPROACH TO JOB CLASSIFICATION FOR PERFORMANCE APPRAISAL PURPOSES

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This paper illustrates a methodological approach to classifying jobs for the purpose of developing performance evaluation instruments. The approach was to administer a worker-oriented job inventory to 2,023 incumbents across several jobs and several levels of responsibility (rank) in the U. S. Coast Guard. The data from the job inventory were then analyzed using Tucker's Three-Mode Factor Analysis. Output from the three-mode factor analysis was used to identify combinations of jobs and ranks for which separate appraisal instruments could be developed. In addition, output from the three-mode factor analysis was used to suggest the content of the various appraisal instruments. Advantages, applications, and limitations of this approach are discussed.

A question that emerges early in the development of a performance appraisal system in an organization is how many different rating instruments are needed in order to provide useful administrative data. This question is essentially one of how to identify a homogeneous group of employees to be combined for evaluation on a single form. The problem is complicated by the fact that an organization not only must evaluate individuals who are performing in many different jobs, but also individuals at many varying levels of experience, proficiency, or responsibility within these jobs.

This challenge is perhaps best illustrated in the context of the job classification systems of the military, the federal civil service, and

This research was supported by Contract DOT-CG-62625-A from the Department of Transportation, U. S. Coast Guard. The views reflected in this paper are those of the authors, and do not necessarily reflect the views of the Department of Transportation.

The authors wish to thank Robert MacCallum for his advice on the three-mode factor analysis. We also appreciate the contributions of Barry Friedman, Steve Wroten, and Lois Darmstadter during various phases of the research. The enthusiastic cooperation of the U. S. Coast Guard is gratefully acknowledged, particularly the efforts of Joseph Cowan, our technical advisor.

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various state and municipal governments. In these settings, there are typically several pay grades within various occupational groups. These grades reflect increasing levels of experience and proficiency. As an example, imagine the jobs Typist I, II, III and Clerical Assistant I, II, III in a state government setting. For performance appraisal purposes, the question arises whether or not Typist I and Typist II are sufficiently different to warrant unique performance appraisal forms. In addition, are Typists and Clerical Assistants doing enough different types of activities to merit separate appraisal forms?

A similar problem is found in the private sector. Evaluation of performance in management jobs is an illustration. It is not uncommon for management personnel to be performing duties in various functional groupings (e.g., maintenance, production, support services) at various management levels (first, second, third, etc.). In developing a performance appraisal system an obvious question is whether or not managers in production should be evaluated using the same instrument as, say, managers in maintenance. With respect to management levels, should foremen and general foremen be evaluated on the same form as supervisors or superintendents?

There are two extreme approaches to this problem. On the one hand the literature on performance appraisal would suggest that the optimum appraisal system should contain rating items that are job oriented and behaviorally specific rather than general. Taking this approach, organizations could develop as many different evaluation forms as there are incumbents performing unique tasks. On the other hand organizations could look for generalities across the different kinds of work and develop a single evaluation form incorporating these commonalities. Unfortunately, there exists across jobs a great variety of tasks, demands, and unique skills necessary to perform tasks, such that a single overall evaluation instrument tends to include items that are so general that they provide minimally useful data. Examples include such performance items as "quantity of work," "quality of work," and a variety of personal characteristics presumed to be important across any job, such as "dependability," "loyalty," and "punctuality." For most organizations, then, an approach somewhere between these two extremes is appropriate.

The purpose of this paper is to propose and illustrate a methodology for solving the problem of determining how many unique performance appraisal forms should be developed in order to evaluate employees in an organization that has multiple job titles and multiple levels of employee proficiency, experience, or responsibility within these jobs. The data reported here are taken from a U. S. Coast Guard study to develop an improved evaluation system for enlisted personnel from various occupational groupings and ranks; however, the general approach is equally applicable to a range of other similar settings.

The Problem

Currently, all enlisted personnel in the United States Coast Guard are rated twice a year. Regardless of type of job or rank, all personnel are evaluated on the same rating form. At the time of this study (1976–1977) there were over 31,000 enlisted personnel in the United States Coast Guard. These personnel were performing job duties in 32 different job groupings. These 32 groupings represented a wide variety of different job functions, from a gunner's mate or a boatswain's mate on a Coast Guard cutter, to a mechanic for a Coast Guard helicopter, to a hospital corpsman. In addition, within each grouping there are a possible nine different levels of proficiency and responsibility (rank). A major question to be answered by this study was to determine how the different jobs and ranks could be collapsed into major groupings for which separate appraisal instruments could be developed.

In answering this question, two distinct choices had to be made. First, a means of analyzing jobs for the purpose of comparing similarities and differences among them had to be chosen. This is essentially a problem of producing an appropriate type of job analysis data. And secondly, a statistical methodology had to be selected that could use the job analysis data to simultaneously consider rank and type of job information.

The Job Analysis Model

There are currently several philosophies in personnel psychology regarding the appropriate unit of analysis for studying jobs. A popular model is the task-oriented job element approach used in the military (Christal, Note 1; Morsh, 1964) and in several civilian settings (Chalupsky, 1962; Hemphill, Note 2; Lawshe, 1955). A second model is the worker-oriented job element approach suggested by McCormick (McCormick, Jeanneret, and Meacham, 1972). A third model is the abilities-oriented approach advocated by Fleishman (1972, 1975). Other less popular models include human motivation dimensions (Hackman and Oldham, 1975), critical behaviors (Flanagan, 1954), physiological data, and various industrial engineering approaches (see Salvendy and Seymour, 1973). It is clear that each of these approaches stresses a different aspect of work that could be important in job classification.

For theoretical and administrative reasons, the worker-oriented approach was selected in this study. Conceptually, the theory of work implied by McCormick's Position Analysis Questionnaire (PAQ) was parucularly attractive for job classification problems. This theory assumes that although diverse jobs may contain an infinite number of unique activities, all these activities can be characterized in terms of a finite number of common underlying process elements. It is perhaps this latter orientation that has made the *PAQ* popular in recent job classification studies (see, for example, Taylor, 1978; Taylor and Colbert, 1978).

The worker oriented approach was also administratively superior. Although the task-oriented approach is clearly the most popular job analysis model in the military, this approach was not feasible in this study. To compare similarities among the specific task activities of all the Coast Guard occupational groups and ranks would require the development and administration of a job inventory with literally thousands of task items.[1] Using a worker-oriented inventory, however, a single booklet could be simultaneously administered to all incumbents.

The Data Analysis Model

Several data analysis techniques have been suggested for job classification problems. Mobley and Ramsay (1973), for instance, urged that clustering algorithms should be used. This approach has proven popular in the military and other settings (e.g., Christal, Note 1; McCormick, 1976; Taylor, 1978). Arvey and Mossholder (1977) have argued that analysis of variance is the appropriate model for determining similarities and differences among jobs. Lissitz, Mendoza, Huberty, and Markos (in press) have pointed out the advantages of Multivariate Analysis of Variance and Discriminant Functional Analysis as job classification techniques. Finally, Sackett, Cornelius, and Carron (Note 3) have used multidimensional scaling as a method for job classification.

Each of the above data analytic models offers unique advantages and disadvantages in job classification problems. However, the nature of the present data (job inventory responses of incumbents who varied simultaneously across jobs and ranks) suggested that a different methodology might be appropriate. In particular, Tucker's three-mode factor analysis (1966) seemed uniquely designed to analyze data of this sort. Tucker's method proceeds in two stages. First, each of the separate dimensions of the data (or "modes") are factor analyzed. Then, a "core" matrix is obtained which relates the factors of the

[1] Job inventories in the military are typically administered *within* occupational groupings only. Even with relatively homogeneous jobs in a single occupational cluster, the number of task statements may be 500 or more (see Christal, Note 1).

various data modes. In this case, three-mode factor analysis could determine the factors of job element items (Mode 1) that were maximally related to factors of jobs (Mode 2) and factors of ranks (Mode 3).

Tucker's three-mode technique was considered superior to the more popular clustering procedures for several reasons. First, the three-mode procedure allowed us to formally preserve the integrity of the three modes of the data. Secondly, the rules of thumb for determining the appropriate solution in factor analysis were considered superior to the procedures for determining the appropriate number of clusters in cluster analysis. Third, the interpretation of the results would be easier, i.e., factor loadings could be used rather than the more clinical and cumbersome procedure of interpreting the profiles of cluster members. A final advantage was the fact that the entries in the "core" matrix could be used directly as an aid in constructing the appraisal forms themselves.

Method

Job Inventory Development

Items from the *PAQ* were used as a starting point for developing a worker-oriented Coast Guard job inventory. Several changes in the *PAQ* were made to adapt it for Coast Guard use. Items were deleted or revised to make them appropriate to the military setting. Also, the reading level of the instrument was reduced. Previous research with the *PAQ* had shown that it required a post college graduate reading level (Ash and Edgell, 1975). Although appropriate for use by trained job analysts, the reading level was too high for use in a mass mail-out to enlisted personnel in the Coast Guard where the average education level was at the 12th grade level or below. In this regard, the reading level of the final instrument was assessed at the 10th grade level.[2] Another change involved eliminating the variety of different response scale formats used on the *PAQ*. All items were converted so that they could be evaluated by the Relative Time Spent scale used in the Air force and other military services. A final revision was to add some 50 items that were called "leadership process items." The source for these additional supervisory-type items was verb lists from previous task analyses performed in the Coast Guard. The final job inventory booklet contained 153 worker oriented elements and was 12 pages long.

[2] Grade level was determined by using the *Star* computer program. *Star* is a program that was developed at General Motors for the purpose of reducing the reading level of shop manuals. *Star* uses the Flesch index and the Dale Chall index to estimate the grade level equivalent of reading materials.

Enlisted Personnel Sample

The job inventory booklet was administered to a cross section of Coast Guard enlisted personnel. A sample of 3,160 enlisted personnel were randomly selected to participate in the study subject to the constraint that there was approximately equal representation of 28 of the original 32 jobs.[3] All questionnaires returned within six weeks of the mail-out were retained in the final sample. At the cut-off date, 2,023 booklets had been received (64% return rate).

Procedure

Job inventory booklets were mailed from Coast Guard headquarters directly to field commanders nationwide. Field commanders then distributed the job inventory booklets to individual sample participants. Job incumbents filled out the questionnaires on their own, and individually mailed the questionnaires to Ohio State. Participation in the study was voluntary.

Results

Before implementing the three-mode factor analysis, some modifications in the number of levels of the three modes were made in order to insure a fully-crossed design. Specifically, the ranks E1–E3 and the three jobs Seaman, Airman, and Fireman were eliminated from the analysis. This was done because personnel in ranks E1–E3 are found exclusively in these three jobs only. Additional modifications were made in order to insure a reliable sample size in each cell of the design. Specifically, the ranks E8 and E9 were combined, and seven job categories (e.g., musicians, photo journalists, others) were eliminated due to small sample size. In all, there were 18 different jobs and 5 different ranks retained for the three-mode analysis. After averaging across individuals, these data formed a three-dimensional cube. One face of the cube had 153 levels representing the 153 worker-oriented job elements from the questionnaire. The second face of the cube contained 18 levels representing the 18 jobs for which sufficient responses were obtained to be included in the analysis. The third face of the cube contained five levels representing the five different ranks to be analyzed. Each cell of this three-dimensional cube contained a mean Relative Time Spent value that represented a unique combination of job, rank, and job elements. The mean value for each cell was based on the responses from 15 to 35 Coast Guard incumbents, depending upon the return rate for that cell.

[3] Questionnaires were not sent to representatives of four job groupings due to the extremely small numbers of incumbents (less than 50) in each one.

TABLE 1

A. Eigenvalues and Sums of Squares Accounted for by Successive Five Factors of the Rank Mode Factor Analysis

Dimension	Eigenvalue	Percentage of Sums of Squares	Cumulative Percentage
1	52579.39	93.60	93.60
2	2375.09	4.23	97.83
3	445.95	.79	98.62
4	424.26	.76	99.38
5	350.09	.62	100.00

B. Two-Factor Rotated Solution for the Rank Mode

Grade	Factors I	Factors II
E-4	*.74*	−.11
E-5	*.59*	.06
E-6	*.30*	*.35*
E-7	.01	*.64*
E-8 & E-9	−.09	*.67*

Note—Defining values (above ±.30) are italicized. In three mode analysis, eigenvectors are scaled such that the sum of squared loadings is 1.0. The entries in Part B of this table are therefore not equivalent to correlations.

Since all variables were measured on the same response scale, sums of squares and cross products, rather than correlation coefficients, were analyzed. Tucker (1966) recommends this approach since the factoring procedure thus incorporates variance due to mean differences.

The Rank Mode

The rank mode was analyzed by factoring 2,754 (18 × 153) observations of five variables. Part A of Table 1 presents the roots and sums of squares accounted for by each of the factors in the rank matrix.[4] The two-factor solution was selected for rotation due to the large drop in sums of squares accounted for after two factors (the two factor solution accounts for 97.8% of the rank mode sums of squares). Part B of Table 1 presents a varimax rotation of the two-factor solution.

The two-factor structure for rank is particularly interesting. The factors were labeled Chief Petty Officer (ranks 7, 8, 9) and Petty Officer (ranks 4, 5). The presence of two orthogonal factors indicated that the nature of relative time spent on the job elements varied appreciably depending on one's rank. There are (at least) two clusters of activities, one of which accounts for much variation in the time spent by E4's and E5's and little variation in time spent by E7's, E8's,

[4] The large size of the first eigenvalue is expected when factoring cross products instead of correlations.

TABLE 2
Eigenvalues and Sums of Squares Accounted for by Successive 18 Factors of the Job Mode Factor Analysis

Dimension	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	50281.87	89.51	89.51
2	1703.16	3.03	92.54
3	685.16	1.22	93.76
4	634.81	1.13	94.89
5	513.81	.92	95.81
6	387.78	.69	96.50
7	313.52	.56	97.05
8	288.96	.51	97.57
9	231.23	.41	97.98
10	201.09	.36	98.34
11	180.48	.32	98.66
12	146.16	.26	98.92
13	128.27	.23	99.15
14	114.47	.20	99.35
15	110.04	.20	99.55
16	90.67	.16	99.71
17	87.89	.16	99.87
18	75.38	.13	100.00

and E9's. The second cluster shows the opposite pattern. The E6 group is especially interesting because its variation is moderately related to both clusters—that is, some E6's must be similar (in terms of relative time spent) to E7's and above, while others are more similar to E4's and E5's.

The Job Mode

The job mode was analyzed by factoring 765 (5 × 153) observations of 18 variables. Table 2 presents the roots and percent of sums of squares accounted for by each successive factoring of the rating matrix. After considering several rotated solutions, the five-factor solution, accounting for 95.8% of the job mode sums of squares, was selected as the best approximation to simple structure. Table 3 presents the rotated loadings for the five-factor solution.

Retention of five factors followed by varimax rotation yielded a clear and reasonable interpretation. Only Electrician's Mate had important loadings on two factors, and even then the pattern of loadings was easily interpreted. Names for the job mode factors are: I. Aviation; II, Service and Clerical; III, Electronics; IV, Engineering: and V, Deck and Watch.

The Job Elements Mode

The job element (or item) mode was analyzed by factoring 90 (5 × 18) observations of 153 variables. Table 4 presents the roots and

TABLE 3
Five Factor Rotated Solution for the Job Mode

Rating	Factors I	II	III	IV	V
Boatswains Mate	−.02	−.05	−.26	*.51*	.21
Quartermaster	−.04	.02	−.10	.16	*.51*
Radarman	−.01	.02	−.02	.11	*.49*
Gunners Mate	−.04	.08	.03	*.32*	.12
Machine Technician	.11	−.14	.08	*.41*	.03
Damage Controlman	.00	.04	.09	*.41*	−.10
Electronics Technician	.04	.03	*.63*	−.02	.01
Electricians Mate	.02	−.12	*.33*	*.31*	−.03
Telephone Technician	−.03	.04	*.57*	.08	−.02
Radioman	.10	.20	.12	−.20	*.43*
Yoeman	−.06	*.38*	.04	−.08	.24
Storekeeper	−.11	*.42*	.08	−.01	.12
Subsistence Specialist	−.04	*.61*	−.10	.29	−.40
Aviation Machinists Mate	*.59*	.04	−.14	−.01	−.03
Aviation Electronics Technician	*.41*	.03	.12	−.09	.10
Aviation Electricians Mate	*.45*	−.04	.05	.02	.02
Aviation Structural Mechanic	*.44*	−.02	−.04	.11	−.08
Hospital/Dental Corpsman	.19	*.45*	.05	−.05	−.01

Note—Defining values (above ±.30) are italicized. For each factor, squared "loadings" sum to 1.00. The entries in this table are therefore not equivalent to "correlations."

percentage of sums of squares accounted for by the first ten stages in the factoring process. After considering rotations of 2 through 9 factors, the 7-factor solution, accounting for 96.3% of the job element sums of squares, was selected as the best approximation to simple structure. Table 5 presents a listing of loadings and "marker" items on each of the seven factors of the job element mode. The job element factors were labeled I, Machine Tending; II, Managing; III, Cooking; IV, Machine Repair; V, Clerical and Contact with Others; VI, Boating; and VII, Air Crew.

TABLE 4
Eigenvalues and Sums of Squares Accounted for by the First 10 Factors of the Job Element Mode Factor Analysis

Dimension	Eigenvalue	Percentage of Sums of Squares	Cumulative Percentage
1	48817.57	86.90	86.90
2	2578.41	4.59	91.49
3	936.79	1.67	93.16
4	575.37	1.02	94.19
5	521.59	.93	95.11
6	369.60	.66	95.77
7	312.11	.56	96.33
8	243.01	.43	96.76
9	197.33	.35	97.11
10	143.89	.25	97.36

TABLE 5
Marker Items and Loadings for the Seven Factor Rotated Solution of the Job Element Mode

	Factor 1: Machine Tending
Loading	Item Label
.28	Notice different patterns of sound (Morse code, engines not running right)
.26	Use remote controlled equipment
.26	Continually watch for frequent changes in your job situation (rescue traffic, constantly watching guages and dials that change often)
.24	Monitor equipment
.21	Use sounds (engine sounds, sonar)
.21	Notice differences or changes in sound through loudness, pitch, or tone quality
.20	Code and decode
.20	Use devices that have fixed or variable settings (TV selector switch, room thermostat)
.20	Stand watches
	Factor 2: Managing/Supervising
.23	Approve requests and/or proposals from others
.22	Assess the quality of work of others
.22	Assign people to tasks
.22	Supervise others
.21	Are accountable for decisions and actions of others
	Factor 3: Cooking
.29	Use taste (food preparation)
.28	Use tools or devices for the purpose of handling things (tongs, ladles)
.25	Use odor (applies to any odor you need to smell to do your job)
.24	Judge speed of some process (cooking time, developing pictures)
.20	Work in an enclosed area that is hot
.20	Judge size or weight of objects without direct measurement
	Factor 4: Machine Repair
.31	Use hand held powered devices that perform very precise or accurate operations (soldering irons, welding equipment)
.27	Repair equipment
.26	Take equipment apart or put it back together
.23	Test equipment
.20	Identify causes of equipment problems
	Factor 5: Clerical
.26	Use finger movements (drawing instruments, keyboard devices)
.26	Use keyboard devices (adding machines, typewriters)
.24	Work in an area of moderate noise (office with typewriters)
.23	Use verbal communications
.21	Use written materials (tech manuals, notices)
.20	Use devices that you draw or write with
	Factor 6: Boating
Loading	Item Label
.24	Work outdoors
.23	Contact public (boating safety, environmental protection, law enforcement)
.22	Use man-made features (bridges, dams, docks)
.22	Coordinate hand and/or foot movement with what you see (driving a car, steering a boat)
.22	Use small boats
.21	Are responsible for the safety of the general public
.21	Judge distances

TABLE 5 *(Continued)*

Loading	Item Label
	Factor 7: Air Crew
Loading	Item Label
.47	Serve as air crewman
.33	Take risks while serving others (SAR teams)
.23	Are subjected to vibration

Note—"Marker items" were all those items with values equal to or greater than .20. Factors are scaled such that the sum of squared loadings for each factor is 1.0. Since there were 153 items in the job element mode, values as large as .20 were considered substantial.

Core Matrix

The core matrix that interrelates the rotated factor matrices is presented in Table 6. Although the scale is arbitrary, numbers in the core matrix are directly interpreted in terms of relative time spent. In general, large values (30 and greater for these data) indicate that persons within the particular combination of modes associated with the large values spend relatively more time in that activity than other members of the sample. A similar interpretation holds for small values (4 and smaller). The mean value in the core matrix is 22.80, and deviation in either direction corresponds to increasing (or decreasing) relative time spent.

Within any row, column, or level of the matrix, time spent may be interpreted either relative to the grand mean or relative to the mean for the row, column, or level in question. Consider the top row of the lower half of the core matrix in Table 6. Chief Petty Officers in Aviation ratings spend very little time performing Air Crew tasks (Factor VII) and divide most of their time evenly among Managing (Factor II), Machine Repair (Factor III), and Clerical and Contact with Others (Factor V). Other cells may be interpreted similarly.

TABLE 6
Entries of the "Core" Matrix

Petty Officer (Rank Factor I)				Job Element Factors			
Job Factors	I Machine Tending	II Managing	III Cooking	IV Machine Repair	V Clerical & Contact	VI Boating	VII Air Crew
I Aviation	29.45	23.57	25.88	*42.95*	*43.00*	13.43	28.28
II Service, Clerical	21.43	*51.87*	14.35	29.37	*49.33*	9.40	16.89
III Electronics	14.54	19.08	26.02	15.78	*47.31*	10.76	*−.33*
IV Engineering	8.43	*43.48*	15.73	9.45	*49.15*	8.23	−2.97
V Deck & Watch	20.31	10.42	12.76	37.14	25.98	6.03	*2.89*

TABLE 6 *(Continued)*

Chief Petty Officer (Rank Factor II)

	Job Factors	Job Element Factors I Machine Tending	II Managing	III Cooking	IV Machine Repair	V Clerical & Contact	VI Boating	VII Air Crew
I	Aviation	17.49	34.62	11.35	32.36	34.10	8.18	*1.24*
II	Service, Clerical	25.89	34.38	32.77	*42.52*	*43.10*	31.39	19.32
III	Electronics	23.17	*57.53*	23.60	37.58	*50.61*	24.01	11.65
IV	Engineering	21.79	18.66	*2.20*	14.65	*43.06*	19.31	5.18
V	Deck & Watch	18.30	33.81	*2.95*	12.30	*43.88*	15.34	*3.05*

Development of the Appraisal System

The results from the three-mode factor analysis suggested that six unique forms should be developed for evaluating enlisted personnel in the U. S. Coast Guard. This decision was made by simultaneously considering the number of factors that emerged from the job mode, the number of factors that emerged from the rank mode, and the entries in the core matrix (Table 6).

The results from the factor analysis of the job mode indicated that there were five different factors of jobs that could account for the relative time spent ratings. At the same time, there appeared to be two factors of rank that could account for the relative time spent ratings.[5] The entries in the core matrix indicated that for Petty Officers (rank Factor I), there were five fairly unique patterns of time spent across the various job element factors, corresponding to the five job rating factors. This suggested that five separate rating forms should be developed for Petty Officers in the Coast Guard. The entries in the core matrix for Chief Petty Officers (rank Factor II), on the other hand, did not reveal radically different profiles across the job element factors. That is, Chief Petty Officers tend to concentrate their time on Factors II, IV, and V, across most job ratings. Engineering and Deck and Watch officers appear to spend less time on Factor IV, relative to the other job groupings. Also, Engineering officers spend more time on Factor I. However, these slight departures were not substantial enough to suggest that separate Chief Petty Officer forms should be developed for each major job rating.

The source for actual rating items on each of these six evaluation forms was also prompted by the entries in Table 6. For example, a

[5] Despite the fact that E6's loaded on both Factor I and Factor II, a decision was made to include E6's with the E4's and E5's on the final evaluation instrument. This decision was a non-statistical one, based on Coast Guard tradition as well as reactions of representatives in a series of field conferences.

common source of items for each Petty Officer rating form was items from Factor V (Clerical and Contact). Likewise, some items for the Aviation Petty Officer form and the Deck and Watch Petty Officer form came from Factor IV (Machine Repair). A deliberate attempt was made to include rating items for each of the six groupings that were unique to that grouping. For this purpose, mean Relative Time Spent values were computed for each item on the inventory for each of the major job factors. When the Mean Relative Time Spent value of an item was substantially greater for a single job group than the grand mean for all groups, that item was considered for inclusion on the evaluation form for that group. Further details regarding the construction of the actual appraisal instruments can be found elsewhere (Cornelius and Hakel, Note 4).

Discussion

This study illustrated a methodological approach to classifying jobs for the purpose of developing performance evaluation instruments. A worker-oriented job inventory was administered to incumbents across several jobs and several levels of responsibility (rank). The results from the job inventory were then analyzed by Tucker's (1966) Three-Mode Factor Analysis. Output from the three-mode factor analysis was used to identify combinations of jobs and ranks for which separate appraisal instruments could be developed. In addition, output from the three-mode factor analysis was used to suggest the content of the various appraisal instruments.

There were several advantages to this approach. For one thing, the results from the statistical analyses indicated that six different evaluation forms needed to be developed. Reaction to these groupings by Coast Guard personnel was generally favorable. The approach, therefore, offered a workable solution to the very difficult question regarding how many ranks and jobs could be combined for the purpose of developing separate performance appraisal instruments. The approach was also administratively feasible, whereas alternative approaches (such as the task-oriented approach) were not.

The success of this methodology in the Coast Guard situation has obvious implications for a variety of other public and private sector settings. The basic requirement for using this technique is to have a setting in which incumbents perform in many nominally different jobs, while simultaneously varying on some other factor, such as experience, proficiency, responsibility, pay grade, etc.

This technique is not necessarily limited to settings with large numbers of incumbents. In the Coast Guard example there were large numbers of incumbents in each cell to provide reliable estimates of

Relative Time Spent on the various job inventory items. In many smaller organizations it may be true that as few as one or two incumbents may be found in any particular job and pay grade combination. From an analysis standpoint, all that is needed are responses from one incumbent for each cell of the design. The important point is that the cell entries for the three-mode analysis should be as reliable as possible. Instead of achieving reliability by pooling responses over large numbers of incumbents, one could compute responses over occasions from a single incumbent. Alternatively, professional job analysts could be hired to jointly work with incumbents to fill out the questionnaires after interviews, observations, and consensus judgment sessions. In this case responses from a single incumbent could be regarded as reasonably stable and accurate.

The overall use of the methodology was regarded as successful, and other researchers are urged to try the technique in similar circumstances. The basic approach might also be appropriate for different job classification purposes. As an example, in promotion testing programs it is now legally necessary to furnish job analysis data regarding ways in which various lines of progression are to be combined for the purpose of administering a single promotion system (see *Albemarle v. Moody,* 9 EPD 10). Job inventories administered to incumbents and analyzed via three-mode factor analysis could provide appropriate job classification results to help answer the question of how many distinct lines of progression exist, in terms of underlying work processes. These and other uses should be explored in future studies.

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