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RESEARCH MEMORANDUM

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IMPLEMENTATION OF OEI-55.
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PERSONNEL RESEARCH BRANCH

PERSONNEL RESEARCH AND PROCEDURES DIVISION, TAGO

IMPLEMENTATION OF OEI-55

I. INTRODUCTION

Each year, the Officer Efficiency Report overall raw scores are analyzed for all officers on active duty as of 31 May. This overall raw score may be defined, roughly (See Section IIIB), as the weighted average of all efficiency ratings rendered on an officer during his most recent five years of service. The distribution of individual officer efficiency ratings (Army standard ratings) should have a median of 100 and a standard deviation of 20. The distribution of overall raw scores should then have a median of 100 and a standard deviation somewhat smaller than 20. In implementing the OEI, the distribution of overall raw scores is examined each year to ascertain how good the approximation is to a median of 100 and a standard deviation of 20. If the approximation is close enough, the overall raw scores are implemented directly as Overall Efficiency Indexes; if not, a conversion is necessary.

In 1951 (1), 1952 (2), and 1953 (3), the distribution of overall raw scores were so close to the ideal characteristics that no conversion was deemed necessary. In those years the overall raw scores were implemented as the official OEI's. A slight increase in the median score and a decrease in the standard deviation were noted each year but such trends were considered too small for correction. However, in 1954 (4), the trend was found to have continued in the same direction. The 1954 overall raw scores were therefore converted to a distribution having a lower median and a larger standard deviation. The converted scores became the official OEI's.

II. OBJECTIVES

The purpose of this study was to analyze the overall raw scores for 1955 to determine whether the conversion table for the 1954 overall raw scores was adequate for use again in 1955, or whether a new conversion table should be prepared for 1955. If a restandardization of the 1955 overall raw scores proved necessary, a new conversion table would have to be submitted to Statistical Accounting Branch TAGO for use in implementing the OEI-55.

In addition, the overall raw scores of Regular and of non-Regular Army officers were compared. Comparisons were also made between the scores of officers having 12 or more months of actual duty time and those with less than 12 months of duty time.

III. PROCEDURE

A. POPULATION

Scores of all warrant and commissioned officers who were on active duty as of 31 May 55 and who had one or more scored efficiency reports rendered on them during the preceding five-year period were analyzed in this study. Approximately 10,000 of the total of 112,939 were officers whose master OEI cards could not be matched, in SAB, by a corresponding Officer Qualification Record. Either the serial number was wrong, or officers had been separated from the Service, or other

undefined causes resulted in the two sets of cards not matching. It was arbitrarily decided to include these unmatched cases, though they probably represented a biased sample. As shown in Table 1, the distribution statistics were only slightly changed by their inclusion, and this change occurred in the proper direction (towards a reduced median and increased standard deviation).

Table 1

DISTRIBUTION STATISTICS OF OVERALL RAW SCORE FOR THE MATCHED AND UNMATCHED
SAMPLES USED IN THE 1955 IMPLEMENTATION OF THE OEI

	Unmatched Cases*	Total Minus Unmatched Cases	Total (All Officers)
N	10006	102933	112939
M	93.3	103.0	102.2
Mdn	93.8	103.6	102.9
SD	14.9	13.5	13.9

*10,006 Master OEI detail cards in SAB did not match any Officer Qualification Records.

B. VARIABLES

1. Overall Raw Scores--a derived score obtained as follows:

a. An Annual Efficiency Index (AEI) is determined for each officer by averaging his yearly accumulation of ASR's weighted by the number of duty months.

b. Each AEI for the most recent five years (or less, if the officer has had fewer than five years of service) is multiplied by the number of duty months upon which it is based.

c. The sum of these AEI's is then divided by the total number of duty months.

2. OEI-Score--theoretically, the standardized overall raw score. The raw score is converted to a scale having a median of 100, a standard deviation of 20, and a range from 51 to 150.

3. Duty-time--the total period of actual duty time upon which a particular score is based, whether it be an ASR or an OEI. In this study the duty-time variable was dichotomized into "less than 12 months" versus "12 months or more".

4. Component--Regular Army, or non-Regular Army, as indicated on the latest efficiency report included in the last AEI.

C. STATISTICAL PROCEDURE

1. SAB furnished PRB with the frequency distributions of overall raw scores for 1955, separately for officers having 12 or more scorable duty months and for those having less than 12 months, at one-point intervals for the Regular Army and

non-Regular Army separately and for all warrant and commissioned grades combined.

2. The following frequency distributions (when not already available from the above distribution) were prepared by one-point overall raw score intervals; and the mean, median, standard deviation, and cumulative percentages were computed:

a. Regular Army and non-Regular Army officers, separately and combined, who possessed overall raw scores based on 12 or more duty months.

b. Regular Army and non-Regular Army officers, separately and combined, with overall raw scores based on less than 12 months of duty time.

c. Regular Army and non-Regular Army officers, separately and combined, regardless of the number of duty months upon which their overall raw scores were based.

3. An Army standard score conversion table, with a median of 100 and a standard deviation of 20, was constructed from the total number of overall raw scores. A new conversion table was prepared in which the range of these converted scores was curtailed at 51 and 150 (See Section IVB).

4. A graph showing the distribution of 1955 overall raw scores and official OEI scores, without regard to duty months, was prepared for the total Army

IV. RESULTS

A. REASONS FOR CONVERTING SCORES

It was decided for the following reasons that a new conversion table should be prepared for use in implementing the 1955 OEI:

1. First, and most important, the median and standard deviation of the 1955 overall raw scores had departed markedly from the ideal distribution values. Table 2 shows that the 1955 raw score (for combined groups) median was 102.9 and the standard deviation was 13.9 in contrast to the expected values of 100 and 20, respectively. The lowered standard deviation reduces the degree of differentiatio: possible among officer OEI's. This can be seen in the 1955 distribution of overall raw scores shown in Figure 1. The scores are heavily concentrated around the middle of the distribution as in a leptokurtic curve instead of being spread out along the entire length of the OEI scale as in a normal curve.

Table 2

MEANS, MEDIANS AND STANDARD DEVIATIONS OF OVERALL RAW SCORE FOR 1955 FOR ALL OFFICERS (WARRANT AND COMMISSIONED) BY DUTY TIME AND COMPONENT BOTH SEPARATELY AND COMBINED
(N = 112,939)

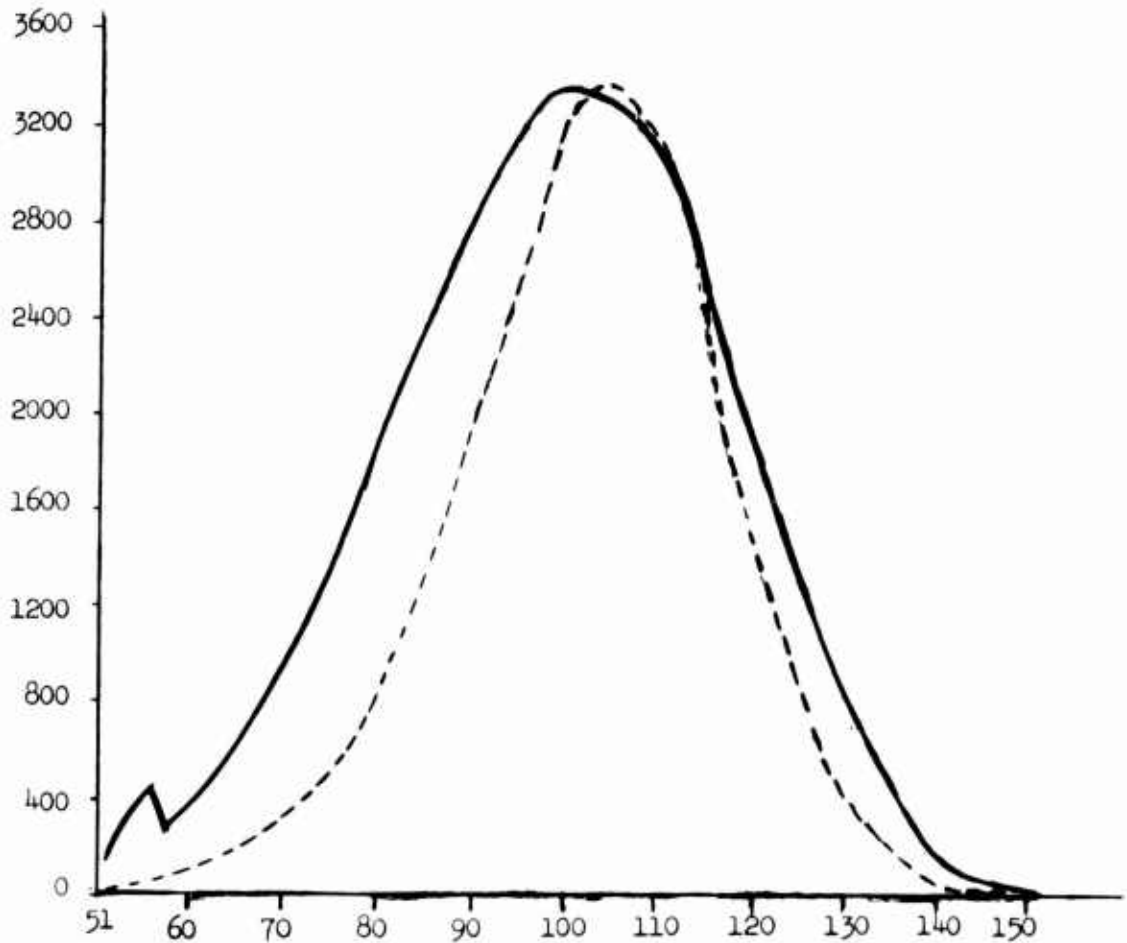| DUTY TIME	REGULAR ARMY				NON-REGULAR ARMY				RA AND NON-RA COMBINED			
	N	M	Mdn	SD'	N	M	Mdn	SD	N	M	Mdn	SD
12 or more months	26596	112.0	112.8	11.6	69888	100.8	101.4	12.0	96484	103.9	104.3	12.9
Less than 12 months	1213	102.3	102.7	14.5	15242	91.1	91.3	5.0	16455	91.9	92.3	15.2
Total	27809	111.5	112.5	11.9	85130	99.1	100.0	13.2	112939	102.2	102.9	13.9

Total Army
(N = 112,939)

Figure 1.   Approximate distribution of overall Raw Score and of Overall
Efficiency Index for 1955

(Adapted from Charts in PRRU Files)

2. As may be seen in Table 3, the standard deviation of the raw scores had gradually decreased from 1/.2 in 1951 to 13.9 in 1955--a definite downward trend which had to be adjusted.

3. The possibility of using the 1954 conversion table was considered because of the similarity of the 1954 and 1955 raw score distributions. However, because of the operational importance of OEI scores, it was decided to test, empirically, the difference in OEI's resulting from the two conversions (that is, comparing converted score equivalents for the same raw score using the 1954 conversion table versus a new conversion table based on the 1955 raw score distribution statistics). Table 4 indicates that the maximum difference in an officer's OEI would have been 2 points if the 1955 conversion table had been used. On the basis of these results, it would not have been necessary to prepare a new conversion table. However, it seemed advisable to use the new 1955 conversion table, even though the obtained differences were small. By converting each year, the amount of change in the official OEI's is small; whereas, if a new conversion is not used each year, the amount of change resulting from conversion will be considerable after a three or four year lapse. As an illustration, the maximum difference between 1954 (first year scores were converted) and 1953 OEI scores was 12 points compared to a maximum difference of 2 points between 1955 and 1954 OEI scores.

B. METHOD OF CONVERTING SCORES

Using the conventional transformation formula, the overall raw score distribution (Columns 1 and 2 of Table 5) was directly converted to a new set of scores having a median of 100 and a standard deviation of 20. The effect of this linear conversion (Column 3) was to extend the range of scores to 25.5 and 167.7.

In order to transform these standard scores into OEI scores, the range of the new distribution had to be restricted to 51 and 150. Therefore, it was necessary to compress the upper extreme by 17.7 points (167.7 - 150.0) and the lower extreme by 25.5 points (51.0 - 25.5). This supplementary adjustment was accomplished by employing the same procedures as in the 1954 implementation (4). The only difference was that a larger adjustment had to be made. The smoothing process was applied to overall raw scores 51 to 82 and 122 to 150 as compared to scores of 51 to 78 and 128 to 150 in the preceding year. The new conversion, which produced the official OEI scores, and the corresponding frequencies are shown in Columns 4 and 5 of Table 5. The distribution of official OEI scores for 1955 is shown in Figure 1. The shape of the distribution approached the normal curve to a greater extent than did the overall raw score distribution. The hump at the lower extreme of the OEI curve was caused by the fitting of a large number of standard scores lying below 51 into the ASR range. No such distortion occurred at the top of the OEI scale, because there were not as many standard scores lying above 150 and the missing standard score intervals at the higher end of the scale were able to absorb the scores which were compressed toward the center of the distribution.

Table 3

COMPARISON OF OVERALL RAW SCORE STATISTICS AND CONVERTED OEI (Official) STATISTICS BY YEAR

	1951		1952		1953		1954		1955	
	Raw	Official	Raw	Official	Raw	Official	Raw	Official	Raw	Official
Number	96273		127588		126437		111027	11027	112939	112939
Mean	100.8		100.0		101.4		102.5	99.1	102.2	99.1
Median	101.8	Same	101.1	Same	102.4	Same	103.3	100.2	102.9	99.9
Standard Deviation	17.2		17.1		16.1		14.8	19.1	13.9	18.9

Table 4

COMPARISON OF 1954 AND 1955 OEI SCORES

1954 OEI	1955 OEI	Lower By	Higher By	1954 OEI	1955 OEI	Lower By	Higher By
150	150			100	100		
149	149			98	99		1
149	148	1		97	97		
148	148			96	96		
148	147	1		94	94		
147	147			93	93		
147	146	1		91	92		1
146	146			90	90		
146	145	1		89	89		
145	145			87	87		
144	144			86	86		
143	143			85	84	1	
142	142			83	83		
141	141			82	82		
140	140			81	80	1	
139	139			79	79		
138	138			78	77	1	
137	137			77	76	1	
136	136			75	74	1	
135	135			74	73	1	
134	134			72	71	1	
133	133			71	70	1	
132	132			70	69	1	
131	131			68	68		
129	130		1	67	67		
128	129		1	66	66		
127	128		1	65	65		
125	127		2	64	64		
124	126		2	63	63		
123	125		2	62	62		
121	123		2	61	61		
120	122		2	60	60		
119	120		1	59	59		
117	119		2	58	58		
116	117		1	57	57		
115	116		1	56	56		
113	115		2	55	56		1
112	113		1	55	55		
110	112		2	54	55		1
109	110		1	54	54		
108	109		1	53	54		1
106	107		1	53	53		
105	106		1	52	53		1
104	105		1	52	52		
102	103		1	51	52		1
101	102		1	51	51		

NOTE: More than one raw score can give the same official OEI score. For example, an OEI of 148 in 1954 could be obtained by having either of two raw scores. This particular example is also true for 1955. However, it may be noticed that one of

1954 OEI	1955 OEI	Compared with 1954, the 1955 OEI is		1954 OEI	1955 OEI	Compared with 1954, the 1955 OEI is	
		Lower By	Higher By			Lower By	Higher By
150	150			100	100		
149	149			98	99		1
149	148	1		97	97		
148	148			96	96		
148	147	1		94	94		
147	147			93	93		
147	146	1		91	92		1
146	146			90	90		
146	145	1		89	89		
145	145			87	87		
144	144			86	86		
143	143			85	84	1	
142	142			83	83		
141	141			82	82		
140	140			81	80	1	
139	139			79	79		
138	138			78	77	1	
137	137			77	76	1	
136	136			75	74	1	
135	135			74	73	1	
134	134			72	71	1	
133	133			71	70	1	
132	132			70	69	1	
131	131			68	68		
129	130		1	67	67		
128	129		1	66	66		
127	128		1	65	65		
125	127		2	64	64		
124	126		2	63	63		
123	125		2	62	62		
121	123		2	61	61		
120	122		2	60	60		
119	120		1	59	59		
117	119		2	58	58		
116	117		1	57	57		
115	116		1	56	56		
113	115		2	55	56		1
112	113		1	55	55		
110	112		2	54	55		1
109	110		1	54	54		
108	109		1	53	54		1
106	107		1	53	53		
105	106		1	52	53		1
104	105		1	52	52		
102	103		1	51	52		1
101	102		1	51	51		

NOTE: More than one raw score can give the same official OEI score. For example, an OEI of 148 in 1954 could be obtained by having either of two raw scores. This particular example is also true for 1955. However, it may be noticed that one of the raw scores which yielded an OEI of 148 in 1954 still yields 148 while the lower raw score this year gives a 1955 OEI of 147.

Table 5

CONVERSION TABLE OF OEI-55 SCORES
N = 112,939

OVERALL RAW SCORE	f	STANDARD SCORE	OFFICIAL OEI	NEW f	CUMULATIVE PERCENTAGES
(1)	(2)	(3)	(4)	(5)	(6)
150	12	167.7	150	12	100.0
149	1	166.3	149)	4	99.9
148	3	164.8	149)		99.9
147	5	163.4	148)	11	99.9
146	6	162.0	148)		99.9
145	13	160.5	147)	27	99.9
144	14	159.1	147)		99.9
143	12	157.6	146)	30	99.9
142	18	156.2	146)		99.9
141	26	154.8	145)	53	99.9
140	27	153.3	145)		99.9
139	50	151.9	144	50	99.9
138	54	150.5	143	54	99.8
137	81	149.0	142	81	99.8
136	98	147.6	141	98	99.7
135	111	146.2	140	111	99.6
134	155	144.7	139	155	99.5
133	188	143.3	138	188	99.4
132	240	141.8	137	240	99.2
131	319	140.4	136	319	99.0
130	340	139.0	135	340	98.7
129	447	137.5	134	447	98.4
128	542	136.1	133	542	98.0
127	697	134.7	132	697	97.6
126	743	133.2	131	743	96.9
125	859	131.8	130	859	96.3
124	938	130.4	129	938	95.5
123	1101	128.9	128	1101	94.7
122	1223	127.5	127	1223	93.7
121	1435	126.0	126	1435	92.6
120	1477	124.6	125	1477	91.4
119	1661	123.2	123	1661	90.0
118	1794	121.7	122	1794	88.6
117	1972	120.3	120	1972	87.0
116	2151	118.9	119	2151	85.2
115	2248	117.4	117	2248	83.3
114	2480	116.0	116	2480	81.4
113	2633	114.6	115	2633	79.2

Table 5 - Conversion Table of OEI-55 Scores (continued)

OVERALL RAW SCORE	f	STANDARD SCORE	OFFICIAL OEI	NEW f	CUMULATIVE PERCENTAGES
(1)	(2)	(3)	(4)	(5)	(6)
112	2701	113.1	113	2701	76.8
111	2979	111.7	112	2979	74.4
110	3127	110.2	110	3127	71.8
109	3147	108.8	109	3147	69.0
108	3160	107.4	107	3160	66.2
107	3180	106.0	106	3180	63.4
106	3189	104.5	105	3189	60.6
105	3383	103.1	103	3383	57.8
104	3239	101.6	102	3239	54.8
103	3395	100.2	100	3395	51.9
102	3289	98.8	99	3289	48.9
101	3218	97.3	97	3218	46.0
100	3192	95.9	96	3192	43.2
099	3031	94.5	94	3031	40.4
098	3135	93.0	93	3135	37.7
097	2893	91.6	92	2893	34.9
096	2844	90.2	90	2844	32.3
095	2663	88.7	89	2663	29.8
094	2445	87.3	87	2445	27.4
093	2344	85.8	86	2344	25.3
092	2153	84.4	84	2153	23.2
091	2149	83.0	83	2149	21.3
090	1990	81.5	82	1990	19.4
089	1872	80.1	80	1872	17.6
088	1711	78.7	79	1711	16.0
087	1574	77.2	77	1574	14.5
086	1581	75.8	76	1581	13.1
085	1312	74.4	74	1312	11.7
084	1202	72.9	73	1202	10.5
083	1079	71.5	71	1079	09.4
082	984	70.0	70	984	08.5
081	960	68.6	69	960	07.6
080	785	67.2	68	785	06.8
079	722	65.7	67	722	06.1
078	641	64.3	66	641	05.4
077	618	62.9	65	618	04.9
076	549	61.4	64	549	04.3
075	532	60.0	63	532	03.8
074	457	58.6	62	457	03.4
073	457	57.1	61	457	03.0
072	347	55.7	60	347	02.6

Table 5 - Conversion Table of OEI-55 Scores (Continued)

OVERALL RAW SCORE	f	STANDARD SCORE	OFFICIAL OEI	NEW f	CUMULATIVE PERCENTAGES
(1)	(2)	(3)	(4)	(5)	(6)
071	328	54.2	59		02.2
070	287	52.8	58		02.0
069	239	51.4	57		01.7
068	208	49.9	56)	419	01.5
067	211	48.5	56)		01.3
066	184	47.1	55)	352	01.1
065	168	45.6	55)		01.0
064	165	44.2	54)	310	00.8
063	145	42.8	54)		00.7
062	119	41.3	53)		00.5
061	85	39.9	53)	287	00.4
060	83	38.4	53)		00.4
059	72	37.0	52)		00.3
058	52	35.6	52)	174	00.2
057	47	34.2	52)		00.2
056	28	32.7	51)		00.1
055	34	31.3	51)	140	00.1
054	22	29.8	51)		00.1
053	19	28.4	51)		00.0
052	20	27.0	51)		00.0
051	17	25.5	51)		00.0

C. DIFFERENCES IN OVERALL RAW SCORES BY COMPONENT AND BY DUTY MONTHS

Table 2 shows the distribution statistics of overall raw scores for 1955 by component and by number of duty months. The Regular Army officers had a median OEI score which was 12.5 units higher than that of the non-Regular Army officers. Also, the median score of those officers with overall scores based on 12 or more duty months was 12.0 units higher than the median score of officers with overall raw scores based on fewer duty months.

V. DISCUSSION

1. The OEI system has been in operation since May of 1951. During this period, users of the OEI have been led to believe that the distribution of OEI scores has a median of 100 and that 68% of the scores fall between 80 and 120, 16% above 120, and the remaining 16% below 80. In practice, this ideal goal has never been attained. For example, in the 1955 distribution of overall raw scores prior to conversion approximately 85% of the scores were between 80 and 120, 9% above 120, and 6% below 80. After conversion, 71% of the scores were between 80 and 120, 13% above 120, and 16% below 80. The effect of the conversion thus permits a relatively constant interpretation of the OEI numerical system.

2. In this study it was found that the OEI score of any officer would not have differed by more than 2 points if the 1954 conversion table had been used. Because of the large overlap of OEI scores from one year to the next, it is probable that conversions for two consecutive years would yield similar results. This would tend to suggest that a conversion of scores is not an annual requirement, because of the relative stability of the ratings and the samples, and that it may well be appropriate to apply a particular conversion table for a period of two or three years, or until such a time as a radical change occurs in the composition of the Army. However, the more years that pass before a new conversion is made increases the amount of change in scores due to conversion when the new conversion table is implemented.

3. This study, as well as previous implementation studies, has shown a difference almost as large as one standard deviation between the Regular Army and the non-Regular Army median scores and between the scores of officers whose OEI's are based on 12 or more months of duty time as opposed to those with less than 12 months of duty time. One would expect the Regular Army to have higher average OEI scores if selection devices for RA integration are functioning properly. However, this difference may be a result of component bias unrelated to 'true' efficiency.

4. Officers whose OEI's are based on more duty months are frequently the higher ranking officers who in turn tend to receive the higher ratings. Also, it should be remembered that included in the standardization group were officers whose overall raw score covered less than 12 months of duty time, even though an officer does not receive an <u>official</u> OEI unless he has 12 or more duty months. If the scores of officers with too little duty time to receive an official OEI were excluded from the distribution on which standardization was based, the rising median score and shrinking standard deviation would be even more pronounced. If unofficial scores were excluded from the standardization group, those officers with sufficient time to permit an <u>official</u> OEI would suddenly experience a severe drop in their OEI ratings.

PERSONNEL

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