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APPENDIX E

RECONCILIATION OF 1940 AND 1950 CENSUS COUNTS OF ENGINEERS

THERE has been considerable disagreement about the accuracy of the 1950 census total count of 534,000 technical engineers. This figure is substantially higher than was anticipated for 1950 by investigators in the late 1940's and, indeed, is still considered too high by some.¹ Fraser, writing in 1947 on the basis of data from a 1946 survey, estimated that there were 317,000 members of the engineering profession in 1946 and forecast that this number would rise to 337,000 by 1950.² The Bureau of Labor Statistics in 1949 estimated that the number of engineers in 1948 was about 350,000.³ And in 1951 it estimated the number in 1950 at "over 400,000."⁴

This question, of course, is partly a matter of determining the boundary between engineers and nonengineers. For the objection to the 1950 census count is usually on the grounds that many persons who were not engineers so classified themselves in the 1950 census.

Wolfe, in discussing this issue, states: "It is quite possible that a considerable fraction of the 543,000⁵ [engineers] included in the 1950 Census were not engineers by anybody's definition but their own. The Bureau of the Census did, however, make special efforts to limit the engineering category to persons who were clearly qualified. Another probable explanation lies in the assumption that the high demand during the past decade led to the promotion of a considerable number of subprofessional engineering aides. On-the-job training, upgrading of employees, and even sometimes changing job titles could all have had the effect of increasing the number

¹ See Dael Wolfe, *America's Resources of Specialized Talent*, Harper, 1954, pp. 95-96.

² Andrew Fraser, *The Engineering Profession in Transition*, Engineers Joint Council, 1947, p. 59.

³ *Employment Outlook for Engineers*, Bureau of Labor Statistics, Bull. 968, 1949, p. 98.

⁴ *Effect of Defense Program on Employment Outlook in Engineering*, Bureau of Labor Statistics, Supplement to Bull. 968, 1951, p. 2.

⁵ The 534,400 engineers, indicated as such in the 1950 census, plus about 8,300 professors and instructors in engineering who were not so classified in the published census materials (see Table 1).

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of people who had legitimate reasons to call themselves engineers in reporting to census enumerators.”⁶

But it is not our goal here to determine whether a narrower definition of the engineering profession than that used by the Census Bureau would yield lower totals; of course it would. Nor is it our goal to produce a new and supposedly more desirable definition. Rather, our purpose is to determine whether the 1950 census data are comparable in scope to the 1940 census data and thus can be used in conjunction with the 1940 (and earlier) data to describe the growth of the engineering profession, for none of those who have questioned the 1950 count have raised objections against earlier census data.

In Table E-1 we derive an estimate of the gross flow of persons into the engineering profession. The difference between the 1940 and 1950 census counts (the former adjusted for comparability) is the net increase in the profession, to which we add estimates of losses during the decade to obtain an estimate of the gross increase in engineers of 320,000. The bulk of the components of this gross inflow can be directly estimated: 179,000 new engineering graduates, 18,000 new nonengineering graduates and 20,000 former engineers⁷ returning to the profession. This leaves a residual of 103,000 other persons, primarily nongraduates, who entered the profession during the decade.

Some of these estimates are, of course, very crude and the actual figures may be somewhat higher or lower. Thus, it is entirely possible that fewer than 20,000 former engineers returned to the profession and it is equally possible that more than 18,000 new nonengineering graduates entered the profession during the decade. But the estimates probably represent correct orders of magnitude and provide reasonably adequate basis for judging the validity of the 1950 census results.

The test of this validity, then, essentially centers on whether the magnitude of the residual category seems reasonable. This category consists primarily of persons who were not college graduates but who entered the engineering profession during the 1940-1950 decade. It also may include some older nonengineering graduates who entered the profession during the decade and some members

⁶ Wolfe, *op. cit.*, p. 95. Wolfe chose to accept the 1950 census count.

⁷ Who were in public emergency work or seeking work in 1940 (and classified themselves as engineers at that time) or for whom engineering was their usual but not current occupation in 1940.

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TABLE E-1

Reconciliation of 1940 and 1950 Census Data on Engineers

1. Engineers employed in 1950		525,000
2. Engineers employed in 1940 (1940 census data)	245,000	
3. Reclassification in 1950 of 1940 census data to make latter comparable with 1950 census data	<u>30,000</u>	
4. Engineers employed in 1940		<u>275,000</u>
5. Net increase, 1940-1950		<u>250,000</u>
6. Estimated deaths and retirements, 1940-1950, of engineers under 55 in 1940	28,000	
7. Engineers 55 or over in 1940, assumed to have died or retired by 1950, less engineers over 65, employed in 1950	17,000	
8. Estimated transfers out of profession, 1940-1950	<u>25,000</u>	
9. Losses to profession, 1940-1950		<u>70,000</u>
10. Gross increase in engineering profession, 1940-1950		<u>320,000</u>
11. New engineering graduates, 1940-1949, less those who never entered the profession	179,000	
12. Other new college graduates who entered the profession, 1940-1950	18,000	
13. Reentry during decade of engineers who, in 1940, were in public emergency work or seeking work, or for whom engineering was their usual but not current occupation in 1940	<u>20,000</u>	
14. Accessions of graduates and reaccessions of experienced engineers		<u>217,000</u>
15. Accessions of nongraduates and of older nonengineering graduates		<u>103,000</u>

Line	Source
1, 2	Table B-1, Appendix B.
3	Letter from David I. Kaplan, Chief, Occupation and Industry Statistics Section, Population and Housing Division, Bureau of the Census, December 30, 1954.
4	Line 2 plus row 3.
5	Line 1 minus row 4.
6	Deaths and retirements estimated on basis of 1940 age distribution and tables of working life.
7	1940 and 1950 census data.
8	Rough estimate based on transfer rates in Chapter 3 and average size of profession during 1940-1950 decade.
9	Sum of lines 6, 7, and 8.
10	Line 5 plus line 9.
11	Appendix Table C-6, col. 2, less 7 per cent (see Chap. III for derivation of loss estimate).
12	Rough estimate based on accession rates for new nonengineering graduates, described in Chapter IV.
13	It is assumed that 20,000 out of the 23,000 engineers in public emergency work or seeking work in 1940 or for whom engineering was their usual but not current occupation in 1940, reentered the profession after 1940.
14	Sum of lines 11, 12 and 13.
15	Line 10 minus line 14.

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of the very large engineering graduating class of 1950 who may have already begun engineering work by April 1, 1950 (the date the census was taken).

The Bureau of Labor Statistics has estimated that at least 26,000 persons (largely nongraduates) between the age of 35 and 60 entered the engineering profession during the depression decade of the thirties, a period during which "many engineers lost their jobs and had to seek other employment, and when many graduates were unable to find engineering jobs."⁸ To these must be added the 20,500 engineers under 35 years of age (in 1940) with less than four years of college training, who were excluded from the engineering category by the 1940 census definitions. Presumably nearly all of these entered the profession during the thirties.

BLS also has estimated that a minimum of 35,000 nongraduates entered the profession during the twenties; however, this estimate, it is pointed out, makes no allowance for losses to the profession other than through death and retirement.⁹ If transfers out of the profession and losses of new graduates occurred at the same rate during that decade as they have in more recent years, they amounted to about 17,000 over the ten years. Thus at least 50,000 nongraduates probably entered engineering work during the twenties.

Conditions were more favorable to the entry of nongraduates during the forties than during the twenties, and substantially more favorable than during the thirties. Not only was the demand for engineers at extremely high levels during and shortly after the war, but also at least 60,000 engineers were inducted into the armed forces. "Steps were taken to secure the services of men who had dropped out of school before completing the engineering course, persons holding degrees in related fields, and experienced semi-professional technical personnel who could be upgraded with intensive training. Many were prepared for some phase of engineering work in connection with war production by the Engineering, Science and Management War Training Program . . . , which gave instruction at college level, but by shorter and more intensive courses. . . . Information gathered from employers in 1946 indicates that considerable numbers of men holding engineering jobs were upgraded during the war from semiprofessional positions. Also, for appointments to some Federal Government positions, completion of ESMWT courses was accepted for at least partial satisfaction of the requirements."¹⁰

⁸ *Employment Outlook for Engineers*, p. 41.

⁹ *Loc. cit.*

¹⁰ *Ibid.*, pp. 41-42.

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Others were given technical training while in the armed forces. And still others participated after the war in engineering training programs conducted by large corporations.

In view of the numbers of nongraduates entering the profession during the twenties and thirties, and the extremely favorable conditions during the forties, an inflow of nongraduates between 1940 and 1950 of the order of magnitude of 100,000 seems quite reasonable, and surely exceeded 50,000 (the number entering in the twenties).¹¹ In other words, there is no clear evidence that the 1950 census substantially overstated the number of engineers (measured by historic census definitions); but if it did, the overstatement was less than 50,000.¹²

¹¹The ratio of nongraduate accessions to new engineering graduates was about two-thirds in the twenties and about four-tenths in the thirties. If the relative rate of accessions of nongraduates during the forties had been equal to that in the twenties, about 130,000 nongraduates would have entered the profession between 1940 and 1950; had it been equal to that in the thirties, about 75,000 would have entered between 1940 and 1950.

¹²The estimates in Table E-1 are not fully consistent with the 1940 census data on the number of graduate and nongraduate engineers and unpublished tabulations of 1950 census data on the education of engineers (see Appendix F). After making some rough adjustments for changes in definition and for incomplete coverage in the education data, as well as a crude estimate of losses among nongraduate engineers, one obtains an estimate of the inflow of nongraduates during the decade that is about 25,000 higher than indicated in Table E-1. But the data in Table E-1 agree quite closely with Wolfe's estimate of 316,000 graduates (and, therefore, 227,000 nongraduates) employed in engineering in 1950 (Wolfe, *op. cit.*, pp. 95-96).