

The Nature and Scope of the Brain-drain of Engineering Graduates

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Brain-drain generally refers to the more or less permanent migration of highly qualified and talented manpower from a less-developed country, in which it has been educated by allocating scarce resources, to developed countries. It is estimated that approximately 6000 high-quality professionals migrate from India to developed countries, a significant fraction of this number being engineers, many among them being alumni of IITs. This paper provides an analysis of the phenomenon of brain-drain, with specific reference to the graduates of IIT Madras. In addition to providing a database, it attempts to analyse and understand the principal factors influencing brain-drain. The results of the study are based on the analysis of responses to a detailed questionnaire mailed to the alumni. The propensity of a graduate to migrate has been found to depend primarily on the place of schooling and the educational background of the parents. These characteristics have been combined into a 'Socio-Economic Status Index', which provides a quantitative measure of the probability that a graduate will migrate. The reasons for migration can be classified into two complementary sets of factors, described as 'push' and 'pull' factors. The former refer to adverse conditions in India that provoke emigration, the most significant of which are poor career prospects, excessive bureaucracy, emphasis in seniority for promotion, and poor utilization of knowledge. The pull factors refer to the favourable conditions in the developed countries that make immigration attractive, the most significant of which are better academic facilities, a spirit of fun and adventure, better career prospects and financial benefits. Suggestions to mitigate brain-drain fall under three broad categories: information-oriented measures, government-policy-oriented measures and industry-oriented measures.

WHAT IS BRAIN-DRAIN?

BRAIN-DRAIN generally refers to the more or less permanent migration of highly qualified and talented manpower from a less-developed country (LDC), in which it has been trained at considerable expense, to a developed country (DC).

Historically, however, the term 'brain-drain' came into currency when Britain started losing highly trained manpower to the US in the mid-1960s.

EARLIER STUDIES

Quantitative data are available in several UN reports on the flow of high-quality manpower (HQM) from LDCs to DCs. The subject has been widely studied and researched, both nationally and internationally [1-9]. These studies highlight the essential nature of brain-drain, its magnitude and causes of brain drain, the status of immigrants, and suggestions for counteracting brain-drain.

It is important to point out that while the use of the word 'drain' presupposes that brain-drain is indeed an undesirable loss of vital resources, without compensation, there are conflicting opinions as to the essential nature of this migration. Thus, two conflicting points of view emerged

during a seminar on brain-drain conducted in 1982 [7]:

1. There is no brain-drain problem, and there is no economic justification for committing resources in measures aimed at getting back the brains settled abroad.
2. There is, in fact, a serious brain-drain problem, which is affecting the quality of research and the pace of technology development in the country.

Indeed, this migration is sometimes referred to as a 'brain bank', suggesting the creation, rather than the loss, of a vital resource, from which the country can draw at will.

The magnitude of brain-drain from India

Various estimates of the magnitude of brain-drain from India to developed countries, primarily to the US and Canada, are available in the literature [8, 10, 11]. Based on these, Sukhatme and Mahadevan [9] estimated that the annual brain-drain from India to developed countries during the period 1973-79 was in the range of 5500-6500, a significant fraction of this number being engineers, many among them alumni of the IITs. So far as migration of alumni from IITs is concerned, only off-the-cuff estimates are available, except for the studies by Sukhatme and

Mahadevan [9] for IIT Bombay and Ananth *et al.* [12] for IIT Madras.

Sukhatme and Mahadevan [9] have obtained statistically reliable estimates of the magnitude of brain-drain for a specific set of alumni of IIT Bombay (those who graduated from between 1973 and 1977). They have estimated that $30.8 \pm 2\%$ of these alumni have settled abroad. A discipline-wise break-up indicates that the magnitude varies from 42.8% in electrical engineering to 20% in metallurgical engineering. (During this period no undergraduate programme in computer science and engineering was offered in any of the IITs.)

The essential nature of brain-drain

Most of the studies view the essential nature of brain-drain as being undesirable:

- It is a reverse transfer of technology, from admittedly technologically backward LDCs to DCs.
- It is a perverse flow, which increases the technological dependence of the LDCs on the DCs—a neo-colonialism, with the multinationals playing a crucial role.
- Absorption and indigenization of technology transferred from DCs to LDCs require HQM; brain-drain decreases this capability, resulting in a persistent and widening technology gap between DCs and LDCs.
- Brain-drain is not the emigration of surplus HQM: the idea of producing a 'surplus' in LDCs is to increase the diffusion of expertise to semi-urban or even rural areas, where it has the maximum value, in terms of social and economic development.
- The value addition to the HQM from LDCs in the DCs is by no means an aid from DCs to LDCs. These value-added products settle in the DCs, conferring many benefits to the DCs:
 - Savings through avoiding the cost of educating their own citizens to the same qualifications.
 - Quick adjustment to changes in manpower demands of their economies.
 - Availability of high-productivity immigrants who fit the job better.
 - Avoidance of the cost of normal benefits to which national labour is entitled by use of relatively inexpensive immigrant labour.

The causes of brain-drain

It is possible to identify broadly two kinds of factors that lead to brain-drain: 'push' factors and 'pull' factors. The former refer to the adverse conditions in the LDCs that provoke emigration; the latter refer to the favourable conditions in the DCs that make immigration attractive. It must be pointed out here that distinctions between the push and pull factors are somewhat tenuous, in as much as they represent two sides of the same coin.

Some of the oft-mentioned push/pull factors are:

- Low level of socio-economic development of LDCs relative to DCs.

- Educational and cultural domination of DCs gives the impetus to outflows, and causes rootlessness of academics and professionals. Brain-drain principally occurs to developed economies of ex-colonial rulers (except in the case of the US).
- Brain-drain is facilitated by the language of instruction in science and technology in many LDCs being English.
- Increasing trends in opening up of DCs, shrinking the world into a global village, spread of knowledge of foreign language and culture, development of the universal culture of the educated and professionals, increasing scope of international contact, and hangover of the colonial past.
- In the long run, brain-drain is the price paid by LDCs for their choice of educational and development models dysfunctional to the needs and aspirations of their own people on the one hand, and amenable to exploitation by DCs on the other.

Other factors that cannot be clearly identified as push or pull factors often operate in a complementary manner. An important push factor is the imbalance between the rate and pattern of educational growth and the manpower-absorbing capacity of the LDC economies. A complementary pull factor is the acute and worsening imbalance between the fast-growing demand for HQM arising from the present-day importance of science and technology and the inadequate supplies in the DCs.

The state of the immigrant

Sudarshan and Mahajan [13] have provided a thought-provoking analysis of the state of the Indian scientist abroad. Their analysis and conclusions are equally valid for other HQM such as engineers. They have divided the typical scientific career of an Indian immigrant into three phases:

1. The 'golden period' as a graduate student under the neo-colonial patronage of a Western professor.
2. The middle phase in which he or she falls into one of two groups:
 - The first group accepts the prevailing value system, together with its discrimination, and settles for a safe but unexciting and colourless professional life.
 - The second group wages a prolonged but unequal and vain struggle, followed by bitterness about lack of adequate scientific recognition.
3. The mature professional life, which for the first group is safe but restless. For the second group, there is a great disparity between what they expect and what they get, leading to frustration that cannot be meaningfully given vent to, and emotional instability.

Sudarshan and Mahajan conclude that this state of affairs is perhaps due to a continuation of the

colonial tradition made lethal by the much-touted slogan 'science is universal'. What is not universal, they point out, are the institutions of science. It is the immigrants who invoke the dogma of the 'scientist as a citizen of the world'. Their Western counterparts are quite cognizant of their nationality.

The solution probably lies in the creation of scientific institutions of our own, built and controlled by ourselves. It is of utmost importance that these institutions be built on solid foundations, and have a large number of competent and well-trained scientists who perform their roles honestly and seriously. The only hope for scientifically-free, exciting and creative lives lies in Indian scientists becoming their own masters.

Suggestions for counteracting brain-drain

The general consensus of these studies is that brain-drain is undesirable. The suggestions for counteracting brain drain fall into two classes: those that seek to reduce brain drain itself; and those that accept brain-drain, and seek to mitigate its adverse effects on the LDCs.

Those that seek to reduce brain drain itself are as follows:

- Restrictive policy actions by LDCs (similar to restrictive immigration policies of DCs).
- DC requirements on the HQM to return to their parent LDCs for a minimum number of years after training in the DCs.
- Making DC facilities available to the HQM on a temporary basis.
- Visits by DC scientists to LDCs (taking care to avoid low-grade, highly paid visitors).
- LDCs inventing and innovating educational and development models suitable to their needs and aspirations, making them less amenable to exploitation by DCs, because the products of their educational system will then be less tailor-made for economic exploitation by DCs.
- Improving the status of the HQM in India, and providing challenging opportunities in the country itself.
- Providing career prospects for very bright people, interlinked with enriching advanced training and education abroad.
- Initiating research programmes that are related to our own needs, and not extensions of work in advanced countries, and therefore involving our HQM, rather than alienating them.

Those that accept brain-drain, but seek to mitigate its unhappy consequences for LDCs by introducing an implementable taxation scheme on the HQM, and collecting compensation from the DCs (under UN supervision?) payable to LDCs of origin in order to:

- Reduce salary differentials of HQM so that resident HQM can be paid satisfactory emoluments consistent with the social objectives of the LDCs.

- Compensate LDCs for losses incurred by emigration.
- Enable LDCs to share in the improved income of their emigrants.

One of the conclusions of the seminar on brain-drain conducted by Chopra [7] was that it is better to reduce brain-drain by improving the science and technology climate in India, rather than by committing resources to measures aimed at getting the brains settled abroad to return. Many participants resented the idea of giving preferential treatment to the HQM who return from abroad, in comparison to those who stayed back home and 'roughed it out'.

THE IIT MADRAS STUDY [12]

It is necessary to have reliable statistical data with respect to individual institutions, and the perception of their alumni, in order to understand the phenomenon and draw meaningful conclusions. Sukhatme and Mahadevan [9] performed such a study for IIT Bombay.

The IIT Madras study was undertaken in order to quantify the extent of brain-drain, understand its nature and identify its causes, with reference to the graduates of IIT Madras. The study was conducted through a questionnaire-based survey of the opinions of the alumni. The questionnaire was carefully designed so as to provide statistical data through objective questions, as well as to elicit free responses that throw light on the perceptions of the alumni.

Methodology adopted for the study

Collection of current alumni addresses. The first step in the data collection involved the procurement of correct addresses of as many alumni as possible. This was done with the assistance of the Academic Section and the Alumni Association. IIT Madras has an active Alumni Association in North America, called the IITM Alumni Association of North America (IIT MAANA). This association supplied an up-to-date list of the addresses of IIT Madras alumni in the USA and Canada, current up to May 1986.

Altogether, questionnaires were sent to 1431 alumni: 384 in India and 1047 abroad. Against this, 429 responses were received: 184 from alumni in India, and 245 from alumni abroad.

Preparation of the questionnaire. A questionnaire was prepared, keeping the major objectives of the study in focus. It was structured into six sections: the first three were designed to determine who migrate, the next two to find out why they migrate, and the last to discuss their perceptions of brain-drain and their suggestions for counteracting the migration. A draft was pre-tested on a sample, including final-year B.Tech. students and on-campus alumni. The feedback so obtained was used to refine the questionnaire. This process

helped, especially with regard to the ease of responding to the questionnaire.

The alumni were classified into four categories:

- P Alumni who stayed back in India after studies at IIT Madras.
- Q Those who went abroad immediately after studies at IIT Madras.
- R Those who went abroad after studies at IIT Madras, and returned to India (presently working in India).
- S Those who worked in India after graduation for at least six months before going abroad.

The questionnaire also included, as a postscript, a summary of some published views on brain-drain. This was intended both to inform and to provoke reaction.

A response sheet was designed to facilitate the entering of responses to the objective questions. It was estimated that each questionnaire would take about 30–45 min to complete.

Viewpoints of industrialists. In order to elicit the views of industrialists, who have a stake in understanding and counteracting brain-drain, a brief one-page questionnaire was prepared and mailed to a representative set of 204 industrialists all over the country. A total of 37 responses was received.

Viewpoints of present final-year students. In addition to the views of the alumni, it was felt that the views and perceptions of the outgoing students would give a relevant perspective to the phenomenon of brain-drain. They would also throw some light on their aspirations and expectations. Accordingly, another two-page questionnaire was designed and circulated amongst the present final-year B.Tech. students.

How many migrate?

The exact determination of the extent of migration requires a complete knowledge of the current addresses of all alumni of IIT Madras. This is not available. Under this constraint, the magnitude of brain-drain has been estimated by two methods.

Overall migration. A total of 5942 persons have graduated with a B.Tech. degree during 1964–1987; out of this, 2750 'permanent' addresses left behind at the time of graduation were available. However, only 526 replies were obtained to letters sent to those addresses; this set consisted of 384 addresses in India, and 142 overseas. If it is assumed that these 526 alumni, whose current addresses are known, constitute a representative sample of the 5942 alumni, then a preliminary estimate of the extent of brain-drain is obtained as: $145/526 = 27\%$.

A few months after the present study was initiated, it was brought to our attention that the IIT MAANA had compiled a comprehensive list of addresses of alumni in the USA and Canada. In response to our request, we received a list of 1047

addresses, current up to May 1986. It is estimated that this list is 75% complete. Secondly, it is well-known that over 90% of the total annual brain-drain from India to DCs consists of migrants to North America. Furthermore, 90% of the alumni listed in the IIT MAANA list have graduated with a B.Tech. degree from IIT Madras, while the rest have obtained M.Tech., MS, Ph.D. or M.Sc. degrees. Hence, a reasonably accurate estimate of the extent of brain drain of IIT Madras B.Techs can be obtained as:

$$(1047 \times 0.9)/(0.75 \times 0.9) = 1396$$

Since the total number of B.Tech. graduates from IIT Madras during 1964–1986 is 5645, the extent of brain-drain is estimated to be: $1396/5645 = 24.7\%$.

Year-wise migration. Data on alumni who graduated between 1964 and 1968 are somewhat incomplete, though it is estimated that the number of migrants was small. From the estimated overall migration, it is possible to estimate the migration for each of the five-year periods from 1968 to 1987: from 20% during 1968–72, it increased to 22% during 1973–77, to 27% during 1978–82, and to 35% during 1983–87.

Discipline-wise migration. It is found that the brain-drain varies from a high of 44.6% in chemical engineering to a low of 18.4% in aerospace engineering. Computer science and engineering was introduced in 1982, and for the graduates of 1986 and 1987, the brain-drain in this subject is 58.5%.

Who migrates?

Ten different aspects pertaining to the personal and professional background of the respondents have been analysed, with a view to identifying the characteristics of potential migrants. Nearly 90% of those who migrate are B.Tech. graduates. The rest are made up of M.Sc., M.Tech. and Ph.D. graduates. Approximately one-half of the respondents are married. It appears that schooling in cities creates a greater awareness of opportunities abroad. The background of parents—education, income and occupation—also appears to have a significant influence on brain-drain.

Educationists have developed a Socio-Economic Status Index by combining different factors, such as income of family, occupation of parents, educational background of parents, availability of resources, etc. Different combinations have been used, and each variable is scaled and a weight assigned to each. Weighted scores are simply added in each case to determine the SES Index. In the present study, an SES Index has been developed, based on the place of schooling and educational background of parents; it appears to correlate directly with the propensity to migrate, and provides a quantitative measure of the probability that a graduate will migrate.

Why they migrate

As already discussed, the general reasons for migration can be classified into two complementary sets of factors, namely push and pull factors. The respondents were presented with a list of these factors which could possibly contribute towards the decision of a person to leave the country, either on a permanent basis, or for higher studies. In addition, information was sought on their perceptions relating to a detailed comparison of different aspects of living and working conditions in India and abroad.

According to this study, the major pull factors for migration are:

- better academic facilities abroad;
- spirit of fun and adventure;
- better prospects abroad;
- better financial benefits abroad.

The major push factors are:

- poor career prospects at home;
- poor work ambience (excessive bureaucracy, emphasis on seniority for promotions, poor utilization of knowledge and lack of interaction with experts);
- peer pressure;
- lack of participation in decision-making at the national level;
- poor industrial climate;
- unsatisfactory living conditions;
- unsatisfactory political situation;
- family influence;
- faculty influence.

Financial benefits, living conditions, working conditions, opportunities for individual growth, opportunities for professional advancement and recognition of merit are perceived by the immigrants as far better abroad than in India.

A large fraction of the graduates in India are in the government sector, rather than in the private sector; the converse is the case abroad. A smaller fraction of graduates in India describe their jobs as academic or R&D, compared to those abroad. There appears to be no significant difference in the level of job satisfaction here and abroad; however, the source of satisfaction abroad is financial benefits, whereas the source of satisfaction in India appears to be the nature of the job. A significantly larger fraction of those employed abroad rate the initiative/freedom permitted on the job as very high.

The free responses corroborate and emphasize these conclusions. The major reasons for not going abroad are:

- family responsibilities;
- financial constraints;
- a sense of belonging;
- national pride.

The major attractions at home responsible for migrants returning are:

- national pride;

- a lack of sense of belonging abroad;
- family and cultural reasons;
- job opportunities in India;
- a preference for children growing up in India.

Free responses on the causes of migration. A qualitative discussion of the factors that promote migration, based on views expressed by the alumni, is presented in this section. In most cases, these responses are complementary to the statistical information presented. This section emphasizes that mere numbers do not describe the picture fully. (All views in this section are those expressed by the respondents.)

1. *Career prospects.* The poor industrial climate in India can be traced to the heavy dependence of our industries on foreign technology. Most industries are interested only in the 'know-how' which is purchased from abroad rather than the 'know-why'. Engineers are employed only as technicians to supervise the running of the plants and in day-to-day maintenance activities. Serious problems are referred back to the parent company which may send a 'foreign expert' to solve the problem. Although this may serve the short-term commercial interests of the company better, in the long run it kills the morale of the local engineers.

Since the engineers are under-employed, engaged only in production and maintenance activities, the so-called HQM finds no outlets for its creative talents. The R&D units are at best quality-control centres where routine tests are carried out. Indian industries have no place for specialists. In fact, the higher one's qualifications, the more difficult it is to get employment.

Many Indian companies are run by families, and the key management posts are held by members of the family. The concept of professional management is often absent.

2. *Academic facilities/research atmosphere.* It is generally accepted that IIT's offer the best undergraduate education in the country, comparable to any in the world. This is not, however, true of the available postgraduate programmes in the country. Furthermore, the reputed technical schools in the USA have challenging graduate programmes with attractive fellowships. Hence it is natural for IIT graduates to seek admission to a US university to continue their education.

There is a sense of resigned sluggishness in Indian research establishments. This is essentially due to the so-called 'job security' which enables one to earn a salary without producing anything. Promotions are usually time-bound, with heavy emphasis on seniority. Thus there is absolutely no incentive for excellence. Even enthusiastic scientists under such conditions become complacent about their work and 'gets used' to their surroundings in the course of time.

3. *Spirit of fun and adventure.* The graduating IITian, at his/her age, is spurred by a sense of curiosity and a desire for foreign travel. In India,

few salaried people have the requisite income or savings to permit foreign travel abroad.

4. *Conditions of work.* Developed countries offer a large variety of options; if one is not satisfied with a job, one can readily move to a more satisfying area. Such mobility is rare in a developing country like India.

The initiative or freedom permitted on the job is a direct reflection of the opportunity to prove one's innovative talents. The organizational set-up in India is too conservative to provide any outlet for a creative mind.

The sense of fairness is conspicuously absent in our society. This lack of fairness manifests itself in various forms—discrimination on the basis of caste, religion, etc., the need to bribe corrupt officials in every walk of life, and so on. Many of the alumni have personally experienced the trauma of caste-based discrimination in seeking admission to professional courses. While the USA may not be 100% fair, the degree of fairness is perceived to be an order of magnitude higher. Discrimination on the basis of race, if present, is considered to be felt only at the higher professional echelons. It may be true that Indians in the USA have to work much harder than their American counterparts to prove themselves, but a capable person ultimately gets his/her due share of recognition, which is not so in India.

5. *Financial prospects.* Most IIT students are middle class, and do not have the financial security of family assets. The financial benefit associated with emigration is a strong pull factor for this group of people. Although in the initial stages, one leaves with the idea of returning after earning the basic financial cushion, one finds it extremely difficult to return after getting used to the lifestyle and comforts of living in a developed country.

6. *Peer pressure.* 'Peer pressure' refers to the strong urge to prove oneself among one's equals. The sheer 'necessity' to prove themselves to others prevents the students from surveying other career options. Even during the final stages before migrating, any doubts about the merits of the decision are suppressed by the rationale that one would rather be wrong along with a large group, than take a chance to be right alone.

7. *Social and cultural factors.* Almost all social factors promoting this migration stem from an inherent inferiority feeling towards anything Indian. It is due to this feeling that society attributes tremendous prestige to a migrant or a returnee.

Most IIT entrants would have done well in school, building for themselves a good image in society. The very fact that they are students in an IIT suffices to keep up this image. If they take up jobs in India, there is no tangible criterion for maintaining this image. Since society holds an emigrant in high esteem, there is a strong motivation to go abroad. In fact, an IIT graduate who does not go

abroad is considered a less intelligent person by our society.

Modern Indian society respects only wealth. Businessmen and politicians are the most respected and influential people in society. Success is synonymous with financial worth. This again promotes the migration of bright scientists and engineers, and deters those already abroad from returning, since the rupee value of one's earnings is many times more than what it could be in India.

Modern education system. The modern education system emphasizes training of the mind, with very little attention paid to creating an awareness of social and cultural surroundings. This lack of overall perspective of the country, its heritage and culture, leads to an absence of attachment to it and a consequent lack of interest in its progress. As we move away from the years of independence struggle, feelings of patriotism and self-sacrifice are becoming less and less important. Added to these is the development of a purely materialistic outlook to life, and one does not have any compunctions about migration. Considering that our education is based on the Western system, emigrants find it quite easy to adapt themselves well when they go abroad.

Media-induced factors. This refers to the English movies and literature, showing fast action and sex, which have become extremely popular among our youth. These paint a romantic, though unrealistic, picture of life in the West, and create a desire to experience life in such a society.

Problems of returnees. In a seminar on brain-drain conducted in the early 1980s, K.R. Narayanan, the then Minister of State for External Affairs (presently Vice-President) said: 'The problem of re-entry into India and Indian society is as intricate as the problem of re-entry in space technology.' While this may be no understatement, the problems referred to by him were mostly on the emotional level. The foremost among the tangible physical problems faced by many prospective returnees is the delay involved in getting a job finalized in India. The process of appointment, from the advertisement stage to the final offer, spreads over a year. This again needs constant following up, which may not be possible from abroad. The alternative is to pack up and return and be without a job during this period. In this regard, the 'Scientists' Pool', operated by the Council of Scientific and Industrial Research (CSIR) was found to be quite helpful, in spite of some cumbersome procedures.

As for starting one's own venture, lack of reliable information and corrupt bureaucracy kill such endeavours even before conception.

It is disconcerting to note that the alumni find nothing professionally attractive in their own country, and that they have to migrate to greener pastures to find professional satisfaction. Many respondents have remarked about the cultural incongruity of an Indian abroad: 'Even in the most urban elite homes of our society, Western-

ization is still confined to the drawing rooms.' Our culture is so vastly different from others that one cannot be truly Westernized even after a prolonged stay in the West. It is this sense of cultural alienation that prompts the Indian abroad to return home.

Brain-drain or brain-bank?

It is often implicitly assumed that the migration of HQM from LDCs to DCs is indeed a brain 'drain'. However, quite a different point of view has been put forth in recent years, both in the press and in government reports, namely that the highly qualified non-resident Indians (NRI) in fact constitute a brain 'bank'. The implication is that the expertise acquired by them in various fields and the goodwill they have earned with influential organizations around the world can be drawn upon for the benefit of the nation.

Essentially, three different viewpoints emerge. Migration is: a 'brain-drain' and a waste of national resources; a 'brain-bank' and a national asset, at least in the long run; or irrelevant in the Indian context.

Approximately 70% of the respondents consider migration as a drain of brains, while about 20% view the migration as the creation of a brain-bank, a national asset in the long run. About 10% of the respondents believe that the migration is of no consequence at the national level.

How to mitigate brain-drain

Assuming that this migration is indeed an undesirable drain of brains, the literature is replete with suggestions for mitigating the problem. In the questionnaire, we included a list of measures that could possibly reduce this migration, and the respondents were required to choose from them; in addition, they were asked to provide suggestions of their own. The suggested steps that find maximum favour with the respondents in all categories are:

- better financial rewards in India;
- better technical utilization of HQM in India;
- better working conditions in India.

The consensus of opinion seems to be that all efforts should be focused on improving the conditions at home, so that prospective emigrants change their minds, rather than on attracting back those who have already migrated. Their suggestions can be classified under three headings:

1. Information-oriented suggestions.
2. Government-policy-oriented suggestions
 - (a) positive measures.
 - (b) restrictive policies.
3. Industry-oriented suggestions.

Information-oriented measures are aimed at increasing the awareness among graduates of career opportunities in India, and of their cultural heritage, and making it easier for returnees to settle in India. The government-policy-oriented suggestions are subdivided into positive measures aimed at improving conditions at home, and restrictive

measures aimed at restraining potential immigrants from emigrating. The industry-oriented suggestions are aimed at providing challenging and attractive career opportunities in Indian industry.

Viewpoints of industrialists

About 70% of the respondents considered the migration as a drain of brains, and about 50% felt that it was undesirable. The majority of respondents recommended positive measures, such as better working conditions at home, for making it attractive for the potential migrant to stay in India. The most significant push factor was considered to be the poor industrial climate in India, while better financial prospects abroad has been identified as the principal pull factor.

Viewpoints of final-year students

It is to be noted that these students are, for the first time, facing a serious decision-making problem. They have to decide what they want to do career-wise. They appear to have three main options:

1. pursue higher studies in engineering;
2. pursue higher studies in management;
3. take up a job in India.

Since they cannot be sure, they play safe by pursuing all three options.

Nearly 86% of the final year B.Tech. students (of 1988) wished to pursue higher education. The majority of them wished to do so in engineering, and over 60% of them preferred to go abroad for the purpose. The majority of those who wished to study management/business preferred to do so in India. The major push factors encouraging brain-drain were identified to be poor career prospects in India, excessive bureaucracy, inadequate utilization of knowledge, poor industrial climate, and lack of participation of professionals in decision-making at the national level. The major pull factors were identified to be better academic facilities abroad, better career prospects, financial opportunities, and curiosity/adventure/freedom.

SOME POINTS OF COMPARISON BETWEEN THE BOMBAY AND MADRAS STUDIES

The Bombay and Madras studies are essentially complementary to each other. The students in all IITs are basically similar, with more or less common aspirations, and they all enter the IITs through a highly competitive common national Joint Entrance Examination.

While the Bombay study chose a relatively homogeneous group of alumni, namely those who graduated between 1973 and 1977, the Madras study included alumni who graduated between the years 1964 and 1987. There are distinct advantages and disadvantages in both kinds of sampling.

The Bombay study considered only B.Techs, while the Madras study included all alumni.

OBSERVATIONS OF THE IIT REVIEW COMMITTEE REPORT OF 1986

The IIT Review Committee of 1986 has discussed the phenomenon of migration of IIT graduates, based on responses to a questionnaire-based survey. The report estimated that the brain-drain was 20%, on average, from all IITs. Of the remaining 80%, a majority were engaged in non-engineering professions (often characterized as 'internal brain-drain').

The primary reason for brain-drain was considered to be the attractive opportunities abroad, and not the lack of academic facilities in India. Only a small section of IIT students settled abroad were engaged in research work.

Little or no guidance was available, during a student's stay in IITs with regard to what the country needed from him/her technologically, and how one could contribute to India's developmental effort. It was felt that the IIT curricula prepared engineer-scientists rather than engineer-technologists, so that the graduates preferred to go abroad or to take up management jobs. The Indian industrial climate lacked opportunities for independent R&D, and did not provide professional satisfaction to the IIT graduates. However, with the recent emphasis on modernization of industry through the application of science and technology, a favourable climate is expected to emerge.

RESULTS OF A STUDY OF BRAIN-DRAIN OF COMPUTER SCIENCE GRADUATES OF IITs

Robert K. Perkins of the University of California, Berkeley, investigated the aspirations of computer science students of the five IITs and Jadavpur University, Calcutta, in May 1986. Rather than study the magnitude and opinions of alumni, he sought to discover the motivations of current final-year students before they go abroad, during the time when they are making the decision to leave India or stay back.

He administered a simple one-page questionnaire to 284 computer science and electrical engineering students of the six institutions. The questions in the survey covered three basic areas. First, the students were asked to give their reasons for choosing computer science as their particular field of interest and eventual career. Second, they were asked about their plans to go abroad for further study or work: whether or not they could see themselves settling abroad, and the advantages and disadvantages they saw in studying abroad. Thirdly, they were asked to evaluate their own institute.

Perkins has recognized two basic requirements

for someone going abroad to be defined as a contributor to brain-drain. First, he/she must be someone who could be useful to India if he/she were to stay back; and second, he/she must stay abroad for a significant period of time and not return immediately after finishing studies.

Among his principal results were:

- 82% of the B.Techs and 56% of the M.Techs said they would probably go overseas.
- 93% of all students, who intended to go abroad, planned to study there, and 31% were planning to work, either in industry or as post-doctoral fellows. In comparison to the B.Techs, a smaller proportion of M.Techs planned to go abroad for the purpose of study.
- His calculations of 'Goindex' and 'Settleindex' reveal that M.Techs had much less of a tendency to go abroad than B.Techs, and also had less tendency to settle abroad.
- His calculations of 'Go correlation' and 'Settle correlation' reveal that those who chose their field of study out of interest in the discipline would most likely follow that interest to wherever the best opportunities exist to learn and grow in that field. Those who chose computer science because of the opportunities it offers in terms of jobs and employment most probably did so with the intention of working in India, rather than abroad. Those who chose computer science for its application to science and society had the largest negative 'Settle correlation'; these students potentially had some desire or sense of duty to see technology used within India to improve society.
- 10% of the students chose computer science at the IITs merely because they had a high enough rank in the JEE, because of the glamour of the field, or even just because it was 'the thing to do'. This group of students was the least goal-oriented, and had large negative 'Go correlation' and 'Settle correlation'.
- In response to their answers regarding their specific fields of interest in computer science, it was found that those interested in artificial intelligence had the highest likelihood of going overseas. The implication is that since AI is a new field, most of the advanced work is being done in the West, and there are few opportunities to apply this kind of technology in a developing country.
- The major disadvantage of studying abroad was stated to be the difficulty of adjusting to the social and cultural differences of another country; some stated that they would miss India.

His principal recommendations were as follows:

- The policies of IITs regarding faculty promotion, both written and unwritten, must be changed in order to favour development of technology which is appropriate to India. The counter-argument is that in order for the IITs to maintain their standing as centres of techno-

logical excellence, their faculty must continue to participate in international forums. Notwithstanding this, it is recommended that encouragement should also be given to publish in Indian journals and do research that is specific to the country, in order to meet the expressed goal of service to India.

- The faculty strength must be increased to lessen the burden on the present faculty members. This could be done by offering more competitive salaries to draw qualified people who might otherwise be lost to industry.
- Other recommendations are made concerning faculty, to enable them to have the competence, attitudes, motivation and time to provide the students with meaningful instruction, experiences, motivation and attitudes to dissuade them from leaving the country.

Perkins focused his attention on the stated goals of the IITs, two of the most important of which relate to service to the nation, and providing an educational resource of technical excellence with international reputation. He perceives a conflict of goals here, with particular reference to computer science education. He believes that while the second goal might, to some extent, have been achieved in the field of computer science, the more primary purpose of serving the nation has become obscured, and has even been hindered by the secondary goal of achieving excellence.

He reiterated the finding of past studies of people who have emigrated to countries like the USA, which is reinforced by interviews with faculty during this study, that most of the students who do come back to India are those who return immediately after completing their studies. Students who decided to stay a few years after completing their studies to gain work experience are far more likely to settle abroad permanently. This gives a clue as to 'when' we should try to attract them back; 'how' is another question.

THE PROBLEM OF 'INTERNAL' BRAIN-DRAIN

Another type of 'wastage' of talented manpower that has been identified is the diversion of engineers from technology to management-oriented post-graduate studies and careers. This is mainly due to the better financial emoluments and prospects in marketing, sales, finance, etc., in comparison to the different fields of technology.

Another source of attraction for professionals like engineers and also doctors is the higher civil service, IAS (Indian Administrative Service), for which recruitment is through a national competitive examination conducted by the UPSC (Union Public Service Commission). In 1986 and 1987, 20–21% of the candidates in the merit list had an engineering background, and some 4–5% were doctors. Since 1987, it has been estimated that the number of engineering, technology and medical graduates entering the higher civil service has more than doubled. Thus candidates with a more liberal educational background were being swamped out by the professionals. This is a clear indication of the aberration in our social system which attaches higher status to the civil servant than to an engineer or doctor.

The main argument of those against engineers and doctors entering the civil service is that these are costly and highly subsidized fields, and hence these graduates should not be permitted to leave their profession for a non-technical career, thus resulting in a loss of the investment made on their education. There are attempts to lessen the chances of professionals entering the civil service by restructuring the examination pattern in favour of generalists. There is even a demand that professionals should be barred from appearing for these examinations.

The origin of the civil services in India goes back to the days of the British educationist Lord Macaulay, who favoured a broad-based educational background for civil servants. Proponents of this concept argue that specialization in a particular field distorts decision-making capabilities. On the other hand, current trends are that civil servants commonly head various technical departments, bossing over even the most senior technical personnel, and are also frequently shifted from one technical department to another. How success in a single examination followed by a year's training in administration is considered to confer superior capabilities in comparison to professional education and competence for heading predominantly technical departments is a moot point.

In this context, it is also necessary to discuss the increasing tendency for school-leaving students to enter professional courses in preference to science courses (not to mention arts courses). Many scientists in the country are worried at this diversion of talent away from science. It is another reflection of the present social milieu that makes young people prefer to be unemployed professionals rather than to pursue careers in science.

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