

**THE DEMAND AND SUPPLY  
OF SCIENTIFIC, ENGINEERING AND TECHNICAL  
MANPOWER IN THE PHILIPPINES**

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The paper is mainly a report on the employment and supply of scientific, engineering and technical manpower in the Philippines.

A comparison of employment and the number of graduates turned out by colleges and universities in the country is made. The comparison points to an imbalance between supply and demand — the former far exceeding the latter despite technological developments and the emergence of numerous industries. Deficiencies in the quality of a big portion of this high level manpower seem to limit its absorption by industry.

1. "Demand", in this paper, refers to the number of scientists, engineers, and technical workers employed in the country. "Supply" refers to the number of graduates put out by the educational institutions from year to year. The self-employed scientists, engineers, and technical workers are not included in view of unavailable information. "Scientists and engineers" refers to those persons who have received "scientific or technical training in natural sciences, engineering, agriculture, medical sciences or social sciences (whether or not leading to a degree or diploma) of at least three years duration after completed education at the second level".[1] A "technician" is any person who has received "specialized vocational or technical training in any branch of knowledge or technology (whether or not leading to a degree or diploma), of either one

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or two years duration beyond completed education at the second level or three to four years' duration beyond the first cycle of secondary education". [1]

Data on employment are from four surveys of scientific and technical manpower conducted in 1965, 1966 and 1967 covering private industry, national government, educational institutions and local government.

2. As of 1967, the group of professional, technical and related workers constitutes only about 4.1 per cent of the employed labor force in the country. [2] To this group belong the scientists, engineers and technicians who total approximately 219,300. These constitute about 48.7 per cent of the estimated total number of professional, technical and related workers.

Private industry is the biggest employer of these high level manpower; about 79 per cent of the estimated total number of scientific, engineering and technical personnel are in private industry; the remaining 21 per cent are in the other three sectors of national activity: the national government (9.6%); educational institutions (7.3%), and local government (4.5%). (Table I). The employment of scientists, engineers and technicians in private industry, however, is small relative to the total employment. Of the estimated total of 3.045 millions in private establishments as of 1965, only about 5 per cent are in scientific, engineering and technical fields.

3. The scientific and engineering personnel comprise about 43 per cent of the estimated total number of scientific, engineering and technical personnel employed in the country. Of these, close to 66 per cent are in private industry; about 12 per cent are in the national government; 15 per cent are in educational institutional institutions; 7 per cent in local governments. The engineers lead the group of employed high level manpower, with them constituting about 56 per cent of the whole group. The mechanical (44.9%), electrical (20.7%), civil (13.2%), and chemical (13.1%) engineers, most of whom are in private industry, constitute about 92 per cent of the

group of engineers. There are very small proportions of geodetic (2.7%), agricultural (2.3%), electronic (1.7%), sanitary (1.5%) and marine (1.2%) engineers. Practically all of the electronic engineers are engaged in teaching in educational institutions; about two thirds of the employed agricultural engineers are in the national government helping in the "green revolution".

Percentage-wise, the groups of personnel engaged in the chemical, medical, social and agricultural fields of activity follow the group of engineers, with percentages relative to the whole group of scientists as respectively 10.3, 8.9, 6.3 and 6.2 per cents. The smallest groups are those in mathematics, earth sciences and physics. (Table I). Private industry got also the biggest chunks of those in chemistry (77.6%), physics (53.0%), medical sciences (48.4%), and mathematics (37.0%).

The principal employer of those in the agricultural and earth sciences is the national government. The various projects of the national government to accelerate food production in the country can account for the big bulk of agriculturists (60.7%) in the national government, while the oil and mine explorations of the Bureau of Mines may explain the big proportion of earth scientists.

The institutions of higher learning have the biggest share of the groups of those in the biological and social sciences. About 65 per cent of those in the biological sciences and 54.5 per cent of those in the social sciences are in colleges and universities. The educational institutions have also a big portion (33.1%) of those in mathematics.

In the local governments, the biggest groups of scientists are in the medical sciences (30.4%), in physics (18.9%), and in the biological sciences (17.8%). Those in the medical sciences are mostly in health centers; those in physics and biological sciences are engaged in teaching in secondary schools supported by the local governments.

4. The employed technicians constitute about 57 per cent of the total employed scientific, engineering and technical per-

sonnel. Like the group of scientists and engineers, the engineering technicians dominate the group, comprising about 56 per cent. Those in the physical sciences follow with 14.1 per cent; those in the agricultural and chemical sciences come next with about the same proportion (6.5%). The smallest groups are those in the biological sciences, social sciences and mathematics.

Of the about 72,000 technicians in the field of engineering, close to 95 per cent are in private industry. The national government and the educational institutions have each about 2 per cent. The local governments are poor employers of engineering technicians.

5. Relative to the estimated total employed scientific and technical personnel in the four sectors of national activity, the women constitute about 14 per cent. (Table 2). With respect to those engaged in scientific activities, the women accounted for more than 23 per cent. However, as a proportion of those doing technical jobs, they comprised only a small 7 per cent.

The proportion represented by women among those with main activity classified as scientific, varied considerably among the various fields, ranging from 18 per cent in the earth sciences to 70.0 per cent in the biological sciences. In four fields — biological, chemical, medical and social sciences — the women staffed more than 50 per cent. In mathematics, there was almost the same proportion of the women as the men. It was only in agricultural sciences, earth sciences and physics that the women staffed only about 20 per cent. Even in engineering which some years ago, was considered only as a man's field, the women contributed about 30 per cent.

Among the technicians, the proportion of women varied more in the various fields than that among those engaged in scientific activities. The proportions ranged from a little more than one per cent in engineering to about 80 per cent in the biological fields. In the fields of mathematics, and medicine, the women staffed more than 50 per cent. In chemistry, they comprised about one fourth; in the social sciences, about a third. It is only in mathematics (1.3%) earth sciences (2.7%), physics

(2.1%), and agriculture (7.1%), where the women constituted only a small proportion.

On the whole, the distribution of the proportions of women among the various fields of activity varied considerably from that of the men, as would be expected, ranging from 1.8% in engineering to 61.2% in the medical sciences. What swelled the women's proportion in the medical sciences is the predominance of women nurses, pharmacists and medical technologists.

6. Personnel engaged in the different scientific fields have educational attainments ranging from Bachelor's to the Ph.D. degrees, although to the biggest bulk (86.4%) belong those with Bachelor's degree. Among the holders of the Master's degree are those in the social sciences (25.3%), medical sciences (17.3%), agricultural sciences (17.9%), and the biological sciences (31.6%), the social sciences (21.0%), the medical sciences (15.3%), and chemistry (10.5%). The smallest groups of Ph.D. holders are in physics (1.0%) and the earth sciences (2.1%). [Table 3].

There are many with Bachelor's degrees (37.5%) among the technical workers. In fact, a few of them reported that they are working towards a Master's degree with the view that someday they would be rewarded with a promotion in pay, if not in rank, in their places of employment.

7. The scientific, engineering and technical manpower turned out by the colleges and universities and vocational schools, currently numbering 668, constitute only a portion of the annual crop of graduates. Private industry absorbs a big bulk of these graduates. In school year 1964-65, the graduates in scientific, engineering and technical fields comprised about 45 per cent but for 1965-66, these formed only about 34 per cent. However, considering the employment of this type of personnel in the four sectors of national activity, the supply, considering numbers alone, more than adequately met the demand in all fields except for those in the fields of mathematics, physics and engineering and chemical technicians. (Tables

4A, 4B, 4C). While the educational institutions seem to provide an adequate supply of practitioners in these fields yearly, there are indications of an unsatisfied demand for their services in private industry. There is a claim that there is need to improve the general quality of the trained manpower and to gear it to the needs of a developing economy. Perhaps this perplexing situation can be explained if the aggregate figures of graduates and employment in the four sectors presented in this paper are broken into finer areas of skills and specialization. For example, the hundreds of engineering graduates which flood the labor market each year do not seem to have the skills and "know-how" needed by industry.

Table 4C shows that the country is producing many in the medical, biological and agricultural sciences every year — much more than what the four sectors can absorb. Yet, in the medical field, a dearth of medical doctors is felt especially in the rural areas as these doctors tend to concentrate in big cities. The problem is compounded by the increasing number of graduates in the medical field who leave the country to seek work abroad. Statistics show that from 1960 to 1965, out of the total of 8,659 physicians and 10,927 nurses who hurdled successfully the Government Board Examination, about 30% (2,597) and 73% (7,997) physicians and nurses respectively had migrated to the United States. Also, statistics on emigration of Filipino workers to Canada from 1965 to 1968 show that the number of workers emigrating to this country have increased by 30%, that is, from 1,285 in 1965 to 2,094 in 1968. Of these about 77% are professionals and out of this more than half are medical doctors and nurses. [3]

The imbalance between supply and demand of the type of manpower considered in this paper point to the urgent need for educational planners to have a careful study of the labor markets for scientific, engineering and technical personnel in order to equate supply and demand.

## REFERENCES

- [1] *Statistical Reports and Studies*; World Summary of Statistics on Science and Technology UNESCO.
- [2] *The Bureau of Census and Statistics Survey of Households Bulletin, Labor Force*, October, 1967, Series No. 4.
- [3] *Journal of Philippine Statistics* (Bureau of Census and Statistics), Vol. 18, No. 2, April 10<sup>1</sup> - June, 1967.

TABLE 1. PER CENT DISTRIBUTION OF SCIENTIFIC, ENGINEERING AND TECHNICAL PERSONNEL BY FIELDS OF SPECIALIZATION IN MAIN ACTIVITY AND BY PLACE OF EMPLOYMENT (1967)

Field of Specialization	Total	Private# Industry	National Government#	Educational Institutions*	Local Government
Total	219,256 * (100.0)	(78.6)	(9.6)	(7.3)	(4.5)
Engineering	56.0 (100.0)	93.4	3.9	1.6	1.1
Mathematics	2.1 (100.0)	22.9	29.0	35.4	12.7
Agric'l Sciences	6.4 (100.0)	62.8	27.7	5.1	4.1
Biological Sc.	1.0 (100.0)	4.0	11.9	71.2	12.9
Medical Sciences	5.2 (100.0)	40.6	13.8	21.4	24.2
Earth Science	2.2 (100.0)	35.5	56.3	4.2	4.0
Physics Science	9.0 (100.0)	82.8	9.7	3.3	4.2
Chemistry Sc.	8.0 (100.0)	87.5	3.5	6.4	2.6
Social Sciences	3.1 (100.0)	3.8	25.8	54.9	15.5
Other Sc. Fields	7.0 (100.0)	81.5	10.3	3.7	4.5
A. Scientists and Engineers					
Sub-total	94,302 * (100.0) (43.0)	(65.8)	(12.3)	(15.3)	(6.6)
Engineering	55.7 (100.0)	82.4	5.3	10.8	1.5
Mathematics	3.8 (100.0)	37.0	23.5	33.1	6.4
Agric'l Sciences	6.2 (100.0)	19.5	60.7	12.4	7.4
Biological Sc.	1.9 (100.0)	5.3	11.5	65.4	17.8
Medical Sciences	8.9 (100.0)	48.4	16.8	4.4	30.4
Earth Sciences	1.0 (100.0)	31.8	47.5	16.4	4.3
Physics	1.4 (100.0)	53.0	3.3	24.8	18.9
Chemistry	10.3 (100.0)	77.6	3.8	16.3	2.3
Social Sciences	6.3 (100.0)	3.4	28.6	54.5	13.5
Other Sc. Fields	4.5 (100.0)	82.8	6.3	—	12.9
B. Technicians					
Sub-total	124,954 * (100.0)	(87.5)	(7.5)	(2.4)	(2.6)
Engineering	26.2 (100.0)	95.2	2.4	1.8	0.6
Mathematics	1.0 (100.0)	1.1	50.8	20.7	27.4
Agric'l Sciences	6.6 (100.0)	88.5	8.4	0.5	2.7
Biological Sc.	0.4 (100.0)	—	20.1	79.9	—
Medical Sciences	2.7 (100.0)	52.1	16.7	5.1	26.1
Earth Sciences	3.0 (100.0)	36.9	59.4	—	3.7
Physics	14.1 (100.0)	86.9	9.8	—	3.3
Chemistry	6.5 (100.0)	92.7	2.6	2.3	2.4
Social Sciences	1.0 (100.0)	7.8	29.1	31.0	32.1
Other Sc. Fields	8.5 (100.0)	85.0	11.5	2.6	0.9

\* — These are absolute totals.

# — Figures were estimated from survey data for 3-6 months periods preceding the survey periods. A linear model  $y = a + \beta x$  was used.



TABLE 2. PER CENT DISTRIBUTION OF WOMEN SCIENTIFIC, ENGINEERING AND TECHNICAL PERSONNEL BY FIELD OF SPECIALIZATION (1967)

FIELD OF SPECIALIZATION	T o t a l		Scientists		Technicians	
	Both Sexes	Female	Both Sexes	Female	Both Sexes	Female
T o t a l	219,256*(100.0)	14.0	94,302*(100.0)	23.3	124,954*(100.0)	7.0
Engineering	56.0 (100.0)	1.8	55.7 (100.0)	30.0	56.2 (100.0)	1.3
Mathematics	2.1 (100.0)	50.1	3.8 (100.0)	48.6	1.0 (100.0)	55.1
Agricultural Sciences	6.4 (100.0)	12.5	6.2 (100.0)	20.2	6.6 (100.0)	7.1
Biological Sciences	1.0 (100.0)	71.4	1.9 (100.0)	70.0	0.4 (100.0)	79.7
Medical Sciences	5.2 (100.0)	61.2	8.9 (100.0)	58.0	2.7 (100.0)	67.7
Earth Sciences	2.2 (100.0)	6.0	1.0 (100.0)	18.2	3.0 (100.0)	2.7
Physics	9.0 (100.0)	3.3	1.4 (100.0)	19.9	14.1 (100.0)	2.1
Chemistry	8.0 (100.0)	45.1	10.3 (100.0)	60.2	6.5 (100.0)	25.4
Social Sciences	3.1 (100.0)	52.1	6.3 (100.0)	55.4	1.0 (100.0)	34.4
Other Science Fields	7.0 (100.0)	17.9	4.5 (100.0)	41.7	8.5 (100.0)	7.7

\* — These are numbers of personnel.

TABLE 3. PER CENT DISTRIBUTION OF SCIENTIFIC AND  
ENGINEERING PERSONNEL BY FIELD OF SPECIALIZATION  
AND BY EDUCATIONAL ATTAINMENT

FIELD OF SPECIALIZATION	Total	Bachelors's Degree	Master s Degree	Medical Doctor's Degree	Ph.D. Degree
T o t a l	94,302*	(86.4)	(4.9)	(7.0)	(1.7)
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Engineering	49.5	56.9	9.0	—	5.3
Mathematics	2.2	1.9	9.8	—	5.8
Agricultural Sciences	9.9	10.4	17.9	—	5.3
Biological Sciences	3.4	2.7	10.9	—	31.6
Medical Sciences	17.7	10.7	17.3	100.0	15.3
Earth Sciences	0.7	0.8	—	—	2.1
Physics	0.9	1.0	1.9	—	1.0
Chemistry	8.5	9.4	6.6	—	10.5
Social Sciences	5.6	4.8	25.3	—	21.0
Other Science Fields	1.6	1.4	1.3	—	2.0

\* — This number of personnel.

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TABLE 4-A. PER CENT CHANGE OF EMPLOYMENT OF SCIENTISTS, ENGINEERS AND TECHNICAL WORKERS IN THE FOUR SECTORS OF NATIONAL ACTIVITY (1964 - 1967)

SECTOR OF NATIONAL ACTIVITY	Estimated Total (1964)	% Change Over Preceding Year		
		1965	1966	1967
T o t a l	201,956	1.7	3.1	3.5
1. Private Industry	<u>166,710</u>	-1.3	1.9	2.3
Scientists and Engineers	61,167	-0.6	0.8	1.3
Technicians	105,543	-1.6	2.5	1.3
2. National Government	<u>19,852</u>	6.4	-0.1	0.1
Scientists and Engineers	11,187	4.1	-0.5	0.3
Technicians	8,665	9.4	0.3	-0.1
3. Educational Institutions	<u>8,799</u>	30.8	23.5	19.1
Scientists and Engineers	6,761	37.8	27.4	21.5
Technicians	2,038	7.5	7.0	6.6
4. Local Government	<u>9,144</u>	0.5	0.8	3.3
Scientists and Engineers	6,077	0.4	0.7	1.8
Technicians	3,137	0.8	1.2	6.2

TABLE 4-B. PER CENT CHANGE OF EMPLOYMENT OF SCIENTISTS, ENGINEERS AND TECHNICIANS, BY FIELD OF SPECIALIZATION (1964 - 1967)

SECTOR OF NATIONAL ACTIVITY	Estimated Total (1964)	% Change Over Preceding Year		
		1965	1966	1967
A. Scientists & Engineers	<u>84,255</u>	4.5	3.3	3.7
Engineering	50,544	0.8	1.5	1.5
Mathematics	2,845	13.9	11.9	10.5
Agricultural Sciences	5,458	17.8	-6.6	-2.6
Biological Sciences	739	47.6	32.1	24.2
Medical Sciences	6,770	8.7	6.8	6.7
Earth Sciences	746	11.1	6.9	6.4
Physics	1,171	4.3	4.1	3.8
Chemistry	7,609	6.7	9.8	8.9
Social Sciences	4,809	3.7	6.8	6.4
Other Science Fields	3,864	1.6	2.1	5.8
B. Technicians	<u>120,059</u>	-0.8	2.4	2.4
Engineering	59,597	-2.7	1.9	2.4
Mathematics	937	4.8	6.7	4.6
Agricultural Sciences	8,470	-5.9	3.0	3.2
Biological Sciences	284	2.8	3.1	2.6
Medical Sciences	4,018	0.7	0.7	3.4
Earth Sciences	3,450	2.8	6.1	-5.5
Physics	17,868	0.5	0.8	0.8
Chemistry	6,003	7.3	7.8	7.1
Social Sciences	734	18.4	14.8	12.9
Other Science Fields	<u>8,698</u>	9.3	1.9	2.7

\* — Standard errors are in Table 5.

TABLE 4-C. RATIO OF GRADUATES IN SCIENTIFIC, ENGINEERING AND TECHNICAL FIELDS TO EMPLOYED SCIENTISTS, ENGINEERS AND TECHNICAL WORKERS BY FIELD OF SPECIALIZATION (1964 - 1967)

FIELD OF SPECIALIZATION	1964		1965		1966		1967	
	Scien- tists##	Tech- nicians##	Scien- tists	Tech- nicians	Scien- tists	Tech- nicians	Scien- tists	Tech- nicians**
T o t a l	10.4	3.6	19.3	9.2	15.7	11.8	17.8	9.1
Engineering	3.0	1.9	8.7	2.4	9.6	2.6	9.8	0.1
Mathematics	( )	( )	0.3	( )	0.6	0.7	0.4	( )
Agricultural Sciences	63.0	2.2	28.1	2.0	20.5	1.4	17.7	0.3
Biological Sciences	2.7	( )	68.0	( )	29.5	( )	29.3	( )
Medical Sciences	3.0	( )	68.5	( )	32.5	( )	88.5	( )
Earth Sciences	2.5	( )	2.8	9.0	2.0	5.3	1.3	0.5
Physics	( )	( )	0.5	( )	0.1	( )	1.1	0.5
Chemistry	1.1	( )	10.0	0.5	6.3	0.4	6.7	0.8
Social Sciences	67.9	( )	72.3	( )	4.8	( )	6.8	( )
Other Science Fields	7.0	32.2	9.3	93.3	7.5	125.7	37.1	104.4

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NOTE: The symbol ( ) means that there were no graduates for the preceding year in these fields.  
 ##—The numerators do not include graduates from private colleges and universities in 1963, as these were not available.  
 \*\*—The numerators do not include graduates from vocational schools for 1966.

TABLE 5. STANDARD ERRORS\* OF ESTIMATES OF TOTAL

FIELD OF SPECIALIZATION	Y E A R			
	1964	1965	1966	1967
<b>A. Scientists and Engineers</b>				
Engineering	17.0	16.6	16.3	15.9
Mathematics	6.3	6.4	6.5	6.6
Agricultural Sciences	8.2	8.3	7.8	7.4
Biological Sciences	3.9	4.6	16.1	5.5
Medical Sciences	11.4	11.3	11.1	11.0
Earth Sciences	3.3	3.2	3.3	3.3
Physics	4.1	4.0	3.9	3.9
Chemistry	9.8	9.7	9.7	9.6
Social Sciences	2.6	8.2	8.2	8.1
Other Scientific Fields	7.7	7.3	7.1	7.1
<b>B. Technicians</b>				
Engineering	13.8	13.8	13.7	13.5
Mathematics	8.7	2.6	2.8	2.6
Agricultural Sciences	7.0	6.9	6.8	6.7
Biological Sciences	1.7	5.6	1.7	1.7
Medical Sciences	5.6	5.8	5.5	5.4
Earth Sciences	4.6	4.6	4.7	4.7
Physics	9.4	9.6	9.4	9.3
Chemistry	6.4	9.6	9.4	9.3
Social Sciences	2.4	2.8	30.0	31.7
Other Scientific Fields	7.5	7.9	7.8	7.6

NOTE: \* — Given as percentage of estimate.