Comparison of Worker Analysis Ratings Based on Job Description and Motion-Time Study*

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SUMMARY

REPETITIVE work carried out in six different jobs was observed by job description and motion-time study methods. Worker requirements were rated independently on the basis of both methods of job observation. Ratings based on one method of job observation were compared with those based on the other method. Comparisons were also made between ratings based on the same method of job observation. The results indicated that there was a high degree of agreement between ratings in both situations.

INTRODUCTION

Job analysis, as pointed out by Thorndike (1949), consists essentially of two different tasks: one is the description of the work performed on a job, and the other is an analysis of worker characteristics relevant for job performance. The first task, job description, is usually qualitative, consisting of an essay on what, how, and where the job is performed (European Productivity Agency, 1956). On the basis of the job description, the second task of worker analysis is carried out. It is often quantitative, consisting, for example, of ratings of different characteristics (Bellows, 1949; Thorndike, 1949).

Motion and time study is an industrial engineering method concerned with determination of preferable work methods, and consists of two main techniques, man analysis and process analysis (Mundel, 1955). Although motion and time study is also a method of job observation, it has been used relatively little as a basis for analyzing worker requirements (Ghiselli and Brown, 1948). The approach to job observation in the case of motion and time study differs from that of job description as generally used by psychologists. Thus, it may be asked whether ratings for worker requirements based on these two methods of job observation would agree or disagree. The study reported here was designed to answer this question for a few types of repetitive work encountered in business and industry.

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PROCEDURE

Three types of repetitive work were chosen for observation: machine tooling, weaving, and punched card machine (I.B.M. and Hollerith) operation. Two jobs representing each type of work were selected: milling and grinding (for machine tooling), and weaving on semi-automatic and frame looms, and sorting and tabulating punched cards.

The design of the study is summarized in Table 1, which shows how the job description and motion-time study methods were assigned to three observers. The design was prepared so that each observer would observe each job once, so that each job was observed twice by one method and once by the other, and that the two methods were used an equal number of times. It was also arranged so that one of the two jobs representing each type of work would be observed twice by job description, and the other twice by motion study. This design permitted one comparison for the same method and two comparisons between different methods for each job. Job observation by either method was divided into two sessions separated by at least one day. After the job observation was complete, worker requirements were rated.

For job description, a record form for that purpose used in the Indian Statistical Institute was employed. It provides for an essay description of the work performed; brief descriptions of equipment, responsibilities, hazards and standards for acceptable performance, and also of the education, training, experience, skills, and personal characteristics of the personnel; and a rating schedule for physical and social working conditions.

Motion-time study was carried out using motion and time study charts

TABLE 1: ASSIGNMENT OF JOB OBSERVATION METHODS TO JOBS AND OBSERVERS

JOB	MACHINE	OBSERVER		
		I	II	III
Milling ..	Universal milling machine	Motion-Time Study	Job Description	Motion-Time Study
Weaving ..	Semi-automatic loom	Job Description	Motion-Time Study	Motion-Time Study
Sorting ..	Punched card sorter	Motion-Time Study	Motion-Time Study	Job Description
Grinding ..	Universal grinding machine	Job Description	Job Description	Motion-Time Study
Weaving ..	Frame loom	Motion-Time Study	Job Description	Job Description
Tabulating	Punched card accounting machine	Job Description	Motion-Time Study	Job Description

for man analysis in the manner described by Mundel (1955, chapter 6). Motions were classified according to the following seven operations:

(i) Facilitative operation: get ready, put away, or other facilitative operations done at one place.
(ii) Productive operation: doing something which affects the product at one place, including regulation of the machine while it is operating.
(iii) Quantity determination: determining the quantity of an item present.
(iv) Inspection: comparing an attribute of a product with a standard, or verifying the quantity present.
(v) Movement: a change in location; moving from one place to another.
(vi) Avoidable delay: idleness, waiting or moving when movement is not related to performance of the job.
(vii) Unavoidable delay: waiting for machine to finish cycle or operation.

Worker requirements were analyzed using the Worker Analysis Form of the Indian Statistical Institute. A 5-point scale was used to rate each of 34 physical requirements (*e.g.*, endurance), 16 sensory and perceptual requirements (*e.g.*, accurate vision), 26 intellectual and academic skill requirements (*e.g.*, verbal comprehension), and 20 personality characteristics (*e.g.*, carefulness).

TABLE 2: AVERAGE FREQUENCY PER HOUR OF MOTIONS FOR SIX JOBS

JOB	MACHINE	AVERAGE FREQUENCY PER HOUR						
		OPERATION		QUANTITY DETERMINATION	INSPECTION	MOVEMENT	DELAY	
		FACILITATIVE	PRODUCTIVE				AVOIDABLE	UNAVOIDABLE
Milling	Universal milling machine	17.43	26.66	0	5.78	4.12	1.79	23.82
Weaving	Semi-automatic loom	45.38	39.62	0	0.25	15.96	2.97	1.34
Sorting	Punched card sorter	33.16	78.48	0	46.66	8.16	4.32	61.09
Grinding	Universal grinding machine	48.48	9.48	0	8.99	7.02	0	7.55
Weaving	Frame loom	34.83	34.34	0.50	0	0.49	0.49	0
Tabulating	Punched card accounting machine	11.54	31.37	0	10.62	9.96	0.51	27.99

TABLE 3: AGREEMENT BETWEEN INDEPENDENT WORKER ANALYSIS RATINGS FOLLOWING THE SAME AND DIFFERENT METHODS OF JOB OBSERVATION

JOB	MACHINE	WORKER REQUIREMENTS NAME*	SAME METHOD PERCENTAGE AGREEMENT	SAME METHOD CORRELATION	DIFFERENT METHODS PERCENTAGE AGREEMENT	DIFFERENT METHODS CORRELATION
Milling†	Universal milling machine	Physical	73.53	.57	76.47	.48
		Sensory	68.75	.56	78.13	.69
		Intellectual	80.77	.46	82.70	.51
		Personality	90.00	.77	95.00	.77
Weaving†	Semi-automatic loom	Physical	67.65	.46	75.01	.50
		Sensory	43.75	.03	62.50	.23
		Intellectual	88.46	.51	80.77	.41
		Personality	95.00	.81	85.00	.59
Sorting†	Punched card sorter	Physical	79.41	.50	79.41	.58
		Sensory	68.75	.33	87.50	.69
		Intellectual	80.78	.20	80.77	.03
		Personality	85.00	.70	90.00	.81
Grinding‡	Universal grinding machine	Physical	79.41	.46	61.77	.38
		Sensory	68.75	.29	59.38	.43
		Intellectual	88.47	.76	76.93	.39
		Personality	85.00	.70	85.00	.63
Weaving‡	Frame loom	Physical	79.42	.49	67.65	.50
		Sensory	43.75	−.05	65.63	.22
		Intellectual	76.93	.10	86.54	.15
		Personality	100.00	.89	97.50	.86
Tabulating‡	Punched card accounting machine	Physical	73.53	.50	79.41	.60
		Sensory	93.75	.83	75.00	.46
		Intellectual	57.69	.27	71.16	.46
		Personality	90.00	.76	90.00	.73

* Number of characteristics rated: physical, 34; sensory, 16; intellectual, 26; personality, 20.
† Same Method = Motion-Time Study
‡ Same Method = Job Description

TABLE 4: AVERAGE AGREEMENT BETWEEN INDEPENDENT RATINGS OF DIFFERENT WORKER REQUIREMENTS

WORKER REQUIREMENTS	SAME METHOD: MOTION-TIME STUDY (3 JOBS) PERCENTAGE AGREEMENT	SAME METHOD: MOTION-TIME STUDY (3 JOBS) CORRELATION	SAME METHOD: JOB DESCRIPTION (3 JOBS) PERCENTAGE AGREEMENT	SAME METHOD: JOB DESCRIPTION (3 JOBS) CORRELATION	DIFFERENT METHODS (6 JOBS) PERCENTAGE AGREEMENT	DIFFERENT METHODS (6 JOBS) CORRELATION
Physical ..	73.53	.54	77.45	.48	73.29	.51
Sensory ..	60.42	.32	68.75	.45	71.36	.47
Intellectual ..	83.34	.40	74.36	.43	79.81	.33
Personality ..	90.00	.78	91.67	.80	90.42	.75

The three observers were research associates in industrial psychology trained in the use of the Job Description and Worker Analysis Forms and in motion-time study. They were assigned the 6 jobs as indicated in Table 1, but the order of observation was rotated so that only one person was actually observing each job at a time. Observers completed the job observation and worker requirement ratings independently.

RESULTS

Table 2 presents the average frequency per hour of the different motions for each of the 6 jobs. Where 2 observers carried out motion-time study, their data were first averaged individually to obtain frequency per hour, after which they were combined.

To determine the degree of agreement between 2 sets of ratings, the data were analyzed in two ways. First, frequency distributions of the differences between the two sets of data were obtained. As there were 5 possible ratings, the difference between any two numbers could range from 0 to 4. The distribution of differences was found for each of the three possible pairs of observers, and separately for the four sets of worker requirements. As the number of characteristics to be rated differed for the four sets of requirements, frequencies were converted to percentages. The percentage of differences of '0' and '1' were interpreted as 'percentage agreement'. These percentages have been reported for the four sets of requirements for all six jobs. If the pair of ratings compared was based on the same method of job observation, either motion-time study or job description, the data are presented under the columns for the 'same method' in Table 3. For the first three jobs in Table 3, motion-time study was used twice for job observation, and for the remaining three jobs, job description was used twice. The two pairs of ratings based on different methods were averaged to obtain the data given under 'different methods' in Table 3. The second method of analysis was to correlate the two sets of ratings. The correlation coefficients (product moment correlations) are presented in Table 3. For different methods, the corresponding z values were averaged to obtain the correlations reported (Edwards, 1950).

To examine the agreement between ratings according to type of worker requirement, agreement percentages and correlation coefficients given in Table 3 were averaged over jobs. Correlations were averaged using the z transformation (Edwards, 1950). For ratings based on the same method of observation, averages are presented separately for motion-time study and job description in Table 4.

DISCUSSION

To see whether the method of job observation affects the analysis of worker requirements, observers made ratings on the basis of two different methods, motion-time study and job description. On the average, there was 77% agreement between two observers who observed the jobs by motion-

time study, and 78% agreement between two observers using the job description method. The average correlations were .53 and .56 respectively. The agreement between observers using the same method provided a standard for comparing the degree of agreement between observers using different methods of job observation. When two observers were compared who used different methods of job observation, the average agreement between their ratings was 79%. The corresponding average correlation was .52. These measures are of the same order as the degree of agreement between observers using the same method. The degree of agreement found for ratings based on different methods of job observation suggests that a majority of characteristics essential for performance of these three types of work were identified by both job description and motion-time study. This interpretation is supported more by the percentage of agreement, which is probably the more appropriate of the two measures employed.

Trattner, Fine and Kubis (1955) also reported that ratings based on different methods of observation agreed to a high degree. In their investigation, ratings based on direct job observation were compared with ratings made from written job descriptions. They interpreted their results as indicating that both groups of raters made their analyses in terms of a common system of concepts, and it was those concepts that were actually being rated. An alternative explanation of their results could be that the ratings were made on the basis of similar information. If their direct observation analysts had written out job descriptions, the written descriptions which they wrote could have been compared with the descriptions presented to the other groups of analysts to see whether they presented similar information. Since this was not reported, this explanation remains tentative. However, it is supported indirectly by the fact that the least degree of agreement was found for physical characteristics, and this is the area in which their two methods might be most expected to provide different information. A greater degree of difference between ratings on physical characteristics might also be expected for the present study, since motion-time study emphasizes physical operations more than the job description approach. Table 4 shows that there was in fact relatively less agreement for physical and sensory requirements in the present study.

Both the present investigation and that of Trattner, Fine and Kubis (1955) were concerned with relatively simple types of repetitive work. It remains to be seen whether different methods of job observation would yield the same results for more complex jobs involving a wide variety of activities.

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