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ABSTRACT

This paper describes the construction of a new examination for Federal Coal Mine Inspectors, using the Job Element (J-Scale) method. Headquarters administrators and field inspectors rated the importance of various job elements. The values given to 32 elements, a comparison of test and actual proficiency, ratings, and examples of the rating parameters of several elements are given. A summary of the workings of the J-Scale Formula is provided. See also TM 001 163, 165-166 for further information on the Job Element (J-Scale) method. (DLG)

Enc. # 2

HANDOUT 4
TOPIC V

APPLICATION OF JOB ELEMENT (J-SCALE) METHOD TO JOB ANALYSIS AND SELECTION OF INSPECTORS

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A Federal Coal Mine Inspector has the responsibility for closing an unsafe mine to save lives, in spite of the economic impact of closing a mine on owners and community. His most important contribution is in cooperative work with mine officials and miners to improve safety conditions in mines.

In previous examinations, applicants were rated in terms of length of experience in positions such as mine superintendent, mine foreman or mine engineer. This type of examination made it impossible to hire a person of considerable ability until his ability had been recognized by a mine company. Also, a miner who preferred to keep a nonsupervisory job, which incidentally often pays as much money to a good producer as a supervisor makes, could not aspire to a Federal Coal Mine Inspector's position.

A new examination was set up, to permit applicants to demonstrate competence in necessary job elements, regardless of how they acquired competence--by combinations of home study, school study, on-the-job training, etc.

This examination was based on the Job-Element approach, which makes use of a validated procedure for analyzing a job in terms of the qualifications that will select the best possible employees.

The first step was to find out what the important qualification elements for the position are. In a round-table conference with nine Coal Mine Inspector Supervisors of the Bureau of Mines headquarters staff, a comprehensive list of knowledges, skills and personal characteristics required by the position were described, such as "ability to learn to make acceptable inspection reports," "fundamental knowledge of mine gases and ventilation," "stamina for work in mining," "ability to obtain cooperation and to cooperate," and "resoluteness to carry out judgment."

The next step was to determine the relative value of each qualification element for an examination. In early studies, this was a lengthy process of extended conferences with experts, a considerable number of unresolved arguments, and often indefinite conclusions. By validation studies (comparing opinions of experts with later successful or unsuccessful use of elements in examining), the J-scale method was evolved, in which the known facts about a position are rapidly indicated on a check sheet by experts, on the basis of their experience and judgment, and conclusions are made by applying a formula based on research.

The nine headquarters administrators and also six inspectors in the field filled out the check list shown in Chart 1.

CHART 1: JOB ANALYSIS BLANK

Used to Determine Total
J-scale Value of Each Element

Job Element No.	To be barely acceptable worker + Must have √ Good to have 0 Little value	To pick out superior worker + Essential √ Valuable 0 Does not differentiate	Trouble likely if ignored + Much trouble √ Some trouble 0 Safe to ignore	Practical to expect + For all eligibles √ For some eligibles 0 Almost no one

J-scale formula, applied to Coal Mine Inspector Examination

+ = 2
√ = 1
0 = 0

Total Value for a rater - Barely acceptable + Trouble likely + (Superior x Practical)

Information on the development and use of the J-scale formula can be secured from the author. See Appendix for a quick view of how the formula works.

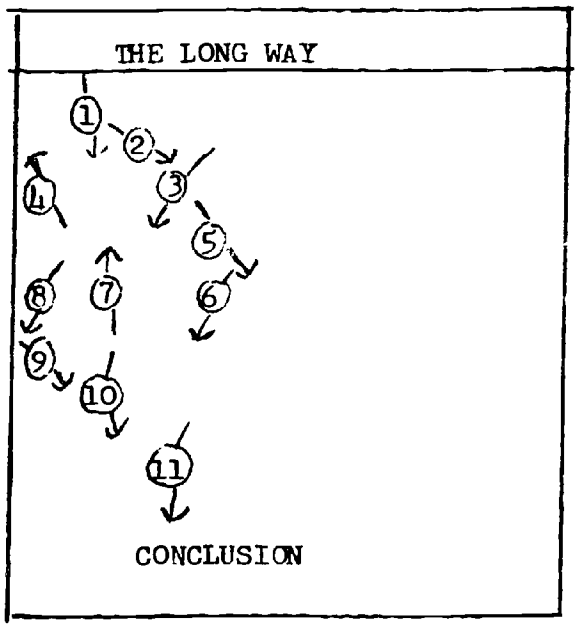
For each element, each rater makes four simple decisions. If the element is extremely important for even barely acceptable work, he marks a + in the "Barely acceptable" column. If the element will distinguish superior workers, the rater puts a + in the "Superior" column. If trouble on the job is likely if we ignore the element in an examination, he puts a + in the "Trouble likely" column. If the qualification is practical to expect in all people hired, he puts a + in the "Practical" column. Similarly, the rater may mark a 0 or √ if he feels that the element is of less importance.

Each rater makes a fairly simple determination--plus, check or zero in each column. The J-scale formula is applied later, by a clerk, to secure a total value.

Chart 2, taken from the Link-Belt News, shows the advantage of rapid decision-making techniques like this one.

CHART 2: HOW DECISIONS ARE REACHED

FROM: LINK-BELT NEWS APRIL-MAY 1958



FACTORS

1. KNOWN FACTS
2. Supposition
3. EXPERIENCE
4. Opposition by others
5. Intuition
6. JUDGMENT
7. Wishful Thinking
8. Day Dreaming
9. RESEARCH
10. Fiddling Around
11. Sweating It Out

CONCLUSION

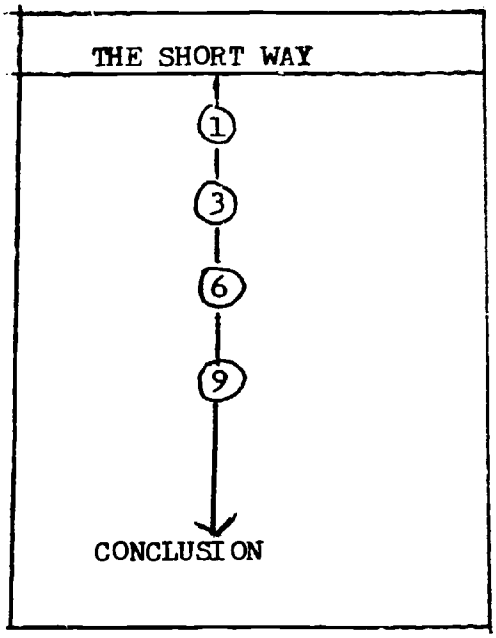


Chart 3 shows the elements that have highest total values for the entry grade and were selected for the examination, the total value of each such element, and how the element is measured:

CHART 3: Total J-scale Values for Elements Selected for Examination for Entry Grade (GS-9), and Means of Measurement

Element	J-Scale Total Value	How Measured in Examination
1. Physical fitness for work in mining	36	Medical examination
2. Stamina for work in mining	36	Performance test
3. Ability to interpret written instructions and regulations	36	Experience evaluation
4. Learning ability for regulations and procedures	36	Experience evaluation; Written test
5. Ability to accept supervision	36	Experience evaluation
6. Ability to interpret and apply instructions given orally	32	Experience evaluation; Interview
7. Ability to work as a member of a team	32	Experience evaluation
8. Ability to learn to make acceptable inspection reports	32	Experience evaluation; Written test
9. Ability to make acceptable inspection reports	1/	
10. Ability to observe, recognize and interpret what is seen	32	Experience evaluation; Written test
11. Ability to drive an automobile	36	Performance test
12. Satisfactory personal conduct and integrity	32	Experience evaluation 2/

1/ Element 9 had a low value for GS-9, although it had a high value for higher grades. The element was not counted for the examination for GS-9 positions.

2/ Experience is interpreted broadly to include relationships with people and society, outside as well as inside job areas.

Element	J-Scale (Total Value)	How Measured in Examination
13. Emotional stability	32	Experience evaluation; Interview
14. Fundamental knowledge of methods of mining	32	Experience evaluation; Written test
15. Fundamental knowledge of mine gases and ventilation	32	Experience evaluation; Written test
16. Fundamental knowledge of roof-control methods	32	Experience evaluation; Written test
17. Fundamental knowledge of properties and use of explosives	28	Experience evaluation; Written test
18. Knowledge of arithmetic as applied to mine safety	28	Experience evaluation; Written test
19. Fundamental knowledge of mine transportation	28	Experience evaluation; Written test
20. Knowledge of machinery, fundamental mechanics, and electricity	20	Experience evaluation; Written test
21. Fundamental knowledge of fire control	16	Experience evaluation; Written test
22. Fundamental knowledge of first aid and mine rescue	12	Experience evaluation; Written test
23. Judgment to determine correct from incorrect courses of action	28	Experience evaluation; Written test
24. Ability to obtain cooperation and to cooperate	28	Experience evaluation
25. Willingness to refer complex situations to higher authority	28	Experience evaluation
26. Resoluteness to carry out judgment	28	Experience evaluation
27. Tact and diplomacy	24	Experience evaluation; Interview
28. Ability to interpret mine drawings and maps	24	Experience evaluation; Written test

Element	J-Scale Total Value	How Measured in Examination
29. Ability to use inspection instruments	24	Experience evaluation; Written test
30. Neatness in dress and appearance	16	Interview
31. Ability to promote public relations	20	Experience evaluation; Interview
32. Ability to express himself orally	20	Experience evaluation; Interview

A written test was prepared with the assistance of Mr. Charlesworth, Mr. Schrecengost, and others of the Bureau of Mines, for appropriate elements, as indicated in Chart 3. Harvey Pearce of the Bureau of Mines validated test units with GS-12 inspectors for some individual elements and for the whole job. For example, for the elements: "Ability to learn to make acceptable inspection reports," a multiple-choice test of ability to organize a report paragraph was prepared. Of fifteen inspectors, three were rated above-average in report-writing ability; all three rea ed 43 in the test. Only one other inspector scored as high; he was rated average in report-writing ability. Three inspectors were rated below-average in report-writing ability, the highest score any of these achieved was 40, three of eight inspectors rated average, and all rated above-average scored higher. Following are results for a test of another element, "Ability to interpret mine drawings and maps." All five inspectors rated above-average in understanding scored 20 or over, 4 of the 6 inspectors rated averag scored as high, all 4 inspectors rated below-average scored lower. Chart 4 shows results for the test as a whole.

CHART 4: Scores for Complete Coal Mine Inspector Test, administered to inspectors of senior grade who were evaluated in job performance.

Test Score	Above-Average in Job Proficiency	Average in Job Proficiency	Below-Average in Job Proficiency
146-	1		
141-145	1	1	
136-140	111	11	
131-135		11	
126-130		1	111
121-125			1

As indicated in Chart 4, the employed inspectors who were considered by their ıpervisor to be above-average in job proficiency all got scores over 136. No em-loyed inspector scored below 121.

For the competitors, a minimum score in the test of 120 is required so that the competitor will be about as high in the test as the lowest scoring inspector. It is realized, of course, that the actual inspectors in the try-out have the advantage of experience. Special forms have been devised for competitors to show their experience, and for supervisors and others acquainted with the competitors to report what they know of the competitors. A group of inspector supervisors have been trained as interviewers.

A competitor's final rating is based on a combination of written test scores and experience evaluation. In evaluating experience, the raters have before them the complete record of each competitor--the experience he claimed, his test scores, the results of interviews, and reports from supervisors and others who know the competitor.

Each of two raters makes a simple determination for each element, as to whether a competitor is worth full credit, 3/4 credit, 1/2 credit, 1/4 credit, or zero credit in each element. For this purpose, rating guides are used. The conduct of the examination, including preparation of rating guides, etc., was the responsibility of Mr. Nathan Shinderman, of the Commission's Bureau of Departmental Operations and Mr. Harvey Pearce, Executive Secretary of the Civil Service Board of Examiners for the Bureau of Mines. Under their direction, Mr. Arthur Charlesworth and Mr. Harry Schrecengost as Board members, developed the drafts of the guides and related material. Mrs. Henrietta Moore of the Commission assisted in the training of raters and interviewers for the examination.

Chart 5 shows several examples of rating guides. The rating guide for element 8 in the chart, that for "Ability to learn to make acceptable inspection reports," illustrates how test scores are balanced with proven experience for elements related to learning ability. As we have already mentioned, inspectors who are known to be excellent writers of reports do get high scores in the written test of this ability. However, it might happen in usual cases that a person with excellent proven experience might fail the report-writing test. Therefore, we give full credit both to a person who can demonstrate his report-writing ability in a test, even though he has not had an opportunity to apply his ability on a job, and to a person who has demonstrated his ability on a job.

Chart 5. Examples of Rating Guides (with Directions to Examiners for their use)

A. DIRECTIONS TO EXAMINERS FOR USE OF RATING GUIDES

Guidelines for rating the elements are given in terms of excellent performance. Evidence of lower quality performance may reveal lack of abilities, knowledges, and skills normally required by the kind of experience presented by a competitor.

The competitor should be given credit merited by his experience and training as they are demonstrated in the examination and by the qualities of his vouchers and personal interview. This may result in the evaluation of an element one or more values below that provided for an "excellent" evaluation.

Carefully read each of the qualifying statements listed under the particular element under consideration. Select that part of the element which most nearly describes the performance of the individual being analyzed and evaluated. Then, enter the corresponding value of that particular element on the Coal Mine Inspector score sheet.

B. EXAMPLES OF RATING GUIDES

1. Ability to Work as a Member of a Team

Consider on-the-job associations, activities in various organizations such as Civic, Safety, Church, and Labor groups, etc.

a. Full credit: Holds responsible elective or appointive office. Serves on committees involving group activities, such as Civic, Safety, Church, and Labor groups, etc.

b. 1/4 credit: Serves in routine positions; records of employment and reputation in the community do not contain any derogatory information.

2. Ability to Learn to Make Acceptable Inspection Reports

The element is self-explanatory

a. Full credit: When applicant indicates actual preparation and writing of technical reports has comprised a major portion of his job. OR candidate gets 43 or higher in Test No. 505.

b. 3/4 credit: When applicant's duties required actual preparation and writing of technical reports which were incidental to job or was responsible for reviewing technical reports. OR candidate gets 38 to 42 in Test No. 505.

c. 1/2 credit: When applicant's duties required preparation and writing of reports containing little detail. OR candidate gets 33 to 37 in Test No. 505.

d. 1/4 credit: When experience of applicant shows some familiarity with technical reports. OR candidate gets 28 to 32 in Test No. 505.

3. Basic Knowledge of Roof-Control Methods

   a. Full credit: When applicant has ability equal to that of supervisor who has successfully completed courses including mine roof-control methods and has had wide experience in supporting various kinds of mine roof with roof bolts and conventional timbering during advance mining and pillar recovery operations, and scores at least 10 in items 1 through 10 in Test No. 502.

   b. 3/4 credit: When applicant has ability equal to that of supervisor who has successfully completed courses including mine roof-control methods and has had wide experience in supporting various kinds of mine roof with conventional timbering during advance mining and pillar recovery operations, and scores at least 9 in items 1 through 10 in Test No. 502.

   c. 1/2 credit: When experience has been gained as timberman or roof-bolter, and scores at least 8 in items 1 through 10 in Test No. 502.

   d. 1/4 credit: When applicant has had limited experience in roof-control methods, and scores at least 7 in items 1 through 10 in Test No. 502.

4. Fundamental Knowledge of Properties and Use of Explosives

   a. Full credit: When applicant has successfully completed courses including mine explosives and has had wide experience, in the transportation, storage, handling, and use of explosives underground.

   b. 3/4 credit: When applicant has successfully completed courses including mine explosives and has had experience in the use of explosives.

   c. 1/2 credit: When experience has been gained as a shot firer.

   d. 1/4 credit: When applicant has had limited experience in the use of explosives.

Mr. Marling J. Ankeny, Director of the Bureau of Mines, and Mr. James Westfield, Assistant Director for Health and Safety, are very highly pleased with eligibles who have passed the examination. As the new inspectors are evaluated in actual work on the job, further validity checks will be made.

APPENDIX

A Quick View of How the J-Scale Formula Works

A plus counts 2; a check counts 1. An element that is rated plus for picking superior workers is thereby given a credit of 2. This consideration must, however, be modified by the consideration as to whether it is practical to expect. We don't want to load our rating schedule with elements that will affect very few competitors.

One example is trigonometry for trades positions. Supervisors often mention trigonometry as desirable for gage checkers and machinists, and one agency requested that we require trigonometry for apprentice applicants. In the latter case, a validity study showed that the rare applicants for apprentice jobs who know trigonometry do reach superior performance on the job. However, there are usually no applicants for a particular apprentice examination who know trigonometry. If examiners had to evaluate every applicant for knowledge of trigonometry, they would spend a lot of unnecessary time, for example, trying to evaluate work experience with Jo-Blocks as 0 or $\frac{1}{4}$ credit in trigonometry. Any advantage that would accrue from examining for trigonometry would be gained equally by consideration given in a rating schedule that knowledge of trigonometry is worth extra credit in an element like advanced lay-out.

Therefore, the rating for Practical on the four-column blank is used as a governor for the rating for Superior Workers. If the element is practical to expect for all eligibles, then it is rated plus, worth 2. This 2 is multiplied by the value for Discriminating Superior Workers. If an element will pick superior workers and is practical to expect, it gets a product of 4. If it is not practical to expect, it gets a product of zero. If it will pick superior workers and is practical to expect for only some hires, then it has 2 for Superior Workers and 1 for Practical to Expect, giving a product of 2. If it is practical to expect, but does not differentiate superior workers at all, it deserves no credit and gets a product of 2 X 0 or zero.

When rating experience, examiners need to give a minimal credit for qualifications that make for barely acceptable work, so as to set a floor for passing with a minimum rating of 70. Therefore, to the above product there is added the value for the rating of relevance to the Barely Acceptable worker. If an element is likely to give trouble if ignored in the entrance requirement, it deserves more consideration than if it is of minor consequence. Therefore, the value for Trouble Likely if Ignored is also added.

The sum of the values for an element computed for each rater makes up a total value on a J-scale for the job ("J" for "Job"). The maximum value that can be given by one rater to an element is 8. With 10 raters, the maximum possible value is 80; thus with 10 raters, elements are evaluated on a J-scale from 0 to 80.

In order to avoid large numbers in actual examining, the total values are multiplied by an arbitrary decimal constant, and reduced to the nearest multiple of 4, since examiners will rate competitors in terms of full, 3/4, 1/2, 1/4, or 0 credits. The amount of credit given by an examiner to a competitor in an element is in proportion to the J-scale value of the element, so that each element counts proportionately to its importance.

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