

Nature of Work and Employment Profiles of Graduate and Postgraduate Alumni of the Indian Institute of Technology, Bombay

S. P. SUKHATME

Mechanical Engineering Department, Indian Institute of Technology, Bombay, Powai, Bombay 400 076, India

The results of two studies conducted with the objective of obtaining career profiles of graduate and postgraduate alumni of the Indian Institute of Technology, Bombay are presented here. The results were obtained by analysing the replies of the alumni to a questionnaire. Data regarding current professional status, sector of work, annual income, present nature of work, etc., are tabulated and analysed. The data show that most of the alumni settle down in India and that they are contributing significantly in a professional sense to the development of the country. The significance of these findings lies in the fact that they are likely to be valid in large measure to all five IITs.

INTRODUCTION

Educational programmes at IIT Bombay

THE FIVE Indian Institutes of Technology were set up soon after independence with the objective of providing highly qualified scientific and technical manpower to meet the country's industrial needs. It was envisaged that they would lay more or less equal emphasis on undergraduate and postgraduate education, and that the students passing out would eventually play an important role in research and development establishments and in industry.

In keeping with these objectives, the present student population of approximately 2500 at IIT Bombay consists of an equal number of undergraduate and postgraduate students. The degree/diploma output of the Institute in a typical year, namely 1987, is shown in Table 1.

It will be seen that the annual output is about 700. Of this, on average, about 250 students obtain their B.Tech. degrees every year in eight disciplines: aeronautical engineering, chemical engineering, civil engineering, computer science and engineering, electrical engineering, engineering physics, mechanical engineering and metallurgical engineering.

On average, 250-300 students obtain their M.Tech. degrees each year from a number of engineering departments and also in a number of interdisciplinary areas. These are as follows.

1. aeronautical engineering;
2. chemical engineering;
3. civil engineering;
4. computer science and engineering;
5. electrical engineering;
6. mechanical engineering;

Table 1.

Degree/Diploma	No. obtaining degree/diploma
B.Tech.	243
M.Sc.	80
D.I.I.T.	6
M.Tech.	290
M.Des.	41
Ph.D.	67
Total	727

7. metallurgical engineering;
8. interdisciplinary areas:
 - industrial engineering and operations research;
 - environmental science and engineering;
 - materials science;
 - energy systems engineering;
 - systems and control engineering;
 - corrosion science and engineering;
 - industrial management;
 - reliability engineering.

Ph.D. programmes are also offered in all the above-mentioned departments and interdisciplinary areas. In addition, Ph.D. programmes are also offered in the science departments (physics, chemistry, mathematics, and earth sciences) and in the humanities and social sciences department. In all, about 60-70 students obtain their Ph.D. degrees each year.

It is worth noting that the engineering component of the M.Tech. and Ph.D. output of the IITs forms a significant part of the national output. Data on M.Tech./ME degrees for all institutions in the country indicate that the IITs contribute about 35-40% of the total. Similarly data on the Ph.D. output

in engineering and technology in the IITs and in all other universities and institutes in the country indicate that the IITs contribute about 50% of the output.

Studies conducted

Two studies with wide-ranging objectives have been conducted recently at IIT Bombay. The first study [1, 2] was conducted with respect to B.Tech. graduates of IIT Bombay who passed out in the 5-year period from 1973 to 1977. The study had the following objectives:

1. To quantify the extent of the brain-drain for the set of graduates selected.
2. To understand the motivations, aspirations and reasons of graduates who settle down abroad and those who stay on in India.
3. To obtain career profiles of IIT Bombay graduates.
4. To obtain feedback on the undergraduate curriculum.

The second study [3] was conducted with respect to M.Tech. and Ph.D. postgraduates of IIT Bombay who passed out in the 15-year period from 1973 to 1987. This study had the following objectives:

1. To analyse and obtain career profiles of postgraduate alumni of IIT Bombay.
2. To quantify the extent of the brain-drain of postgraduate alumni.
3. To obtain feedback on the curriculum undergone by the alumni with a view to judging its appropriateness and the need for modifications.

In this paper, we present results pertaining to objective 3 of the first study and objective 1 of the second study. These results have been obtained by analysing the replies given by the alumni to a carefully prepared questionnaire.

Categorization of alumni

For the purposes of analysis, the respondents to the questionnaire have been divided into three broad categories.

Category X: alumni who have been essentially working in India since they passed from IIT Bombay.

Category Y: alumni who are currently living abroad more or less on a permanent basis.

Category Z: alumni who have been abroad for more than one year and have returned to settle and work in India.

The categorywise break-up of the replies received from the alumni is given in Table 2. It will be noted that 501 replies were received from B.Tech. alumni in the first study, while 974 and 295 replies were received from M.Tech. and Ph.D. alumni in the second study. These replies constituted about 40% of the total population under consideration in the case of the B.Tech. and

Table 2. Categorywise break-up of replies received

Category	Replies received from alumni		
	B.Tech.	M.Tech.	Ph.D.
X	322	806	233
Y	140	127	34
Z	39	41	28
Total	501	974	295

M.Tech. alumni and over 50% in the case of the Ph.D. alumni. In each case, the number of responses is clearly large enough to draw reasonable inferences regarding the population as a whole.

NATURE OF WORK AND EMPLOYMENT PROFILE

We now turn our attention to the main purpose of this paper, namely an analysis of the nature of work being done by alumni of IIT Bombay. Aspects such as the current professional status, the sector of work, the annual income and the major duties will be examined.

B.Tech. alumni

Graduates of the B.Tech. programme come primarily from an urban background. Data collected at the time of their entry to the Institute indicate that 85.6% have done their schooling in a city or a metropolitan city. Data on further studies undergone after obtaining the B.Tech. degree indicate that nearly two-thirds (64.1%) do go in for further studies. Of these, the largest number (28.7%) obtain a postgraduate degree or diploma in management or related fields. Also, a very significant number (12.2%) obtain the Ph.D. degree. As far as the location of the alumni is concerned, an analysis of the address lists shows that 30.8% have settled abroad and 69.2% are in India.

The current (1987) professional status of B.Tech. alumni is given in Table 3. The data in this table reveal a number of interesting facts. A very large number of alumni settled in India (133 out of 322 in category X and 19 out of 39 in category Z, i.e. 42.1%) are in the 'executive/manager' class. Significantly, the next highest number in these categories (93 out of 322 and 10 out of 39) are entrepreneurs/industrialists/self-employed consultants. This corresponds to 28.5% of categories X and Z and indicates that a large number of IIT alumni in India run their own businesses. A detailed analysis of the questionnaires of these alumni shows that while a number of them are in fact part of their family concerns, an equal number have started their own enterprises from scratch after first obtaining some experience by working in a firm. This is a most encouraging feature.

Table 3. Current professional status of B.Tech. alumni

CPS	Category			Total	Per cent
	X	Y	Z		
Practising engineer	60	39	5	104	20.7
Research scientist/ engineer	10	13	-	23	4.6
Executive/manager	133	41	19	193	38.5
Industrialist/entrepreneur/ consultant (self-employed)	93	10	10	113	22.5
Academic researcher/teacher	8	13	3	24	4.8
Consultant (employee)	16	17	2	35	7.0
Other	2	7	0	9	1.9
	322	140	39	501	100.0

Among those settled abroad (category Y), the dominant professional status is 'executive/manager' (41 out of 140) and 'practising engineer' (39 out of 140). Only 10 out of 140, i.e. 7.1%, are entrepreneurs/industrialists/self-employed consultants.

In Table 4, alumni are classified by the sector in which they are working. Those working in the public sector, in educational institutions and government service are included in one category, while those working in the private sector are included in another. It is seen that the vast majority (83.2%) are working in the private sector—a clear reflection on the ability of the private sector to offer better salaries and rewards, and perhaps in some cases a better work atmosphere as well.

The annual income of salaried respondents is reported in Tables 5 and 6, a subdivision being made in terms of the postgraduate education of the alumnus.

From Table 5 for alumni settled in India (categories X and Z), it is seen that there is a very wide range in the incomes and that the highest mean income (Rs 64,470) is reported by alumni who have obtained a postgraduate degree/diploma in management. Alumni with a postgraduate qualification in a field other than their B.Tech. field or with no postgraduate qualifications follow with lower means of Rs 58,380 and Rs 57,700, while alumni with a postgraduate degree in the same field as their B.Tech. have the lowest incomes, averaging Rs 49,970 per annum. The mean annual income for alumni in categories X and Z is Rs 58,520. The trend in incomes noted is a little surprising. While it is known that a postgraduate degree or diploma in management commands a certain premium, it had been expected that a postgraduate degree in one's own discipline would result in a higher income than the lack of a postgraduate degree. This is appa-

Table 4. Sector of work of B.Tech. alumni

Sector	Category			Total	Per cent
	X	Y	Z		
Public sector/government/ educational institutions	52	20	5	77	15.3
Private sector	269	114	34	417	83.2
Other	1	6	0	7	1.5
	322	140	39	501	100.0

Table 5. Annual income of B.Tech. alumni in India (categories X and Z)

	PG in same field as B.Tech.	PG in management	PG in other fields	No PG study
Number	49	84	17	86
Income range (Rs)	21,000-90,000	30,000-130,000	7200-100,000	30,000-112,000
Mean annual income (Rs)	49,970	64,470	58,380	57,700

Mean annual income for alumni in categories X and Z = Rs 58,420

Note: Alumni who have listed their CPS as 'industrialist/entrepreneur/self-employed consultant' are not included.

Table 6. Annual income of B.Tech. alumni settled abroad (category Y)

	PG in same field as B.Tech.	PG in management	PG in other fields	No PG study
Number	46	41	14	12
Income range (US\$)	14,000-91,000	13,500-150,000	11,000-100,000	15,400-60,000
Standard deviation (US\$)	12,875	31,510	23,135	15,140
Mean annual income (US\$)	46,100	61,400	54,100	39,200

Mean annual income for alumni in category Y = US\$51,895.

Notes: (1) Alumni who have listed their CPS as 'industrialist/entrepreneur/self-employed consultant' are included. (2) The low values of minimum income are associated with alumni working in the Middle East, where salaries are low by US standards but high by Indian standards.

rently not so and is a clear indication of the priorities of IIT alumni who stay back in India and work as salaried employees. The most able among them (in an all-round sense) would prefer to go in for a management education immediately or after a few years. The next group would prefer to join a company as a management or engineer trainee straight away and move up. The last priority for a B.Tech. alumnus in India would appear to be an M.Tech. degree in his own field.

Table 6 gives the same data for alumni settled abroad (Category Y). The overall mean annual income for alumni in this category is US \$51,895. Once again there is a very wide range in the incomes and the group with postgraduate degrees/diplomas in management has the highest mean income of US \$61,400. This is followed by those groups that have postgraduate qualifications in other fields (US \$54,100) and in the same field as their B.Tech. (US \$46,100). It is to be noted that many alumni in these groups have Ph.D. degrees. The group with no postgraduate qualifications has the smallest annual mean income of US \$39,200.

Comparing the data in Tables 5 and 6, it is clear that there is a very wide disparity between the incomes of alumni in India and alumni abroad. This economic disparity is obviously the principal reason for the brain-drain.

An interesting question which often arises is whether alumni continue to work in the discipline in which they received their basic training. In their replies, 58.7% of the respondents indicated that they were working (to a reasonable extent) in the fields in which they received their B.Tech. degree.

The final table for B.Tech. alumni (Table 7) pertains to the nature of the work being done by the alumnus in his/her present job. The respondents have been requested to check one or more than one of the duties listed and to rank them. For the purposes of the table, only the duty ranked first (the primary function) is considered. In both categories X and Z, the largest number (37.9% and 53.8%) are engaged in some aspect of management (project planning, marketing, finance, etc.). The next highest number (24.5% in category X and 18.0% in category Z) are engaged in activities like production, maintenance/trouble-shooting and construction/erection/commissioning. This is followed by teaching/R&D/design (16.5% in category X and 15.4% in category Z). On the other hand, in category Y, the numbers in teaching, R&D, and design, and in management are about the same (33.6% and 32.1% respectively). This difference is clearly a reflection of the fact that many of those overseas have a research degree.

M.Tech. alumni

In contrast to the B.Tech. alumni, the number of M.Tech. alumni with an urban background is smaller: 56.3% have done most of their schooling in a city or a metropolitan city. As expected, data on studies undertaken after obtaining the M.Tech. degree indicate that only 18.7% do undergo further studies. Of these, only 4.9% go in for a postgraduate degree or diploma in management, while 8.8% obtain the Ph.D. degree. From the point of view of location, only 13.4% (constituting the brain-drain) have settled abroad; 86.6% are in India.

Table 7. Major duties in present work—B.Tech. alumni

Category	a, b, c	d, e, f	g, h	i, j, k, l, m, n	o	Total
X	16.5	24.5	11.5	37.9	9.6	100.0%
Y	33.6	2.9	20.7	32.1	10.7	100.0%
Z	15.4	18.0	10.2	53.8	2.6	100.0%
Total	21.2	18.0	14.0	37.5	9.4	100.0%

Code: a, teaching; b, R&D; c, design; d, production; e, maintenance/trouble-shooting; f, construction/erection/commissioning; g, consultancy; h, EDP/computer; i, project planning; j, marketing; k, finance; l, personnel management; m, industrial management; n, general management; o, any other.

Table 8 presents data on the current (1989-90) professional status (CPS) of M.Tech. alumni. Since the CPS depends significantly on the number of years that have elapsed after obtaining the degree, the data is split yearwise into three spans of five years. In an overall sense, the largest number of alumni, namely 22.0%, list their CPS as 'executive/manager'. They are closely followed by 'research scientist/engineer' (20.5%) and 'practising engineer' (16.7%). Those listing themselves as 'industrialist/entrepreneur' and 'consultant (self-employed)' are running their own business. They constitute $(9.2 + 5.9) = 15.1\%$ of the total. This is a significant fact.

It is worth noting that the number of alumni listing their CPS as 'other' is high. These alumni are mostly students pursuing studies after their M.Tech. After completion of their studies, they will eventually redistribute themselves into the other types. A further examination of the data in Table 8 on a yearwise basis shows a gradual change. Thus the percentage profile for alumni who passed from 1973 to 1977 is substantially different from the overall percentage profile for all alumni. It indicates a large increase in alumni listing their CPS as 'executive/manager' and in those running their own business. It is likely that this profile is a 'final' profile more representative of the professional status that M.Tech. alumni eventually tend to acquire.

In Table 9, alumni are classified by the sector in which they are working. It is seen that the majority (61.6%) are working in the private sector. An approximately equal but smaller number are working in educational institutions (14.2%) and in the public sector (13.2%). A still smaller number (9.7%) are in government service.

An examination of the data for alumni who passed from 1973 to 1977 shows that with the passage of time there is a clear increase in the percentage working in the private sector. The shift to the private sector is because of the better salaries and 'perks' offered to salaried employees as they become senior, and also because of the fact that many alumni start their own enterprises after serving for a few years.

In the private sector, the following are some of the companies that have a large number of alumni working for them: Tata Consultancy Services, Larsen & Toubro, Tata Electric Companies, Tata Consulting Engineers, Crompton Greaves, Tata Exports, Thermax (India), Telco, Tata Unisys, Bajaj Auto, Philips India, Godrej & Boyce.

In the public sector, the largest employers of M.Tech. alumni are the Oil and Natural Gas Commission (ONGC), Hindustan Aeronautics Ltd, Indian Telephone Industries and Indian Oil Corporation, while in the government, a significant number of alumni are working in the Department

Table 8. Current professional status of M.Tech. alumni

CPS	Alumni who passed out in			All alumni 1973-87
	1973-77	1978-82	1983-87	
Practising engineer	9.3	15.2	21.9	16.7
Research scientist/ engineer	11.5	18.6	26.8	20.5
Executive/manager	35.0	27.6	10.8	22.0
Industrialist/entrepreneur	22.1	6.8	4.2	9.2
Academic researcher/teacher	9.3	10.5	9.2	9.7
Consultant (self-employed)	7.1	5.6	5.4	5.9
Consultant (employee)	5.3	12.4	12.2	10.7
Other	0.4	3.4	9.4	5.3
	100.0%	100.0%	100.0%	100.0%

Table 9. Sector of work of M.Tech. alumni

Sector	Alumni who passed out in			All alumni 1973-87
	1973-77	1978-82	1983-87	
Government	5.8	6.2	14.4	9.7
Public sector	12.8	9.6	16.2	13.2
Private sector	71.7	69.0	50.6	61.6
Educational institutions	8.4	14.6	16.9	14.2
Other	1.3	0.6	1.9	1.3
	100.0%	100.0%	100.0%	100.0%

of Space, Department of Atomic Energy and in various laboratories of the Council for Scientific and Industrial Research (CSIR).

The mean annual income of alumni in India is reported in Tables 10 and 11. Data for alumni in categories X and Z are combined together as the data on incomes did not show any real difference between the two categories. It is to be noted that in the income tables, alumni who have listed their CPS as 'industrialist/entrepreneur' or 'self-employed consultant' are not included. For annual income, most alumni have reported their basic pay and allowances. However, some seem to have stated only their basic pay.

Table 10 gives the mean annual incomes of M.Tech. alumni in India from three periods, 1973-1977, 1978-1982, and 1983-1987. [Data on income of alumni abroad (Category Y) are not presented because the numbers involved in 5-year time spans with subdivisions by sector of work are small and variations in income are large. Consequently averages are not meaningful. Also data from many countries with different standards of living are involved.] A subdivision is made in terms of the sector of work. Table 11 presents the same data with a subdivision being made in terms of the further studies undergone by the alumni. An examination of the tables shows some interesting trends. Firstly, as is to be expected, mean incomes of alumni as a whole who passed from 1973 to 1977 (Rs 73,467) are higher than those who passed from 1978 to 1982 (Rs 65,466). In turn the incomes of these alumni are higher than those who passed from 1983 to 1987 (Rs 49,137). This statement is also true when alumni are considered

by the sector of work or by the further studies they have undergone. Secondly, it is seen that the incomes for those in the private sector are the highest. They are followed by alumni working for the government or in the public sector. Alumni working in educational institutions have the lowest average incomes. The differentials are also seen to increase with the passage of time. It is to be also noted that the private sector (and to some extent the public sector also) offers many perks and subsidies that are not reflected in the data on annual incomes presented in the tables. Thus the actual differences are in fact even more marked. Finally the subdivision by further studies shows that it is beneficial to obtain a postgraduate degree or diploma in management. The annual incomes of such alumni are about Rs 7000-14,000 more than the average for all alumni taken together. In contrast, the extra time and effort spent in studying for a Ph.D. does not seem to help an M.Tech. much from a financial standpoint. The annual incomes of such alumni are about the same as the average for all alumni taken together.

The following response was obtained in reply to a question as to whether the alumnus was working in the same field in which he/she was trained at IIT Bombay:

Same field	61.4%
Different field	29.4%
Partly same field	4.2%
Not answered	4.7%

The response shows that a large number (61.4%) are in fact working in the same field. This is a satisfying percentage, indicating to some extent the

Table 10. Mean annual income (Rs) of M.Tech. alumni in India (categories X and Z)—classification by sector of work

Year of passing out	Government	Public sector	Private sector	Educational institutions	Mean
1973-77	64,362	62,082	82,121	56,339	73,467
1978-82	55,876	59,630	71,573	49,659	65,466
1983-87	43,907	45,976	54,576	40,760	49,137

Notes: (1) Alumni who have listed their CPS as 'industrialist/entrepreneur/self-employed consultant' are not included. (2) Most alumni have reported basic pay and allowances. However, some seem to have reported only their basic pay. This has resulted in lower mean values.

Table 11. Mean annual income (Rs) of M.Tech. alumni in India (categories X and Z)—classification by studies after M.Tech. degree

Year of passing out	No further studies	Ph.D. in India or abroad	PG diploma/degree in management	Mean
1973-77	72,814	72,625	80,769	73,467
1978-82	65,396	60,300	72,822	65,466
1983-87	48,559	49,184	63,333	49,137

Notes: (1) Alumni who have listed their CPS as 'industrialist/entrepreneur/self-employed consultant' are not included. (2) Most alumni have reported basic pay and allowances. However, some seem to have reported only their basic pay.

relevance of the education received. In order to obtain an idea of the specific work being done, respondents were requested to describe their present field of work. Approximately 900 alumni gave brief descriptions. A perusal of the descriptions is revealing. It shows the remarkable diversity of the work being performed by alumni. It also shows that a very large number of them are in research, design and development, and that many are working in high-tech areas.

Table 12 is an important table indicating the major duties performed by an alumnus in his/her present work. For the purpose of analysing the data, it is convenient to group some of the similar duties (those that overlap with each other) together. Thus one may consider alumni listing teaching, research and development, or design (a, b or c) as their major duties under one group. Similarly alumni listing their major duties as production, maintenance/trouble-shooting, or construction/erection/commissioning (d, e or f) may be considered under one broad group. Alumni listing their work as consultancy or EDP/computers (g or h) may be considered under the next group, and finally alumni listing their major duty as some aspect of management (1-n) may be considered under one broad group. It is seen that in all categories (X, Y or Z), the largest number of alumni come under the first group, namely teaching, R&D or design. The overall percentage of alumni who list one of the above as their major duty is 50.6%. The percentage of alumni in the other three groups is much smaller and ranges from 13.1 to 15.3%. It is clear, therefore, that a large number of M.Tech. alumni continue to work in engineering and technology rather than drifting gradually towards management.

We now turn our attention to data on alumni running their own business, i.e. those who have given their CPS as industrialist/entrepreneur/self-employed consultant. It has already been noted that these alumni constitute a significant percentage. An important question that arises is whether these alumni started new businesses or joined existing businesses. Data on the alumni show that in more than 90% of the cases, they started the business on their own. Data on turnover and the number of employees show that the annual turnover of the companies is Rs 2.6 million and that the average number of employees is 19. It is of interest also to study the nature of the business

being conducted. Three groupings—'production/manufacturing', 'consultancy/project planning/execution' and 'marketing/trading'—have been used. The data obtained show that as befits technical persons an approximately equal percentage (around 45%) are engaged in the first two types of business activity, with only a few being engaged in the third type of activity.

Ph.D. alumni

For Ph.D. alumni, the percentage with an urban school background is less than that for B.Tech. and M.Tech. alumni. Only 44.8% have done most of their schooling in a city or a metropolitan city. The brain-drain is also the least: only 9.6% have settled abroad, while 90.2% are in India.

Table 13 presents data on the CPS of Ph.D. alumni. As with the M.Tech. alumni, the data are split yearwise into three spans of five years. In an overall sense, it is seen that the largest number of alumni (37.0%) list their CPS as 'research scientist/engineer'. They are closely followed by 'academic researcher/teacher', who constitute 35.6% of the total. The strong influence of the Ph.D. degree on the professional status is thus clearly seen. A much smaller percentage (13.2%) list their CPS as 'executive/manager'. Similarly, the percentage of those running their own business is small ($5.8 + 2.4 = 8.2\%$) but not negligible. A further examination of the data in Table 13 shows that for alumni who passed from 1973 to 1977, the percentage profile is not very different from the overall percentage profile for all Ph.D. alumni.

In Table 14, Ph.D. alumni are classified by the sector in which they are working. Keeping in mind the data of the previous table, it is not surprising that the largest number (41.4%) are working in educational institutions. The next largest number (31.5%) are working in the private sector, while a small number are in government service (17.6%) and in the public sector (8.1%). A yearwise analysis of the data does not show any significant differences from the percentages obtained for all alumni. A perusal of the companies/organizations in which alumni are working indicates that in the public sector, the ONGC is one of the largest employers, while in the government, a significant number are working in the Department of Space and in various laboratories of the CSIR. In educational institutions, the largest number are in IIT Bombay itself, working either as faculty members or on the staff of

Table 12. Major duties in present work—M.Tech. alumni

Category	a, b, c	d, e, f	g, h	i, j, k, l, m, n	o	Total
X	47.6	14.6	15.8	16.3	5.7	100.0%
Y	66.1	5.5	14.2	9.5	4.7	100.0%
Z	61.0	7.3	9.8	12.2	9.8	100.0%
Total	50.6	13.1	15.3	15.2	5.8	100.0%

Code: same as in Table 7.

Table 13. Current professional status of Ph.D. alumni

CPS	Alumni who passed out in			All alumni 1973-87
	1973-77	1978-82	1983-87	
Practising engineer	4.8	1.0	2.7	2.7
Research scientist/ engineer	33.3	30.7	45.5	37.0
Executive/manager	19.1	14.9	7.3	13.2
Industrialist/entrepreneur	7.1	4.0	6.4	5.8
Academic researcher/teacher	29.8	45.5	30.9	35.6
Consultant (self-employed)	1.2	2.0	3.6	2.4
Consultant (employee)	4.8	2.0	1.8	2.7
Other	0.0	0.0	1.8	0.7
Total	100.0%	100.0%	100.0%	100.0%

Table 14. Sector of work of Ph.D. alumni

CPS	Alumni who passed out in			All alumni 1973-87
	1973-77	1978-82	1983-87	
Government	21.4	12.9	19.1	17.6
Public sector	8.3	6.9	9.1	8.1
Private sector	33.3	28.7	32.7	31.5
Educational institutions	36.9	50.5	36.4	41.4
Other	0.0	1.0	2.7	1.4
	100.0%	100.0%	100.0%	100.0%

the various research centres in the Institute. A significant number are also working in other IITs.

The mean annual income of Ph.D. alumni in India is reported in Table 15, a subdivision being made in terms of the sector of work. Data for alumni settled abroad are not presented for the same reasons given earlier for M.Tech. alumni. The table shows some clear trends. Firstly, as is to be expected, mean incomes as a whole and in all sectors of work increase with seniority. Thus the mean incomes of alumni as a whole who passed out from 1973 to 1977 is Rs 77,284; this drops to Rs 60,946 for those who passed out from 1978 to 1982 and to Rs 52,219 for those who passed out from 1983 to 1987. A more important trend seen from Table 15 is that mean incomes of alumni in

the private sector are the highest. They are followed by alumni working in the public sector and government. Alumni working in educational institutions have the lowest mean incomes. In response to a query as to whether alumni are working in the same field in which they were trained or in a different field, a high percentage of alumni (65.8%) indicate that their current field of work is similar to the field in which they were trained. As in the case of M.Tech. alumni, descriptions of the specific work being done by Ph.D. alumni indicate that they are working in areas of a varied nature with emphasis on teaching, research and development.

Table 16 lists the major duty performed by the alumnus in his/her present work. It is seen that in all categories the largest number of alumni (more

Table 15. Mean annual income (Rs) of Ph.D. alumni in India (categories X and Z)—classification by sector of work

Year of passing out	Government	Public sector	Private sector	Educational institutions	Mean
1973-77	71,223	71,833	105,286	58,610	77,248
1978-82	57,653	65,714	87,667	49,365	60,946
1983-87	49,258	61,625	62,245	44,136	52,219

Notes: (1) Alumni who have listed their CPS as 'industrialist/entrepreneur/self-employed consultant' are not included. (2) Most alumni have reported basic pay and allowances. However, some seem to have reported only their basic pay. This has resulted in lower mean values.

Table 16. Major duties in present work—Ph.D. alumni

Category	a, b, c	d, e, f	g, h	i, j, k, l, m, n	o	Total
X	73.4	7.7	5.2	7.7	6.0	100.0
Y	85.3	2.9	2.9	0.0	8.8	100.0
Z	92.9	0.0	0.0	3.6	3.6	100.0
Total	76.6	6.4	4.4	6.4	6.1	100.0%

Code: same as in Table 7.

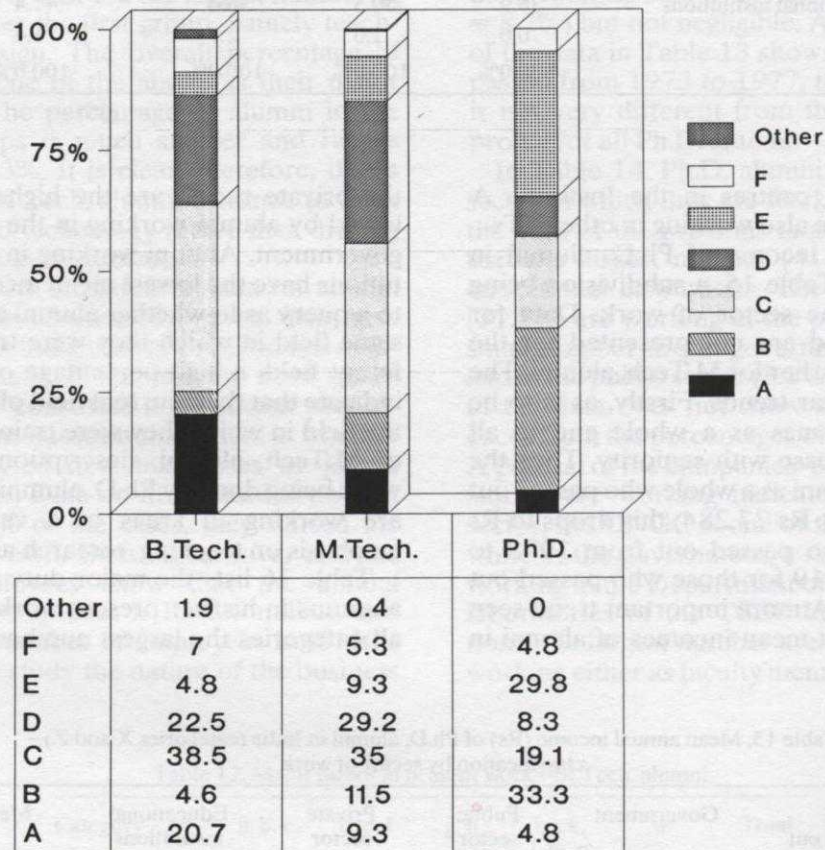
than 70%) list their major duty in the first group, namely teaching, research and development. This is in agreement with the data on current professional status given in Table 13.

Comparisons

Finally, it is of interest to compare the data on B.Tech., M.Tech. and Ph.D. alumni. Figure 1 shows a comparison of the current professional status. Since the B.Tech. study was made for the batches that passed out from 1973 to 1977, the comparison is restricted to these batches. The figure shows similarities in the data for B.Tech. and M.Tech. alumni. For both groups, the largest number

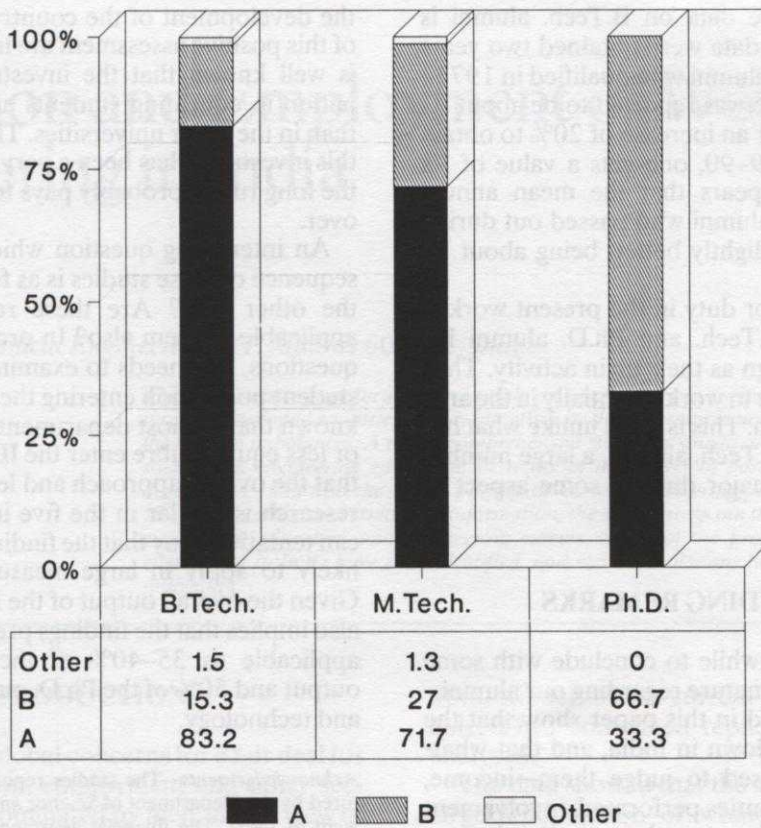
classify themselves as 'executive/manager' (38.5% for B.Tech. and 35.0% for M.Tech.). The next largest number are alumni running their own business (22.5% for B.Tech. and 29.2% for M.Tech.). In contrast, as far as Ph.D. alumni are concerned, the largest number (33.3%) classify their status as 'research scientist/engineer'. The next largest number (29.8%) are alumni whose status is 'academic researcher/teacher'.

A comparison of the sector of work is given in Fig. 2. Here again the data for B.Tech. and M.Tech. alumni are somewhat similar, with most of them (83.2% and 71.7%, respectively) working in the private sector. However, in the case of Ph.D.



A - Practising engineer
 B - Research scientist/engineer
 C - Executive/Manager
 D - Own business
 E - Academic researcher/teacher
 F - Consultant (employee)

Fig. 1. Alumni comparison—current professional status.



A - Private Sector
 B - Public Sector, Edu Inst, Govt Service

Fig. 2. Alumni comparison—sector of work.

alumni, the number working in the private sector is only 33.3%.

Comparing the annual incomes of M.Tech. and Ph.D. alumni settled in India (Table 17), one sees that in each time span and in almost every sector of work, Ph.D. alumni have incomes higher than M.Tech. alumni. (This difference is essentially due

to the additional time required to acquire a higher degree.) The difference increases if one considers only the incomes of Ph.D. alumni who passed from the engineering departments. This is a fairer comparison since most M.Tech. alumni are engineers. These data are also presented in Table 17. In the case of annual incomes, only an approximate

Table 17. Comparison of annual incomes (Rs) of M.Tech. alumni and Ph.D. alumni in India

Year of passing out	Sector of work				All sectors
	Government	Public sector	Private sector	Educational institutions	
1973-77					
M.Tech.	64,362	62,082	82,121	56,339	73,467
Ph.D.					
All depts	71,223	71,833	105,286	58,610	77,248
Engng depts	75,960	78,333	109,333	60,186	82,237
1978-82					
M.Tech.	55,876	59,630	71,573	49,659	65,466
Ph.D.					
All depts	57,653	65,714	87,667	49,365	60,946
Engng depts	58,806	66,000	101,374	56,307	70,440
1983-87					
M.Tech.	43,907	45,976	54,576	40,760	49,137
Ph.D.					
All depts	49,258	61,625	62,245	44,136	52,219
Engng depts	48,880	65,000	79,136	50,099	60,034

comparison with the data on B.Tech. alumni is possible since those data were obtained two years earlier. For B.Tech. alumni who qualified in 1973–1977, annual income was reported to be about Rs 58,000. Allowing for an increase of 20% to obtain the income for 1989–90, one gets a value of Rs 69,600. Thus it appears that the mean annual income of M.Tech. alumni who passed out during the same period is slightly better, being about Rs 4000 more.

As far as the major duty in the present work is concerned, both M.Tech. and Ph.D. alumni list teaching/R&D/design as their main activity. Thus the majority continue to work essentially in the area of their specialization. This is quite unlike what has been observed for B.Tech. alumni, a large number of whom list their major duty as some aspect of management.

CONCLUDING REMARKS

It would be worthwhile to conclude with some remarks of a general nature regarding our alumni.

The data presented in this paper show that the vast majority settle down in India, and that whatever the measure used to judge them—income, professional status, duties performed, involvement with entrepreneurship, etc.—they are clearly very successful by Indian standards. They are also contributing significantly in a professional sense to

the development of the country. The implications of this positive assessment are important because it is well known that the investment made by the nation in educating students at the IITs is higher than in the other universities. The results show that this investment has been a very worthwhile one. In the long run, it probably pays for itself many times over.

An interesting question which arises as a consequence of these studies is as follows: What about the other IITs? Are these results likely to be applicable to them also? In order to answer these questions, one needs to examine the nature of the student population entering the IITs. It is generally known that in most departments, students of more or less equal calibre enter the IITs. It is also known that the overall approach and level of teaching and research is similar in the five institutes. Thus one can tentatively say that the findings of this study are likely to apply in large measure to all the IITs. Given the overall output of the IITs, this statement also implies that the findings presented are broadly applicable to 35–40% of the nation's M.Tech. output and 50% of the Ph.D. output in engineering and technology.

Acknowledgements—The studies reported herein were sponsored by the Department of Science and Technology, Government of India. The financial assistance received is gratefully acknowledged. I would also like to thank Dr (Mrs) A. R. Rajeswari, Joint Adviser, DST, and my former colleague, Professor Indira Mahadevan for their help and advice.

REFERENCES

1. S. P. Sukhatme and I. Mahadevan, Pilot study on magnitude and nature of the brain drain of graduates of the Indian Institute of Technology, Bombay, Report submitted to the Department of Science and Technology (1987).
2. S. P. Sukhatme and I. Mahadevan, Brain drain and the IIT graduate: part I—magnitude of the brain drain, part II—understanding the brain drain process. *Econ. Polit. Weekly*, 1285–1293 (1988).
3. S. P. Sukhatme, A study on the nature of work and placement of postgraduate alumni of the Indian Institute of Technology, Bombay. Report submitted to the Department of Science and Technology (1990).

Suhas P. Sukhatme is Professor of Mechanical Engineering at the Indian Institute of Technology, Bombay. He received his education at the Banaras Hindu University, where he obtained a bachelor's degree in mechanical engineering, and at the Massachusetts Institute of Technology, where he obtained M.Sc. and Ph.D. degrees. Dr Sukhatme conducts research in the areas of heat transfer and energy. He was the recipient of the Bhatnagar Award for engineering sciences in 1983 and was elected a Fellow of the Indian Academy of Sciences in 1986.