DST/EE/9139/PR-4

THE ROLE AND IMPACT OF TEACHING CURRICULA IN MEETING NATIONAL NEEDS: A Case Study of the IITs

FINAL REPORT

Naresh C. Mathur

November 1994

DEPARTMENT OF ELECTRICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY
KANPUR - 208 016

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CONTENTS

PREFACE

A Research Project entitled "The Role and Impact of Teaching Curricula in Meeting National Needs: A Case Study of the IITs" was sanctioned by the Department of Science and Technology (DST), Government of India, in September 1991 to the Department of Electrical Engineering, Indian Institute of Technology, Kanpur with the undersigned as Principal Investigator. The project was initially sanctioned for two years but its duration was subsequently extended to 30.11.1994. A Project Advisory Committee was formed with the approval of DST which consisted of 16 members including faculty members of IIT Kanpur and other experts from industry, Government, and academia. Their names are included in Annexure IV.

As input to the study, questionnaire surveys were conducted for the alumni of the five IITs, the industry and other organizations which employ IIT engineering graduates, and the faculty of the five IITs. Sample questionnaires are included in Annexures I, II, and III. In addition, personal interviews were conducted with a large number of eminent persons. A list of persons interviewed is included in Annexure IV. A large amount of literature was studied related to the subject. This included curricula of the IITs, reports of curriculum review committees, other reports of the IITs, and other literature on the subject from India and abroad, particularly that related to the global scene in engineering education. The questionnaire data was analyzed to generate survey statistics. The descriptive comments provided by the respondents were studied and grouped into various themes. Information was also generated by two Panel Discussions which were held at IIT Kanpur on the general theme of the project.

Some of the information generated is compiled in the form of reports which cover the IIT Kanpur curriculum in detail, a comparative study of engineering curricula in India and abroad, and a compilation of the comments sent by the alumni in response to the questionnaire. These reports have been prepared with the following titles:

(1) Mathur, Naresh C. and Madhuri Deshpande, "The IIT Kanpur Curriculum - Its History and Evolution", DST/EE/9139/PR-1, February 1993.

(2) Dash, Motilal and N. C. Mathur, "Undergraduate Engineering Curricula - Status Report", DST/EE/9139/PR-2, November 1994.

(3) Srivastava, Alka and N. C. Mathur, "The IITs - As the Alumni View Them", DST/EE/9139/PR-3, November 1994.

The project employed several project personnel at various times. These included Mrs. Madhuri Deshpande as Senior Project Associate (from 1.11.91 to 31.10.1992), Mr. M.G. Ganesh Babu as Project Associate (from 26.6.1992 to 30.7.1993), Mrs. Alka Srivastava as Project Associate (form 1.12.1992 to 30.11.1994) and Dr. Motilal Dash as Senior Project Associate (from 1.10.1993 to 30.11.1994).

This Final Report summarises the total work and includes an Executive Summary and a section on Conclusions and Recommendations.

Kanpur, November 1994. Naresh C. Mathur

ACKNOWLEDGMENTS

This study has been a source of immense pleasure and a great learning experience. I am deeply grateful to the Department of Science and Technology for sponsoring this study and for providing the necessary financial support. In particular, special thanks are due to Dr. A. R. Rajeswari, Advisor (NSTMIS), Department of Science and Technology, who encouraged me to write the proposal when my desire to study the subject was discussed with her and for her constant support throughout the course of this study.

Thanks are due to the members of the Project Advisory Committee who participated in the meetings of the committee and gave freely of their time and shared their views and experiences. The discussions with a large number of eminent persons have been extremely useful and have provided new insights into how the IIT system is viewed by them and by the nation. I am grateful for their time and the courtesy extended to me. Thanks are also due to the large number of alumni, industries, and faculty members who took the trouble to respond to the questionnaires. Their contribution forms the bulk of the material on which this report is based. I have personally gained an invaluable insight into this subject as I have gone through each and every comment from the respondents.

Director, IIT Kanpur and Dean, Research and Development, have provided all necessary support in the execution of this project. A very special mention must be made of the enormous help and cooperation that three successive Heads of the Electrical Engineering Department, Dr. V. Sinha, Dr. R. N. Biswas, and Dr. M. U. Siddiqi have given in providing the space and other facilities in the department. The secretarial and reprographic services staff has also rendered valuable help.

Dr. Surendra Gupta, Professor in Electrical Engineering, has very kindly taken up the task of looking after the project during my absence for two extended periods. This is in addition to his valuable comments and advice as a member of the Project Advisory Committee. I am very grateful to him.

Last, but not the least, the project staff has done an excellent job of carrying out the different activities of the project. I would like to record my thanks to Mrs. Madhuri Deshpande and Mr. M. G. Ganesh Babu who helped in the earlier phases of the project. Dr. Motilal Dash and Mrs. Alka Srivastava have contributed greatly to this project and have been largely

responsible to bringing it to a successful close. I wish to express my very special thanks to them. Their cooperation and hard work have been truly inspiring.

November 30, 1994 Naresh C. Mathur

The Role and Impact of Teaching Curricula in Meeting National Needs: A case Study of IITs

EXECUTIVE SUMMARY

The five Indian Institutes of Technology (IITs) have been established as institutions of national importance and are governed by an Act of Parliament. They are funded directly by the Ministry of Human Resource Development. The five institutes were reviewed by the IIT Review Committee which brought out its report in 1986. The present report is the final report of a DST sponsored project to study the role and impact of teaching curricula of the IITs on the national scene.

As inputs to this study, a number of questionnaire surveys were conducted covering the alumni of the IITs, the industry and other employing agencies, and the faculty of the IITs. In addition, two panel discussions were organized on the subject, two meetings of the Project Advisory Committee were held, and a number of eminent persons were interviewed. A number of reports related to the subject were also studied.

While views on what constitutes national needs (as far as engineering education is concerned) vary from person to person, it was found that certain amount of commonality emerges. The Review Committee Report also lays down certain expectations from the IITs vis-a-vis national needs. It is generally agreed that top class institutions like the IITs can and should frame their curriculum to suit the national needs and that this is not inconsistent with having a world class curriculum.

The curricula of the IITs have been studying in details as also the periodic revision in the curricula and the methodology used in redesigning the curriculum. The curricula of some of the other well known engineering institutions of India have also been studied as also the model curricula prepared on behalf of the ministry of the Human Resource Development. The international scene have been surveyed. It is found that there are common problems which are forcing all nations to have a critical look at the engineering curricula and to revise it to meet the emerging needs. Some of the needs are specific to the country or the region concerned. In the case of India, there are very specific reasons why the engineering curricula need an overhaul. This is related as much to the rapidly changing technology as to the new economic policies and the changing industrial scenario.

The impact of the IITs on the national scene has been looked at from

two perspectives - the impact on technical education and the overall S and T scenario. It is found that the IITs have very significantly contributed to the growth and development of technical education in the country. This is largely under a number of programmes started by Ministry of Human Resource Development as a follow up of the National Policy on Education. The overall impact of the IITs on the industries and research and development work had also been good. In particular, areas such as space, defence, electronic, computers, etc., have gained appreciably form inputs from the IIT faculty as well from the work of IIT graduates. The IITs have created a feeling of national pride and have demonstrated the country's ability to set up and run world class technical institutions.

There are certain areas of concern where the achievements have not been as expected and other areas where the overall impact is adverse. The chief area of concern is the lack of interaction of the IIT faculty with the Indian industrial environment. Curriculum related items such as summer training and industrial tours have not been organized well and have not been very effective. The IITs have failed to convey to the students a feel for India's industry and the challenging problems. The students tend to feel alienated form the mainstream of Indian life and work. IITs have been unable to cultivate a sense of national pride, and a commitment to the nation in its students.

The main recommendations arising out of this study are:

1. The components of the undergraduate programme which contribute to the student's awareness of the Indian industrial scene, namely, summer training and industrial tours, should be organized with much greater care and effort. Persons from the industry should be invited to give lectures in the courses as well as give extra-mural lectures.

2. The IIT faculty should consciously improve their involvement in the industrial scene. This can be done at several levels. There is need to modify some of the reward and incentive systems so that faculty will feel better rewarded for industrial interaction. Recruitment should also take this into account.

3. There is a need to develop contact with the alumni on a much larger scale than what exists at present. This will contribute to the financial resource position and also lead to greater industrial interaction.

4. There is a need to increase the availability of Indian authored text and reference books for every subject and this should be taken up as a mission with proper planning, incentives and financial gains. This will go a long way in generating confidence in the students in the caliber of the faculty and also provide an 'Indian perspective' to the teaching of engineering.

5. The student evaluation of course and teachers is well recognized factor which all well known universities in the world use for improving their education standards as well for reward/punishment of the faculty. This system has not evolved properly in the IITs although some form of student evaluation is done in many of the IITs in many departments. There is need to develop a well thought out system in this regard.

Chapter 1

INTRODUCTION

1.1 Motivation for the Study

As a developing country with gigantic problems and scarce financial resources and yet determined to tackle its problems by utilizing the benefits of Science and Technology, India has laid a great deal of emphasis on the development of appropriate numbers and quality of scientific and technical manpower to undertake this task. As a result, engineering education has expanded enormously since independence, both in numbers and in quality. Engineering education at the degree level has been developed at three levels - the State run engineering colleges, the Regional Engineering Colleges funded jointly by the Central and State Governments, and the five Indian Institutes of Technology (IITs). Of these, the IITs occupy a unique position in the country today even though they account for less than two percent of the engineering graduates at the first degree level produced in the country every year.

More than three decades ago the Indian Parliament passed a Bill known as "The Institutes of Technology Act, 1961", which, along with its subsequent amendments, governs the working of the the five Indian Institutes of Technology located at Kharagpur, Bombay, Madras, Kanpur and Delhi (in the order of their date of establishment). These Institutes were to be "Institutions of National Importance", conferred with the powers to design their own programmes and confer their own degrees with funding coming directly from the then Ministry of Education. Today the five IITs are recognised as centres of excellence and are much sought after by the students wishing to pursue careers in engineering and science, academicians seek-

ing faculty positions in these areas, industry and other employing agencies seeking engineers of high quality, and funding agencies wishing to sponsor research projects.

Because of the great hopes and expectations from the scientific and technical manpower, it is natural that questions be raised about the quality of education vis-a-vis the national needs and expectations. Not only is the actual learning and its relevance to our needs important, but equally important is the impact that the engineering education has on the overall development of the personality, thinking, and sense of values of the graduates. Engineering students spend the most impressionable years of their lives (age group 18 - 25 years) in the engineering institutions where they pursue their Bachelor's and Master's degrees. Their perceptions of our national needs and their role in meeting them are developed while they pursue their engineering education. It is therefore, very important that the educational system meet this broader objective. It must be periodically reviewed to provide mid-course corrections and changes where necessary.

Many questions have been raised about the quality of engineering education in India. The concern is not unique to India. Worldwide there is deep introspection about what the future course of engineering education should be. In India it is even more relevant because of our very special problems, our financial resource limitation and the new initiatives in our economic policy. The very special position that the IITs occupy make it necessary that their performance be looked at with greater care. It is this concern which has resulted in this project being taken up. This project concerns itself with the role and impact of teaching curricula in meeting national needs, taking the IITs alone for a case study. While the role of teaching curricula is emphasized in the title of the project, the actual study deals with the entire IIT educational experience.

The concerns which prompt us today have not arisen all of a sudden. Similar concerns have been expressed in the past and led to the formation of the IIT Review Committee in 1984 (which was chaired by the late Dr. Y. Nayudamma and is popularly known as the Nayudamma Committee). In 1986 IIT Delhi produced a report entitled "IIT Education - Reflections and Prospects" and the Foreword by the Director says:

> *"Should it alarm us that a large percentage of the IIT graduates turn to managerial careers ?" "Is it in the interest of the nation that many of the IIT graduates go abroad ?"*

"Should we lay more emphasis on management and other fields of education ?" "Is the IIT fulfilling the role that was assigned to it ?" These and many other questions have been engaging the attention of not only the IITs but also the Government and other national bodies. A very high level review Committee constituted by the Government has been studying the working of the IITs. Many inputs, including those from old students of the IITs, have been collected by this committee. Their report is awaited".

The report of the IIT Review Committee (mentioned above) came out in 1986 and its recommendations have, by and large, been accepted by the Government [1]. The report had said (Recommendation 10) that "if the recommendations are accepted and acted upon, changes will be clear and visible in five years' time". There is no information generally available regarding what follow-up action the IITs have taken regarding those recommendations which have been accepted by the Government and what is the present position. It thus appears that a study of the kind taken up in this project was very timely and very much needed. It must be acknowledged, however, that this is a much more limited and personal effort and has no comparison whatsoever with the magnitude of the IIT Review Committee work - if one were to to quantify this effort in comparison with that massive work, we may say that the effort here is one micro-Nayudamma !

1.2 Methodology

It was clear that in order to study the role and impact of the teaching curricula of the IITs in meeting national needs, a variety of inputs are necessary. We need the views and opinions of the alumni of the IITs, the employers of IIT graduates and the teachers of the IITs who are responsible for the curriculum and overall IIT environment. The views of eminent people who are both knowledgeable in matters of technical education and are involved in policy making and planning are also very important. As a third input it was necessary to see the results of the various surveys and reports prepared earlier which deal with this subject. Accordingly, we have adopted the following inputs for this project.

1.2.1 Questionnaire Surveys

It was decided that a number of constituencies must be consulted through questionnaire surveys. First and foremost are the alumni of the IITs who constitute the major contribution of these institutions to the nation. Since our objective was to look at the contribution of the IITs to the country, we decided to limit our survey of alumni to those working in India. This is not to ignore the not-so-explicit contribution made by those who have migrated. However, certain limitations have to be put on the size of any survey and we have chosen the sample keeping this in mind. We also limited our survey to those alumni who obtained a B.Tech degree from an IIT, thus confining ourselves to the first degree engineering graduates. These graduates have by and large taken up various jobs in India and somewhat less than 15 percent have gone in for entrepreneurship. We, therefore, took on the employers of IIT graduates as our next constituency for our survey. The third constituency was the teaching faculty of the IITs (the word 'faculty' is used in the IITs to denote the teaching staff and not to faculties as understood in the usual university parlance). The teaching faculty is ultimately responsible for both the design of the curriculum as well as for its implementation. Also, the work and interests of the faculty determine the exposure the students get to the nature of the science and technology environment in the country and what our graduates will do. It was, therefore, decided to carry out questionnaire surveys of the alumni, the industry and other employers of the graduates, and the faculty members of the IITs.

For the survey of IIT graduates it was initially decided to send questionnaires to approximately 1000 alumni of each of the five IITs. However, when efforts were initiated to collect addresses of the alumni, it was found that different IITs had widely different amount of information about their alumni. The number of questionnaires actually sent were, therefore, determined by the available number of addresses. Where large number of addresses were available, attempts were made to choose equal numbers from different five-year intervals such as 1965-70, 1971-75, etc. Also addresses chosen were on the basis of selecting alumni from all engineering disciplines.

It may be mentioned here that the state of affairs about the alumni information in each IIT is far from satisfactory. In the present scenario of

resource crunch when a great deal is being talked about regarding the need to use alumni contribution as one of the inputs for the funding of the IITs, a much more serious and concerted effort has to be made to reach out to the alumni, collect correct and up-to-date information about their whereabouts and career profiles and involve them in the activities of institutes as is done in some of the privately funded institutions abroad.

The final numbers of questionnaires sent and responses received are given in Table 1.1.

Table 1.1
Response of the Alumni

IIT	Numbers sent	Responses received	Percentage response
Bombay	1092	238	21.7
Delhi	1070	259	24.2
Kanpur	1540	297	19.6
Kharagpur	384	66	17.2
Madras	815	121	14.8
Total	4901	1023	20.9

It is thus seen that the overall response is about 20.9 percent. However, a total of 389 questionnaires were returned undelivered, presumably because of incorrect addresses. If these are ignored the percent response is 22.7 percent.

It is worth noting that the 1023 responses received represent almost 2 percent of all the B.Tech graduates of all the IITs in their entire period of existence .

The questionnaires were designed with great care and were pretested on a sample of respondents as well as discussed with various experts in the field of social sciences surveys. It is, nevertheless, recognized that in any survey of this type, the questionnaire is not perfect and that the responses are biased by the nature of the questionnaire items, the sample chosen and the kind of persons who respond. A sample questionnaire is given in Annexure I. Also included on this questionnaire are the numbers representing the percentage of alumni responding to the item and an overall weighted response as indicated in Annexure I. For Part E of the questionnaire (in

which respondents were asked to give their own views) a separate report has been prepared [4].

The nature of job placement of the alumni who responded is a good indication of what the IIT alumni living in India are doing. Table 1.2 indicates the percentage of alumni in different types of occupations. For the purposes of this table the occupations have been divided into the following categories - entrepreneurs, private sector industry, public sector industry, government research and development organizations, other government jobs (including Indian Engineering Services), Indian Civil Services, and academics. While the table indicates the figures for each IIT, some of the respondents did not indicate the IIT from which they graduated and these have been included in the column marked 'others'. Some of the percentages may not add upto 100 since some respondents did not specify their current occupation.

Table 1.2
Percentage of graduates working in different sectors

Nature of Job	IIT BOM	IIT DEL	IIT KAN	IIT KGP	IIT MAD	Other	Overall
Entrepreneur	25.8	14.3	7.4	13.6	12.6	12.5	14.8
Private Sector	64.4	53.7	48.2	40.9	54.6	40.0	53.4
Public Sector	5.1	15.4	20.9	31.8	17.6	15.0	15.9
Govt. R and D	0.8	1.5	4.6	1.5	5.9	7.5	3.0
Other Govt.	0.8	5.7	9.2	4.5	5.0	7.5	5.5
Civil Services	0.0	4.2	3.9	0.0	0.0	0.0	2.2
Academics	3.0	4.6	5.7	7.5	4.2	17.5	5.2
Management degree	30.0	34.4	20.5	13.6	22.7	-	25.5

We have also included in the above table (at the bottom row) information on the percentage of the graduates who have taken a management degree after their engineering. This has a significant effect on the nature of jobs taken. It is also important in the context of the type of engineer/managers needed in India to meet the challenges of globalisation of the economy. In fact a large number of graduates have expressed the opinion that the IIT curriculum should include a greater content of management subjects.

For the survey of the employers of IIT graduates, we selected 389 employers including Private and Public Sector Industry, Government Research and Development organizations, and other employers where IIT graduates working in India have been employed. The number of questionnaires sent to different types of organizations and the responses received are given in Table 1.3

Table 1.3
Industry Survey

Organization	Number sent	Responses received	Percent response
Private Industries	229	34	14.8
Public Sector Industries	123	12	9.8
Government Organizations	16	7	43.7
CSIR Laboratories	12	3	25.0
DRDO Laboratories	9	1	11.1
Total	389	57	14.7

A sample questionnaire for the industry is given in Annexure II. Also contained in Annexure II are the percentage responses to each item. The overall weighted response is also indicated.

The survey of the faculty of the IITs was done through another questionnaire which was mailed to every single faculty member of each of the IITs after ascertaining the latest faculty position of each department of each IIT. The response rate was disappointing as indicated in Table 1.4 below.

Table 1.4
Faculty Survey

Institution	Number sent	Responses received	Percentage response
IIT Bombay	379	66	17.4
IIT Delhi	374	82	21.9
IIT Kanpur	313	82	26.2
IIT Kharagpur	521	75	14.4
IIT Madras	347	70	20.2

The sample questionnaire is given in Annexure III along with the responses received (in percentage). The weighted average response to each item is also indicated. The opinions expressed by the faculty on items of an open ended nature have been discussed elsewhere.

In all the questionnaire surveys, no attempt was made to send reminders due to lack of time.

1.2.2 Personal Interviews

The question of national needs is somewhat subjective as also perceptions about how people see the contribution of the IITs. It was decided to interview a number of eminent persons who would have a broad picture of the country's needs and who have some role to play in the formulation of policies and their implementation. A number of persons were interviewed and the list indicating their names is given in Annexure IV. As will be seen from the list, categories of persons interviewed included Directors of IITs, Vice-Chancellors, members of the Planning Commission, current and former officers of the Ministry of Human Resource Development, Chairmen of the University Grants Commission (UGC) and All India Council of Technical Education (AICTE), professors and deans of the IITs, top management persons from the industry and others.

In addition to views of the persons as mentioned above, a large amount of information was also generated during two meetings of the Project Advisory Committee that were held in Kanpur during 1991 and 1993. Two Panel Discussions were held at IIT Kanpur, sponsored jointly by the project and other agencies, at which the topics were "Relevance of IIT Undergraduate Engineering Education to the Needs of the Nation" and "The IITs and the Dream of Self-Reliance: More Self than Reliance". These were attended by a large number of students and faculty as well as alumni and other experts. Very informative and useful information came out of these panel discussions about how the various sectors of society view the IITs.

1.2.3 Study of Reports

There is not much general literature available about the IITs except their own publications including annual reports, convocation addresses, courses of study bulletins, etc. The basic document which led to the formation of the IITs and the enactment of the IIT Act is the Sarkar Committee Report which was prepared by a committee constituted by the then Viceroy of India in 1946 to study the needs of higher technical education in India in the post-war years. The IITs have carried out a number of reviews of the undergraduate curriculum, and their reports, as far as available, have been studied during the course of this study. The curricula and other features of some of the other well known technical institutions in India have also

been studied. The Government have, from time to time, commissioned the preparation of model curricula for engineering education through the Quality Improvement Programme (QIP) of the Ministry of Human Resource Development. These have been followed by many engineering colleges. The AICTE Act mandates it to go into the question of accreditation. The Indian Society for Engineering Education (ISTE) has also done some work regarding curricula. The Accreditation Board for Engineering and Technology (ABET) of the U.S.A. has laid down guidelines for the accreditation of engineering institutions and their curricula in the U.S.A. All these reports have been studied during the course of this project.

The worldwide scene of engineering education has been surveyed in several publications and many papers have been written on the subject. A study of this literature gives interesting insight into the similarities of some of the problems as well as the solutions being proposed. It also becomes evident, however, that the problems of each country and region have some characteristics unique to that country or region which requires different approaches to solution. A study of this literature has been found to be very useful and instructive for the present project. Two separate reports have been prepared dealing with the subject of curriculum.

1.3 Report Format

This study was directed towards finding out the role and impact of the IITs vis-a-vis the national science and technology scenario. The role of the teaching curricula was intended to be studied in particular. The report is accordingly, divided into different chapters covering these topics. Chapter Two considers the National Needs as perceived and/or defined and what role the IITs were expected to play in meeting them. The role of the curricula in the overall contribution of institutions is discussed in Chapter Three. The global scene is also described and the perception of problems and needs of some countries are discussed there. Next we consider, in Chapter Four, the impact of the IITs. This is divided into two parts - the impact on engineering education and the impact on the national science and technology scene. Arising out of the mandate as laid down in the Act and the review committee reports and the impact actually produced, the areas of concern are discussed in Chapter Five. Broad conclusions and

recommendations are discussed in Chapter Six. Some of the important and relevant information generated by the questionnaire survey is included in the Appendices.

In order to keep the size of the Final Report to a minimum, specific issues have been documented in other reports produced during the course of this study. These include a complete report on the IIT Kanpur curriculum entitled "The IIT Kanpur Curriculum - Its History and Evolution" (Report DST/EE/9139/PR-1), [2], one report on engineering curricula (including the IITs, other institutions in India, and the global scene), entitled "Undergraduate Engineering Curricula - Status Report" (Report DST/EE/9139/PR-2), [3], and one report on the comments of the alumni in the questionnaire survey entitled "The IITs - As the Alumni View Them" (Report DST/EE/9139/PR-3), [4].

Chapter 2

NATIONAL NEEDS AND THE IITs

2.1 Perception of National Needs

The national needs, even when considered specific to the area of science and technology and technical education, are, at best, nebulously defined. There is no clear mandate either from the Government or the Constitution of India which can help define the objectives of an educational institution such as an IIT in terms of meeting national needs. The National Policy on Education 1986 (NPE), with modifications undertaken in 1992, says the following with regard to Technical and Management Education [5, section 6.1].

> *"The reorganization of Technical and Management Education should take into account the anticipated scenario by the turn of the century, with specific reference to the likely changes in the economy, social environment, production and management processes, the rapid expansion of knowledge and the great advances in science and technology ... training in entrepreneurship will be provided through modular or optional courses ... the curricula of technical and management programmes will be targeted on current as well as the projected needs of industry or user systems; active interaction between technical or management institutions and industry will be promoted in programme planning and implementation ... "*

In a way, this comes as close as one can to indicating the national needs in regard to engineering education. It helps institutions define their objectives consistent with their own strengths and thrusts and with the NPE.

The views of different people differ both regarding which needs can be classified as national needs as well as what is their prioritization. A study directed towards finding the impact of a set of institutions in meeting national needs is, therefore, necessarily somewhat subjective. In order to reduce the subjective content of this study the views of a large number of people were taken. This was done both through the questionnaire surveys and through direct interviews with eminent persons.

2.1.1 Alumni and Faculty Views

The questionnaires which were sent to the alumni and the faculty of the IITs contained items meant to elicit the views of the respondents regarding national needs and the role of the IITs. It is instructive to see the response to the items related to this issue. Identical statements were included in both questionnaires and the respondents were asked to tick one of the five responses ranging from 'Agree Strongly' to 'Disagree Strongly'. Given below is list of the items and the percentage of respondents who have ticked a particular response. Also included in brackets is the weighted average response for the question. This is calculated by giving weightages of +10, +5, 0, -5 and -10 to the five choices, multiplying each choice weight by the number of respondents giving that choice, adding the total and dividing by the total number of respondents. This weighted average can be looked upon as the marks awarded (in the range +10 to -10) to each item by the responding group. All response figures are in percentage.

Table 2.1

Response of Alumni and Faculty about National Needs

Item 1. The 'National Needs' in the context of engineering education are well understood to include achievement of technological self-reliance.

Respondents	Weightage	Agree Strongly	Agree	Undecided	Disagree	Disagree Strongly
Alumni	+2.23	19.6	39.7	9.5	24.2	7.1
Faculty	+7.67	61.3	31.3	1.2	3.9	0.6

Item 2. The 'National Needs' in the context of engineering education are well understood to include application of science and technology to improve the rural life.

Respondents	Weightage	Agree Strongly	Agree	Undecided	Disagree	Disagree Strongly
Alumni	-0.94	10.7	25.8	14.3	34.9	14.3
Faculty	+6.21	40.8	42.9	6.6	7.4	1.2

Item 3. The national needs are not adequately defined and hence IITs cannot take them into account in the context of their curriculum.

Respondents	Weightage	Agree Strongly	Agree	Undecided	Disagree	Disagree Strongly
Alumni	-0.54	9.5	30.7	12.4	35.7	11.8
Faculty	-0.38	15.5	25.3	9.5	33.3	14.9

Item 4. The purpose of IITs is not to worry about national needs but to produce graduates comparable to those of the best institutions in the world.

Respondents	Weightage	Agree Strongly	Agree	Undecided	Disagree	Disagree Strongly
Alumni	-1.96	16.5	16.9	6.9	32.8	26.8
Faculty	-3.20	10.4	13.7	5.7	41.1	25.9

Item 5. A top class curriculum in engineering is country- independent and cannot be moulded to suit the national needs of India.

Respondents	Weightage	Agree Strongly	Agree	Undecided	Disagree	Disagree Strongly
Alumni	-2.69	10.8	17.4	6.1	42.1	23.7
Faculty	-2.63	9.5	16.7	9.5	42.6	19.9

An analysis of this response is very instructive. The first item, namely, that national needs include achievement of technological self-reliance, evokes a fairly strong positive response both from alumni and faculty. However, a much greater number of faculty members agree with this view compared to number of alumni.

The next item, viz., that national needs include application of science and technology to improve rural life draws a fairly strong positive response from the faculty but the alumni are not so sure about this. However, it would be wrong to conclude that the alumni do not agree with this statement by and large. One must recognize the fact that most alumni in India are not working on problems directly (or even remotely) related to application of science and technology to improve rural life. They, however feel (like most persons working in any field) that their work is directed towards meeting national needs (in fact as far as IIT alumni are concerned, many feel that their very decision to work in India shows their commitment to work for the national needs). The response may, therefore, be more of an indication of a subconscious self-defence attitude to justify what they are doing rather than an unbiased indication of their opinion about national needs. However, this is one view with which many may not agree.

The response to items three to five is roughly same from faculty and alumni. The response indicates that both the faculty and the alumni feel that national needs are sufficiently well defined to enable the IITs to take them into account while designing the educational programme and it is the

business of the IITs to do so. They agree that the curriculum is not country independent and that IITs should take the national needs into consideration when designing the curriculum.

2.1.2 Views of Eminent People

As mentioned in Section 1.2.2, discussions were held with a number of persons who have been involved in technical education, the IIT system, general higher education, industrial scene, and general planning in India. The list of persons interviewed is given in Annexure IV. Naturally, not all of them have expressed views on the specific issue of the role of the curriculum in meeting national needs. Rather, they have commented on the IIT system and its effectiveness and its contribution to the national needs. We summarize below the gist of the opinions expressed by them on the national needs vis-a-vis the IIT system.

When we talk of the national needs of India we have to realize that India is not only a vast country in terms of area, population, and diversity but also that, in terms of historical development and changes, India is 2000 years of history living contemporaneously. As such its needs are varied and range all the way from an improvement of the bullock cart and the plough and development of smokeless chulhas to sophisticated telecommunications, satellites and launch vehicles, biotechnology and genetic engineering. India must maintain and develop state- of-the-art military technologies to defend itself and must maintain a high rate of industrial growth to secure more employment and a better quality of life for its people. As a result, there is no kind of engineer which is not needed in India. Each engineering institution has an ethos and a culture of its own which is reflected in the type of engineers it produces. The IITs have their own ethos and their engineers are of a particular kind and are as relevant to India as any other kind of engineers. The IITs, which produce less than 2 engineering graduates, are meant to produce creative manpower to assume leadership in India's Science and Technology endeavours.

Another significant observation was that one of the important national needs was the improvement of the education system. In the context of engineering education this includes the creation of world class institutions which will serve both to train outstanding students and also act as pace setters and catalysts for the improvement of engineering education in the

country. IITs are quoted as an example in this context and their role in achieving an entirely new and outstanding standard of education is cited in support of their achievements. Production of high quality manpower is an important national need which can only be met by the creation of such institutions.

The question of national needs and design of engineering programmes to meet them without compromising on quality has been addressed by Jha [6]. He argues that since technology is nation- and culture-specific, all educational programmes in engineering and technology should be specifically designed to meet the needs of the country concerned. Socially relevant engineering education is compatible with internationally comparable standards. It is possible to develop programmes in developing countries which are intellectually challenging, meet international standards of achievement and at the same time equip students with competence in technology assessment, with awareness of pitfalls of technology transfer and with experience in use of technological solutions for current social and economic problems. Qasim [7] stresses the need for application-oriented training to produce designs suitable to the needs of the industries and to create centres of excellence in new technologies so as to produce manpower which would be well-equipped with the knowledge of many inter-disciplinary engineering areas.

Some light on the perceptions of the IIT faculty on national needs has also been thrown by their descriptive responses to the questionnaire. Some of the recurrent themes are worth recording. Reduction of dependence on import of technology, development of indigenous technology and strengthening of research and development are considered prime needs (in the context of technical education). An equally strong need is the development of self-confidence, a sense of pride in the country and to make India a global player. A basic need is inculcating a sense of responsibility towards the Indian society in our young people. The pursuit of excellence needs to be fostered in the students. It is emphasised that specific national needs change with time but value systems are permanent and need to be inculcated at all levels.

2.2 The IIT Mandate

The origin of IITs is traced to the Sarkar Committee report which "envisaged establishment of these institutions to meet the anticipated requirements of the post-war (1939-45) industrial development in respect of higher technical personnel ... these higher technical institutions were expected to be centres of excellence like the Massachusetts Institute of Technology, USA and at the same time evolve and conduct programmes relevant to meet the anticipated requirements of the country", according to Review Committee Report [1]. The Institutes are governed by the "Institutes of Technology Act, 1961" which does not lay down in any detail the goals and objectives of the IITs but only states that "whereas the objects of the institutions ... are such as to make them institutions of national importance, it is hereby declared that each such institution is an institution of national importance".

The IIT Review Committee was the first such committee set up to review all the five IITs together. Its recommendations have been accepted by the government. The recommendations relevant to the goals and objectives can, therefore, be considered as the mandate given to the IITs since 1987. The relevant recommendations are quoted below (numbers in brackets, ( ), indicate recommendation number in the report).

- The Indian Institutes of Technology were established with the objective which is best described in the words of the late Prime Minister Pandit Jawaharlal Nehru - 'to provide scientists and technologists of the highest calibre who would engage in research, design and development to help building the nation towards self-reliance in her technological needs' (1).

- Technological manpower production is admittedly the basic function of the IITs. The product has to be excellent in quality, relevant to the technological needs of the country, motivated to give of its best and have commitment to the country (7).

- The goals and tasks of these institutes in their process of development have to relate continuously to:

    1. significant and notable changes that are taking place in the socio-economic development of the country; and

2. rapidly exploding universe of knowledge in science and technology (8).

- Their goals must be:

1. to excel in teaching, research and in all aspects of academic activity and produce a high quality science- based engineering student;
2. to survive on specialization, work increasingly in front line areas that transcend disciplines;
3. to have a perception and a value system appropriate to the pursuit of high engineering science to meet the critically evaluated needs of the society;
4. to programme into their activities emerging technological needs with a futuristic outlook;
5. to accept extension and public service as a third dimension to their role in addition to education and research;
6. to attain a stature that enables them to provide leadership with credibility. They should be the "think- tank" for higher technical education;
7. to aim at preparing more of creative engineers, innovative thinkers and engineer entrepreneurs;
8. to develop a special nexus with rural development mainly by way of involvement in technology-based solutions of problems in rural areas;
9. to maintain and foster interactive linkages with leading technological institutions and centres of research in India and abroad (9).

Chapter 3

ENGINEERING EDUCATION CURRICULA

3.1 Role of the Curricula

3.1.1 Curricula and the Environment

Curricula, in a narrow sense, deals with the organization of the subjects which are taught to the students registered for a particular degree programme. In an engineering programme, it also includes associated learning processes such as practical training in industries, visits to industries and other organizations which employ engineering manpower, and project work which requires students to use and demonstrate their ability to design and complete a particular project. There are also other exposures such as seminars, extra-mural lectures, technical conferences, etc., which, while not being counted towards grades/marks for the purpose of evaluation, nevertheless contribute to the learning process. In addition, there are co- and extra-curricular activities such as sports, social work, cultural activities, etc., which are very important. All these influence the total capabilities with which a student passes out of an institution. They contribute towards the effectiveness of his contributions to the society and the nation as also his ability to choose the type of work he does as an engineer and the extent to which he can achieve his self-defined goals.

However, not included in the above is a set of parameters which are connected with the overall environment that an institution provides and which have a marked (though hidden) influence not only on the knowledge and the ambitions of a student but also on the way his whole personality and thinking is moulded. These relate to the freedom (both academic and

other) which he sees, the ease of accessibility to information and facilities, the example set by the teachers, and the example of his senior students. Therefore, a study of the role and impact of an institution has to take into account more than merely the curriculum. In this chapter we consider mainly the curriculum and its different aspects.

3.1.2 The Alumni Viewpoint

It is useful to see how the alumni have seen the different aspects of the curricula and environment. Several questions and statements in the questionnaire related to this subject. The results are revealing.

In a scale of 1 to 5, with 5 representing 'maximum' and 1 representing 'minimum', the question "how important is summer training in an engineering curriculum ?" has a score of 4.34 while the question "how useful did you find the summer training ?" gets a score of 3.31. Clearly, the way summer training is arranged is not very proper. Summer training has only very marginal effect on the decision to work (or not to work) in India (score is 2.37). The importance of the role of an industrial tour is rated at 3.84 by the alumni. The role of the project is also rated high (score 3.86) by the alumni. With regard to the factors which influenced the decision on post-B.Tech options, 64.1 alumni rated the B.Tech Curriculum as 'very strong' to 'moderate' while 72.6 category. Other factors are Peer Pressure (42 (46.2

The above is undoubtedly a very limited information since only some aspects have been touched in the questionnaire. However, it does bring out the fact that most alumni feel that summer training, industrial tours and B.Tech Project are very important inputs to the curriculum. There is also the feeling that their effectiveness is not fully realized because of the way these are organized. Also curriculum is neither the only nor the most important factor which affects the decision of the students about what they want to do after graduation.

3.2 The Curricula at the IITs

The distinguishing features of the IIT education can be categorized in terms of the admission process, the teaching curricula (and the way it is administered), and the overall environment of the IITs. There are strong positive aspects in all of these. The IIT admission test has come to be recognized as one of the most impartial, unbiased and honest system which enables

the IITs to select the most gifted young persons for their undergraduate programme.

The IIT undergraduate programme is characterized by the adoption of the semester system, continuous evaluation, course- wise promotion, strong dose of basic sciences, a large component of humanities and social sciences, and a very large number of elective courses from which a student can choose (including courses from different departments, which enables the student to develop a strong inter-disciplinary base if he so chooses). Many of these features are not found in the University system in India which most engineering colleges follow. In the IITs the teacher is completely responsible for the evaluation of the students in the course which he teaches. Since the IITs have been successful in attracting very bright persons into their faculty who have deep involvement in research, they are thus enabled to introduce minor changes in the course content without having to go through a very cumbersome process (as in the universities). This helps keep the courses up to date with respect to the latest developments in technology. The IITs have also carried out major curriculum revision exercises periodically which take into account the national and international trends and feedback from the alumni and the employers of the graduates.

The overall programme is divided into a 'core' programme which is common to students of all disciplines and other courses which may be specific to the departments concerned. Different IITs also have different amounts of availability of elective courses. After the most recent curriculum revision done in 1991, IIT Kanpur has started a provision of 'minor streams' by which a student can take three related courses from a different department which will give a rigorous introduction to a sub-discipline. The core programme has also got electives to be taken form Science-Options and Engineering-Options, thereby enabling different departments to choose which core courses are more relevant to their needs.

The curricula of some of the IITs is characterized by its "science-based engineering" bias. This has been a major departure from the traditional curricula in other engineering colleges and has been much appreciated. Even Review Committee [1] has recognized that the aim, as perceived by the IITs, was to produce a category of engineering personnel best described as 'Engineer- Scientist' as against 'Engineer-Manager'. The Review Committee has recommended that IITs should continue to produce engineer-scientists by maintaining a science-based engineering curriculum.

The total engineering curricula can be broadly divided into four parts: Humanities and Social Sciences (including languages), Basic Sciences, Engi-

neering Sciences and Technical Arts, and Professional courses. The break-up of the total contact time available for the undergraduate degree programme into these four areas is different in different IITs and is indicated in the table below.

Table 3.1
Curriculum Share of Different Areas

Institute	Hum and Soc Sc.	Basic Sc	Engg Sc	Professional Courses
	(A)	(B)	(C)	(D)
IIT Bombay	15.0	30.0	25.0	30.0
IIT Delhi	11.0	22.0	29.0	38.0
IIT Kanpur	19.6	24.0	26.0	30.4
IIT Kharagpur	8.1	18.1	23.2	50.0
IIT Madras	7.5	22.5	24.2	39.6
MIT, USA	21.0	25.4	21.5	32.1
AICTE/UGC	8-10	20-23	67-72 (C+D)	

Also shown in the last two rows are the break up at the Massachusetts Institute of Technology (MIT), USA, and the percentage ranges suggested by the All India Council of Technical Education (AICTE) and the University Grants Commission (UGC) Panel for a model curriculum. It is seen that IITs Kharagpur and Madras have much less stress on Humanities and Social Sciences while IIT Kanpur has the maximum. The questionnaire asked the alumni "How strong has been the role of 'science-based engineering' curriculum of the IIT education in your career ?". About 64 percent rated it 'very strong' to 'strong'. Discussions with alumni also indicate they have valued greatly this aspect of the curriculum.

The stress on Practical Training, Industrial Tours and industry-oriented B.Tech projects is also different in different IITs (and also between the different departments within the same IIT). The questionnaire had inquired about whether there was compulsory summer training and compulsory industrial tour. The responses, in percentage, saying yes are shown in Table 3.2 in columns 2 and 3. Also included in column 4 in this Table is the 'yes' response to the question whether the B.Tech project was related to some real life problem of Indian industry.

Table 3.2
Summer Training, Industrial Tours, B.Tech Project

Institute	Summer training	Industrial tour	B.Tech project
(1)	(2)	(3)	(4)
IIT Bombay	98.3	63.8	43.8
IIT Delhi	94.2	69.1	50.8
IIT Kanpur	59.4	76.8	45.4
IIT Kharagpur	98.5	63.6	45.4
IIT Madras	25.2	51.2	40.0
Overall	76.7	70.5	46.1

In the case of IIT Kanpur, about which more complete information could be gathered, a survey of the present practice in various engineering departments with regard to industrial tour and summer practical training shows that out of the 7 engineering departments, only Aerospace Engineering and Materials and Metallurgical Engineering departments have compulsory industrial tour for their students. Only the Materials and Metallurgical Engineering department attaches a weightage to the tour. The frequency with which the tour actually materializes varies from department to department but only in the Mechanical Engineering and Materials and Metallurgical Engineering departments has the tour gone every year in the last five years. Summer training is not compulsory in the departments of Computer Science, Electrical Engineering, and Mechanical Engineering. There is no uniform or satisfactory method of placing students for summer training. Also, there is no system of monitoring the work of the student during the training. A fair number of students take their summer training in the IIT itself working on various sponsored research project. There is little coordination between various departments and the Student Placement Office in the matter of summer training.

3.3 The Global Scene

Engineering curricula throughout the world, including both developed and developing countries, are undergoing intense introspection and change. There are a number of reasons for this, all well known and well articulated. Included in these are (a) the fast changing technology and the consequent reduction in the obsolescence time of techniques and products, (b) the

rising inter-relationships between what used to be distinct disciplines requiring greater stress on inter-disciplinary work, (c) the changing economic patterns and policies in several countries, (d) the changing pattern of multination integration of different aspects of production such as availability of raw material, skilled and economically viable manpower, necessary political stability, and land and power, (e) the break-up of the Soviet Union and its impact on the engineering profession and education, (f) the emergence of the European Union with its consequent need for mobility, and commonalty of language and engineering curricula, etc. In the light of this, most countries are set on a path of redefining the kind of engineers needed and the method of training them. There have been an increasingly large number of articles on this subject and, in particular, an in-depth look at the global scene is contained in [8] - [10]. What follows is largely taken from these sources as well as subsequent publications.

In the USA, there has been growing concern that the existing engineering practices are no longer appropriate to satisfying the nation's current and future needs. There is also grave concern about the dwindling numbers entering engineering schools. The National Science Foundation has set up four Coalitions - the Synthesis Coalition, Engineering Coalition for Excellence in Education and Leadership, Gateway Coalition, and Southern University and College Coalition for Engineering Education. These Coalitions have been entrusted with the responsibility to look at problems related to inter-disciplinary studies, integration of engineering studies from pre-college to post-graduate education, hands-on engineering design, programmes stressing leadership and management skills, curriculum structure development, quality assurance and evaluation measures, cost-benefit studies of engineering education, and enhancement of minority students.

In Europe two factors have contributed heavily to a thinking towards reorganization of engineering education. One is the formation of the European Union (now Council) and the consequent need for standardization in products, manufacturing techniques, and manpower training. Countries are feeling the need for a greater mobility in the engineering manpower and hence some uniformity in the teaching programmes in terms of duration, entrance requirements and curriculum. These issues were discussed at the first European Conference on Assessment and Accreditation of Engineering Training and Qualifications held in 1990. The second important factor is the break up of the erstwhile Soviet Union and the emergence of the former COMECON countries from the Soviet dominance. Increasingly many are trying to establish closer relations with the western European countries and

the Common Market with consequent stress on changing the engineering education structure to help this process. There is a distinctly felt need for training their engineers abroad and a consequent need for learning English and establishing some parallel with the engineering education structure of the rest of Europe. In Germany, after the unification of East and West Germany in 1990, the planners are trying to integrate the university education. In Poland, subsequent to the coming to power of the Solidarity Party, a new Higher Education Act was voted, and a Trans-European Mobility Scheme for university studies was adopted in 1990. In Hungary, various factors such as the coming in of a large number of foreign companies and the emergence of a lot of new and successful small ventures and firms has the authorities worried and they feel a planning for a new curriculum in engineering has become essential. In 1991, a new plan got approved by the National Accreditation Board and the Ministry of Education. Also, English is fast becoming a second language.

The situation in other countries outside Europe and north America is also similar. In Japan, technology underwent a metamorphosis from a domestic, single-country endeavour to an international orientation. According to Morikawa [11], substantial changes are being introduced which are aimed at solving some of the problems mentioned at the beginning. Taiwan's economy is going through a transitional stage and its industrial structure tends to be more capital and technology intensive. The special emphasis on graduate programmes in engineering and science in the educational policy of the government reflects the need of the country for industrial automation and high-technology industrial developments. For the government, engineering education and industrial, economic, and social development seem to be the same problem simply viewed from different directions. In Brazil it is felt that a large percentage of the students who are graduating from the engineering schools do not have the type of knowledge needed. To overcome the crisis there is an on-going attempt to reformulate the engineering courses.

Thus one sees that around the world there is almost a revolution as far as engineering education is concerned. The emphasis may vary from country to country depending upon their own very specific difficulties. But both in developed countries an well as developing countries, there are a large number of common factors necessitating changes in the curriculum of engineering education.

Chapter 4

THE IMPACT OF THE IITs

4.1 Impact on Technical Education

4.1.1 Engineering Education - Status and Problems

In order to understand the role and impact of the IITs on the technical education scenario of the country, it is necessary first to understand the basic structure of technical education and its problems and weaknesses.

Engineering education in the country at the first degree level consists of a four-year programme which, as entrance requirement, requires completion of the 10 + 2 system of school education. While attempts have been made by the Ministry of Human Resource Development at the development and adoption of "model" curriculum for the undergraduate programme, there is, by and large, considerable diversity in the curricula followed at different institutions. Basically the curricula in the majority of our colleges consist of a few courses common to all branches of engineering (including courses in Mathematics, Physics, and Chemistry), a number of courses in the specific branch of engineering in which a student is registered, and a very few optional courses within the specific branch. In addition there is a Project in the final year of engineering. Many institutions arrange an educational tour for the students which enables them to have a quick look at some of the industries and other engineering establishments. In addition, there is provision for summer training of the students for at least one summer during their programme in many of the colleges. However, opinion of students about the utility of the summer training and the educational tour is generally somewhat negative because of the way they are arranged.

There are many problems faced by the engineering colleges in their attempts to improve the quality of education. The curriculum plays an

important role in the quality of education imparted. All engineering colleges are affiliated to a parent university (with the exception of institutions which are deemed universities such as BITS, Pilani, Thapar Institute, Patiala, etc.) in which changes in curriculum are to be approved by the Academic Council. This is a very slow and difficult procedure and is a big hurdle in attempts to keep the curricula updated. The scheme of the University Grants Commission (UGC) to give autonomous status to certain colleges is aimed at overcoming this difficulty.

The problems with the quality of education are not limited to the curriculum alone. One of the greatest problems of the engineering colleges is the lack of availability of good teachers. Most colleges have large number of unfilled faculty positions and they are not able to attract bright young men into the teaching profession. The result is that there is neither the initiative nor the ability to incorporate changes to keep pace with the changing technology and the national scenario. The lack of financial resources adds to the difficulties of updating the laboratories. The result is that the graduating students have neither the theoretical knowledge of the latest developments in technology nor the hands-on experience of working with the latest equipment.

4.1.2 Expected Role and Actual Achievements of IITs

Within the broad guidelines laid down by the IIT Council from time to time, the IITs have set their own goals and objectives. The Review Committee throws light on the expected role vis-a-vis the growth of technical education in the country. It is worthwhile to quote some of the relevant passages of this report. The Report says, inter alia, [1, pp. 5, 6]:

> *"Our remit requires us ... to examine how far the Institutes have interacted with other Technical Institutes with particular reference to courses of study, programmes of research and faculty development and to assess the overall impact of the Institutes on the training of high grade engineers for the technological development of the country.*

With regard to the achievements of the IITs, the report states:

> *"The IITs have also contributed their share in upgrading the quality of Engineering Education in the country, through QIP (Quality Improvement Programme) and FIP (Faculty*

Improvement Programme) ... A number of faculty of our Technical Institutions have received intensive programme of training including exposure to the techniques of modern teaching methods. Some of them are trained, as part of these programmes, for their Ph.D., while some others are given training in the development and planning of the laboratories. All these programmes are carried out by the IITs within their own resources ... IITs have also helped laboratory planning in selected engineering institutions under the Institutional Network scheme since 1970, by planning their core facilities ... IITs have helped these institutions in drawing up relevant laboratory manuals, and generally improved experiments in the laboratory. Such efforts of the IITs cannot be measured specifically in terms of graduates and postgraduates. But they all go to enhance qualitatively the general level of engineering education in the country."

The Quality Improvement Programme of the Government of India has concentrated on a three-pronged approach to improving the quality of the engineering colleges. This has included enhancement of qualifications of the faculty of these colleges through degree level programmes (including M.Tech. and Ph.D.) and organization of short term intensive courses in areas of emerging interest by the QIP Centres. In addition, these Centres have supported the preparation of text and reference books, laboratory manuals and other teaching aids in all disciplines of engineering. The following Table indicates the number of engineering college faculty trained at M.Tech. and Ph.D. levels and the number of short term intensive courses run by the IITs since the inception of QIP until 1993-94 (data taken from reports from the QIP Centres of the IITs).

Table 4.1
Teachers Trained and Courses Run Under QIP

Institution	M.Tech.	Ph.D.	Courses Run
IIT Bombay	224	251	98
IIT Delhi	181	183	142
IIT Kanpur	135	155	125
IIT Kharagpur*	211	169	99
IIT Madras	282	215	141
Total	1033	973	605

* Figures for period upto 1992-93 only

These figures indicate that the IITs have made a substantial impact in updating the quality of faculty of the colleges. In addition a large number of books have been written by the faculty of the IITs under QIP. IIT Kanpur alone has produced 88 books under this programme and many more are in the pipeline. Also, an Institution Networking Scheme (INS) was initiated in 1981-82 to develop an internal assistance programme of networking between the QIP Centres and other institutions such as the RECs and State engineering colleges for development of laboratories, exchange of faculty, training of faculty members and collaborating in research programmes. According to the Annual Report of the Ministry of Human Resource Development, 1991-92 [12], during the seventh Plan period, 199 laboratories were supported through INS and another forty laboratories were supported during 1990-92. (It is to be mentioned that in addition to the IITs, the QIP and FIP programmes have also been established at the Indian Institute of Science, Bangalore, and the University of Roorkee).

Another area in which IITs have had a substantial impact on the technical education is in the academic reforms that have been carried out at many institutions and the method of admission through competitive examinations which has now become almost universal throughout the country (it may, however, be mentioned that the method of admission through competitive examination had been followed in a selected number of institutions, such as University of Roorkee, much before the establishment of the IITs). There is an increasing trend towards adoption of the Semester system and award of letter grades. The pattern of external examination is also gradually being reduced and greater weightage is being given to continuous evaluation by the teacher concerned. More colleges are offering elective courses to the students. There is also more openness in the examination system. Overall it is felt that the impact of the IITs on the technical institutions goes far beyond the quantitative figures of number of faculty trained and short-term courses offered.

In general there is a great deal of appreciation of the impact of the IITs on the technical education scene of the country. This impact was the prime objective of setting up the IITs and the this was the expectation from them, according to both the questionnaire responses of the IIT faculty and personal interviews with eminent persons.

4.2 Overall Impact

In addition to having a catalytic effect on the improvement of technical education in the country, the IITs, as institutions of national importance, are expected to contribute to the science and technology scene of the country and generally to an enhancement of quality. In this respect their impact is felt in several ways. Many have commented that our outstanding programmes such as space, missile systems, atomic energy, etc., could not have been successfully completed but for the contributions of institutions like the IITs through their graduates and their faculty. Many organizations such as the Departments of Science and Technology, Space, Electronics, Telecommunications, Atomic Energy have looked up to the IITs as think tanks. Even the Planning Commission has had meetings with IIT Directors in the formulation of specific missions for the IITs in the context of national needs. There has also been a substantial contribution to entreprenеurship by the graduates of the IITs. The Government have also frequently selected faculty members of the IITs to head major national laboratories (such as CSIR laboratories) and other well known organizations.

A major impact, somewhat invisible and non-quantifiable, is the production of engineers with self confidence, willing to take up the unchartered path rather than adopt the security of tried and tested systems. Their contribution everywhere has enhanced the image of the country. Discussions with industry personnel have disclosed that, notwithstanding the complaint that few IIT graduates join the industry and of those who join, a large number leave, those IITians who have stuck with the industry are today rated amongst the most dynamic leaders who have contributed most to the growth. This is attributed to their independent thinking, self confidence and willingness to take risks.

There has been a valuable psychological gain for the country by what the IITs have done. The IITs have demonstrated that globally competitive institutions of excellence can be set up and maintained in India - in short, that 'oasis can exist and are not always mirages' (quote from one respondent). They have enhanced India's prestige in the industrially advanced countries by the quality of their education and of their graduates. The Joint Entrance Examination (JEE) system has also led to a new spirit of competition amongst the young high school students and generated a culture of hard work and discipline amongst the youth. (However, there are many reservations also about the impact of the JEE on the high school students - in fact, a review of the JEE has been initiated by the IITs and may result in changes starting in 1995).

Chapter 5

AREAS OF CONCERN

5.1 Concerns Then and Now

5.1.1 The Review Committee View

The Review Committee had indicated certain areas of weakness and concern in the report and pointed out the following problems [1, section 2.3]

1. The undergraduate programmes have tended to become stereotyped although when the IITs were started, the programmes were very flexible. The way practicals are conducted is another source of disappointment.

2. The total research output of IITs and the quality of research carried out have not reached the levels expected of them.

3. Over the last few years the emphasis on experimental research has dwindled. There is a tendency to avoid experimental work.

4. Though these are institutes of technology, there are relatively few doctorates in technology. Ph.Ds are awarded equally in science-based and engineering-based subjects but few have earned a doctorate in technology.

5. Their contacts with industry are few and far between. There is no substantial technological fallout from the projects undertaken by the IITs or from the results following from their research.

6. The IIT faculty have an ambivalent attitude to the application of science and technology in rural areas.

7. The cream of IIT graduates are not available for service in the country.

8. Not many IITians have become entrepreneurs and job generators.

9. The IIT value system does not motivate the students to be committed to work in the country which has invested so much on their training.

5.1.2 The Concerns Now

In the eight years or so since the report came out, there have been many changes of perception. On many counts the problems are not viewed the same way today. For example, the question of brain-drain is not now considered one of prime importance. In fact the Programme of Action (POA), 1992, of the Government of India, Ministry of Human Resource Development [13], states that "in the present situation of global inter-dependence, interaction of institutions in one country with institutions and academics in another country has become inevitable and in most cases desirable. One should not get alarmed with the fear of the so- called brain-drain ... [those who go abroad] could, in a way, be treated as a Brain Bank". In other areas, the POA states that "the IITs will also take up new activities like thrust areas of technology development, establishment of industrial foundations/parks,international consultancy etc. Steps will be taken to make them more and more self-reliant and financially autonomous through creation of Corpus Fund and other measures for generation of resources and such other innovations recommended by the Review Committee". Most of these ideas are now in the process of implementation. Another example of change is the recent review of the JEE system which has gone into all the problems and weaknesses that have been talked about.

The main concerns at present emerge out of the discussions with various eminent persons and from the response of the faculty and the alumni to the questionnaires. It must be stated to the credit of the IIT faculty that they are their worst critics. This strong tendency of self-introspection is indeed a healthy sign and is one of the strong points of the IIT environment. The alumni criticism and suggestions must be viewed in the light of the fact that 84 percent of the respondents are working in industry (public sector,

private sector, or their own) and their views may be tinged by the problems they face and which they relate to the IIT curriculum or the environment.

There is substantial criticism of the non exposure of the students to the Indian industrial scene both in terms of what is taught in the courses and in terms of summer training and industrial tours and the way they are organized. There is strong feeling that these two components of the engineering education, viz., summer training and industrial tour, are very important in the programme. The faculty also feels that both these aspects are very important and should be compulsory. Survey results show that 83 percent faculty agree that industrial tours for students are a very important part of the curriculum and seventy five percent feel that industrial tour should be compulsory and assignment of a teacher to organize the tour and accompany the students in the tour should be a part of normal teaching load assignment. Ninety two percent faculty members feel summer training of students in industry should be compulsory for at least one summer. Yet one does not find sufficient thought and care being given to this aspect of the engineering education. The example of other Indian institutions, such as Birla Institute of Technology and Science, Pilani, where the practice school system ensures a far greater exposure of the students to the industry and is meticulously planned, are only looked at with suspicion (if not disdain) by much of the IIT faculty.

There is also a strong feeling that the B.Tech project should be a practical, design and fabrication type of project, preferably related to the actual needs of some industry. While many projects are of this type, in the majority of the cases, this is not so at present (see Alumni questionnaire response to item C-3, Annexure I).

The two main criticisms which stand out are (i) lack of interaction with the industry, and (ii) alienation of students from the Indian work place and Indian environment. On the question of interaction with the industry and what to do about it, the alumni and faculty survey results are significant. Almost 95 percent alumni and 94 percent faculty agree with the statement that IITs need to consciously increase interaction with industry. Eighty five percent alumni feel that more practical orientation should be given to the curriculum by hiring teachers with industrial background and 92 percent feel that teachers should be required to keep in touch with industry by summer visits or longer stays in the industry (78 percent faculty members also agree with this statement). The methods that can be adopted

for increasing the interaction with the industry have been discussed in the Industry questionnaire. The responses there indicate what are the inhibiting factors and also in what ways the interaction can be increased. This topic has been discussed almost ad nauseum and the arguments will not be repeated here (see Mathur, [14]). Suffice it to say that most academicians feel that the industry is as much (if not more) at fault for the dismal state of interaction as the institutions.

In a sense both the criticisms, viz., lack of industrial interaction and alienation of the students, are inter-related. It is said that for the majority of the IIT faculty, their reference point is not in India but outside India. In almost all decision making and planning the practices of USA and other countries are quoted and projected as examples of what we should be doing. Many faculty members keep strong contacts abroad and visit those countries during the summer, working in their industry and universities. These faculty members are viewed as examples to be emulated by many others. The few who are devoting their time and energy to looking at problems of Indian industry or other problems of India are hardly ever seen as the role models to be copied. The reasons for this attitude are not far to seek. Contacts abroad are more rewarding both financially as well as in terms of career advancement.

The IITs have failed to develop a measure of faculty evaluation which will reward contribution to the Indian scene or excellence of teaching. The emphasis on getting the best brains for the faculty usually translates into identifying those who have the most outstanding publications in foreign journals and best recommendations from foreign experts. No apparent effort has gone into identifying other measures which will help locate committed and capable persons with an Indian bias. Unlike universities abroad, the IITs have failed to generate a mechanism of student evaluation of courses and teachers and to use such evaluation effectively for making appropriate changes in the courses as well as in assessing faculty members for promotion/rewards/incentives. This is despite the fact that the Academic Senates of many IITs have endlessly debated the desirability of having a proper student evaluation of the courses and the teachers.

The above problems with regard to faculty have their effect on the thinking and orientation of the students. The faculty, with their lack of contacts with the Indian science and technology scene, are unable to give proper examples to the students. No wonder the latter are alienated. One

is reminded of the prophetic comments made by members of the Kanpur Indo- American Programme team in the final report at the end of the ten-year progamme of collaboration (1962-72). Dahl has said, "The question of what the graduates do will be influenced markedly by what the faculty are doing professionally. I am disappointed that so few IIT Kanpur faculty are engaged in current problems of India, both because of what they might contribute to the solution of these problems and because of the professional and psychological benefits which would accrue to their students through the faculty's involvement in such problems. Who can blame the graduates for responding to the excitement of post-graduate study abroad when they see no opportunity in postgraduate work at IIT Kanpur to work on problems which matter to India or to their future career in India ?" [15]. In a similar vein Halfman says, "While accumulating skills, facts, and techniques, the student's personal maturation is proceeding apace. He listens to what the faculty says but is impressed more by what it does. He learns from the hidden curriculum as well as the overt one" [16].

Also, frequent reference to, and use of, books by foreign authors reinforces this feeling amongst the students that all worthwhile work is done abroad by foreigners. Given the outstanding calibre of the students, the reluctance to work in India is a natural consequence. It is felt by many that the publication and use of world class books by Indian authors will go a long way towards generating a feeling of pride and confidence in the quality and calibre of the faculty.

5.2 Negative Impact

That the IITs have had a strong positive impact on technical education in particular and the nation as a whole in general comes out amply by this survey. That there are areas of concern is also not unexpected. Any single institution can only meet a limited number of targets and requirements and amongst those not met, there is often no unanimity of opinions. However, the unique position of the IITs in India today causes certain features to have a negative impact on technical education. This is because IITs are seen as (and also paraded as) pace-setters and role models for other institutions. This implies that the weaknesses of the IIT system tend to get reflected as acceptable and even desirable qualities. Their impact on

the faculty and students of other institutions becomes a negative contribution. Chief amongst such problems is the perception that a measure of good engineering education in India is the ability of the graduate to go to a good foreign university for higher education or to be able to go to a good management school. Also, the emphasis on theory over practice gains a measure of respectability which is not good if followed by a large number of engineering institutions. The involvement of a large number of faculty members in theoretical research also affects the nature of theses guided by them which has its effect on the teachers trained under the QIP. Thus it has a snowballing effect, to the detriment of the country.

Another negative impact arises from the very existence of the IITs as islands of excellence and institutions of national importance. The effect on other engineering colleges is indirect. They face difficulty in recruitment of good faculty because the best faculty is attracted to the IITs. The causes for this attraction do not always lie in the excellence demonstrably achieved by the IITs. The IITs offer not only better research facilities and environment and smaller teaching loads with better quality students, but also better housing, better schooling facilities for the children, better medical facilities, better opportunities to interact with the international scientific community, and better pay scales. Most of these factors result from the more liberal funding given to the IITs compared to other technical institutions. Many faculty members of other engineering colleges (both state supported and RECs) feel that the claim of excellence of the IITs is based perhaps as much on the massive financial inputs into the IITs by the government and the resulting facilities and infrastructure created as on actual achievements and performance. The result is that the very existence of the IITs causes a certain demoralization in the faculty of other institutions, a certain sense of being only the 'second best'. The influence of this mental attitude on the quality of teaching and research output can only be guessed but discussions with a large number of faculty members of these institutions indicates that it is substantial. The problem is, of course, not unique to India or the IITs. All over the world the better known institutions attract the best faculty and the best students. However, the situation in India is different and some measures can be adopted to reduce this negative impact.

The influence of the JEE on the high school students is also beginning to become a matter of alarm to both parents and school teachers. While the examination certainly results in the choice of the 'cream of the intelligent

students' (as JEE qualifiers are usually called), many feel that it has distorted the learning process and the perception of what constitutes achievement. Many persons both faculty members and others have expressed this apprehension. The fierce competition results, on the one hand, in creating a traumatic experience for thousands of students who fail to qualify for the IITs and, on the other hand, creates an elitist feeling amongst those who do qualify - a feeling that the country owes them everything and they owe the country nothing.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

This study of the IITs regarding the role and impact of teaching curricula and other related factors in meeting national needs has brought many interesting issues to light. The collection of views from the alumni, industry and the IIT faculty shows a large agreement regarding areas of strength, concerns, and ideas on where we have failed and what should be done. The picture that emerges shows we have much to be proud of and we are going in the right direction. Only certain areas need to be looked into and some steps need to be taken to modify priorities in the future. In this chapter we include the broad conclusions that can be drawn.

6.1 Institution Building

Since independence in 1947, the country has purposefully embarked on building certain institutions of national importance in chosen areas of professional education. These institutions include the five IITs, the four Indian Institutes of Management (IIMs), and the All India Institute of Medical Sciences (AIIMS). They were created with a great vision originating in the thinking of Jawaharlal Nehru. Their success is indicated by the status and reputation they enjoy both in the country and abroad. Much of this success is owed to the vision and personality of the individuals who were the first heads of these institutions. In the case of IIT Kanpur, for example, it is difficult to find a single individual who does not attribute the institution's strength to the vision and foresight of its founding Director, the late Professor P. K. Kelkar. In fact, each of these institutions carries the stamp of its founding Director. This is an important lesson in institution building and is also well known and accepted. However, even for institutions

which have been created and established very meticulously, the head of the institution plays a very significant leadership role in the future growth of the institution. An institution, painstakingly built by men of high stature, can quickly degenerate and disintegrate in the absence of the right man at the top. Leadership in an academic institution, particularly in one of the institutes of national importance such as the IITs, is a much more difficult task than in any other organization. The presence of fiercely independent faculty having the highest credentials who vociferously express their views and opinions, and who refuse to be led, makes the task of providing leadership extremely difficult and challenging. Many in the IITs and outside feel that the government have sometimes failed in their duty to appoint, and appoint in time (see below), such leaders to lead the IITs.

The delay in the appointment of a successor head is a peculiar problem of the Indian system. A great misfortune of institutions in India is to remain headless for extended periods of time due to government indecision. Headless institutions tend to be incendiary and the head, when he eventually comes, has little else to do but to do fire-fighting. He has little time left to provide academic leadership. It is pathetic to see the large number of institutions in India which are allowed to remain headless and drift almost aimlessly for extended periods of time, thereby destroying a stature that has been built after years of effort. Such institutions include institutions of national importance, universities, public sector enterprises, etc. This kind of misfortune has befallen the IITs time and again and many place the blame for some of the ills of the IITs on this factor. The role of leadership has been stressed by a large number of persons. We have, therefore, decided to include this section here.

6.2 The Role of Curricula

There is an overwhelming agreement about the role of the curricula in the overall education of the students. The curricula of the IITs has been recognized as of world class. The teaching has also been recognized to be of the highest quality. (Amongst the 1023 responses of the alumni there were only 2 or 3 which had criticized the teaching.) The ability of the IITs to set up and maintain high quality facilities and the high calibre faculty deserves all credit. The organization and conduct of an all India competitive

examination for admissions which has run successfully and without blemish for over 30 years is a big achievement. In the Indian context, the running of an educational programme with clockwork precision in terms of admission, classes, examinations, declaration of results and holding of convocations every year is also a great achievement. In fact many parents and students choose an IIT education for these characteristics only (even if engineering is not their main concern). The creation and operation of a new (to India) system of internal evaluation, course-wise promotion and offering of elective courses is also a contribution to the Indian educational scene.

There are two aspects which have caused concern. One is the inadequate attention paid to summer training, industrial tours and B.Tech projects. The other aspect is the lack of exposure of the students to the Indian scene through the contents of the lectures and through organization of lectures by persons from the industry. In this context the role of the Academic Senates leaves something to be desired. Even when the curriculum review committees have recommended an increased emphasis on this aspect and have suggested ways and means of achieving this, there has been no positive action taken. Many feel that in the Senate meetings, decision making is dominated by the vociferous few resulting in what has been described as the 'tyranny of the minority'. The inability of the Chairmen in such cases to have the curriculum review committee recommendations implemented somehow creates a feeling of lack of leadership. This is unfortunate because few institutions have gone about the task of curriculum review so methodically as the IITs have done through their review committees. That these reviews are not effectively utilized is a matter of concern.

Another matter in which IITs have failed to create a proper example is the creation and adoption of a system of student evaluation of the programme and of the teachers. Such evaluation is even more important in the IITs than in the conventional university system because of the enormous responsibility placed on the teacher and the power given to him. A proper procedure evolved in this regard will go a long way in setting a new tradition in the country.

6.3 The Science and Technology Scene

With regard to the impact on the science and technology scene of the country there are undoubtedly areas where the IITs have contributed greatly through their students and their faculty. These include major thrust areas like space, defence, electronics, computers, atomic energy, etc. The industry also has benefited greatly from the quality and temper of the manpower generated by the IITs. IITs have also contributed towards the growth of entrepreneurship although they have not met people's expectations in this regard. It is generally felt that the contribution of the IITs is far more than what is generally known due to the poor public relations posture adopted by them.

Nevertheless, the overall interaction with industry is not as much as expected (or as is prevalent in western countries). The consequent lack of exposure of students to our industrial scene has many consequences. Many alumni also feel that even when the faculty members are deeply involved in research, their research activity is not highlighted in the teaching. The students remain unaware of the work being done by their teachers. All this has contributed to the alienation of the students from the Indian scene. In the process the country has missed a great deal of what might have been contributed by the faculty and the students.

The new economic policy and the consequent liberalisation and globalisation have added a new dimension to the thinking of our industries. It is felt that this will remove some of the barriers which prevented institution-industry interaction. Some effects are already becoming visible. In that sense it will not only lead to greater exposure of the students and the faculty to the industrial scene but will also create a new challenge for the graduates which they presently lack.

6.4 National Pride and Role Model

Every country has certain landmarks of success and achievement which create a sense of pride amongst its people. They help boost the national ego and are a great source of strength to its people. They are quoted by other countries as evidence of the strength of its character and ability. In the modern environment, they serve as a measure of the country's ability to

achieve results and thus generates confidence about itself in other countries and organizations. This confidence is of great value which is not measurable in terms of costs. The returns of such investments are often hidden and not directly visible.

In this context, the country's decision to set up institutes of national importance and its success in setting up the IITs has become a matter of national pride. These institutions are recognized the world over as institutions of excellence because of the calibre of the students and of the faculty. Their facilities are appreciated even in the well developed western countries and are superior to the best found in the developing countries. Nationally they have set a standard of honest and unbiased admission on merit, teaching regularity and quality, and an environment of freedom which has few parallels in the country. Their contribution to the national pride is itself an achievement which is noteworthy. One needs examples to emulate and IITs provide such an example to the technical education institutions.

The role of a pace-setter and a model imposes high responsibility on the system. In this context the negative impact of the IITs has been mentioned in Section 5.2. This needs careful consideration.

6.5 Alumni as a Resource

One of the strengths of the education system in the west is the participation of the alumni in the development and growth of the institutions. While IITs are often seen as having copied the western system, their relationship with the alumni is far from what is practiced in USA, for example. In the present context of reorientation of our economy and funding of higher education, the alumni can play a very significant role and a strong interaction with them is necessary. The responses of the alumni show that, apart from possible monetary contributions, their participation can have meaningful impact on the teaching programme as well as efforts at more meaningful research and industrial interaction. This needs to be taken up as a matter of priority.

6.6 Recommendations

The overall findings of this project lead to identification of certain areas which the IITs need to strengthen to enhance their utility and impact. These are listed below.

1. A new course of action needs to be adopted to enhance the exposure of the B.Tech students to the industrial scenario of the country. Various steps in this direction have been suggested by the curriculum review committees of the IITs. These include a well planned and supervised summer training programme and industrial tour for the students. The quality of the B.Tech project needs improvement with greater relationship to the actual needs of the industry. This can only be achieved if the faculty have greater involvement with the industry and the institute as a whole invites more participation from industry personnel through lectures in courses, extra-mural lectures and adjunct professorships. All these are feasible and need only the will to achieve them.

2. The involvement of faculty in the industrial scene requires a multi-pronged approach. The following are amongst the possible steps:

   (a) Incentives to faculty who participate in industrial interaction in one way or the other.

   (b) Changing the rules regarding sabbatical leave so that greater leave can be utilized for industrial participation.

   (c) A tilt towards favouring industrial experience as a desirable qualification when considering candidates for faculty recruitment.

   (d) Encouraging consultancy by reducing the amounts that go to the institute as overheads from consultancy income.

   (e) Changing rules so that faculty can draw part of their salary from project funds in return for reduced teaching load.

   (f) Encouraging faculty to start their own industry and providing suitable facilities and benefits (as has already been started in IIT Kharagpur).

3. The IITs must start a concerted effort at getting top class text books written for use in India which emphasize the Indian work environment and developments in India. Some IITs have already started this scheme. However, a much greater effort needs to be made with proper incentives and remunerations. This should be considered equivalent a teaching load and a definite time frame should be set.

4. IITs must develop a system of student evaluation of both the teaching programme and the teachers. Such systems are widely used in the USA and provide an input for faculty assessment as well as course improvement. When used for faculty assessment, they provide both an incentive and a check to maintain standards.

5. The contact with the alumni needs to be increased to encourage financial contributions and increase their participation in the growth and development of the institutes.

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INDIAN INSTITUTE OF TECHNOLOGY KANPUR
DEPARTMENT OF ELECTRICAL ENGINEERING

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27 APR 1993

Dear IIT Alumnus,

I am seeking your help in carrying out a study entitled **"The Role and Impact of Teaching Curricula in Meeting National Needs: A Case Study of the IITs"** which is supported by the Department of Science and Technology, Government of India. As inputs for this study I am collecting opinions of the B.Tech graduates of the five IITs. I am enclosing a Questionnaire with a request that you kindly take the time to fill it and mail it back to me (a pre-paid self-addressed envelope is enclosed for use of respondents in India). Pre-testing of the questionnaire shows that it will take only 10-15 minutes of your time. May I request you to respond right away ?

The Questionnaire has four parts. Part A seeks factual information about the respondent. Needless to say, all information supplied by you will be kept strictly confidential and will be used only for statistical analysis, without disclosing your identity to any one. Parts B, C, and D seek your views on various aspects of the IIT education.

I would be particularly keen to know your views on any aspect related to this study and for this purpose Part E is reserved for your own comments. Please feel free to write to me if you need any other information or would like to know more about this project.

I hope to get your response very soon. With best regards,

Sincerely yours,

N.C. Mathur

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ANNEXURE I

QUESTIONNAIRE FOR THE ALUMNI

A. BACKGROUND

1. Name :

2. Present Address :

3. Telephone :

4. B.Tech Information :

Graduating year ..... Branch .....

IIT : Bombay ☐ Delhi ☐ Kanpur ☐ Kharagpur ☐ Madras ☐

5. Higher Studies (if applicable) :

Period	Degree	Institution
19 .... - 19		
19 .... - 19		
19 .... - 19		

6. Work Profile :

Period	Organisation	Designation	Nature of Work
19 .... - 19			
19 .... - 19			
19 .... - 19			
19 .... - 19			

B. CHOICE OF CAREER

1. What did you do immediately after B.Tech ?

Higher studies abroad	☐	Higher studies in India	☐
Job in India	☐	Entrepreneurship	☐
Other (please specify)	☐		

2. Please indicate the factors which influenced your decision on post-B.Tech options using a five-point scale [(a) very strongly, (b) fairly strong, (c) moderately, (d) marginally, (e) not at all].

	Very strongly (a)	Fairly strong (b)	Moderately (c)	Marginally (d)	Not at all (e)
i) The B.Tech curriculum	☐	☐	☐	☐	☐
ii) The overall IIT environment	☐	☐	☐	☐	☐
iii) Peer pressure	☐	☐	☐	☐	☐
iv) Family pressure	☐	☐	☐	☐	☐
v) Performance in B.Tech	☐	☐	☐	☐	☐
vi) Any other (please specify)	☐	☐	☐	☐	☐

C. ON THE B.TECH CURRICULUM

This section is designed to elicit factual information as well as your evaluation of some aspects of the B.Tech curriculum and co-curricular activities such as summer practical training, industrial/educational tours and B.Tech project, etc.
Please give factual information on the following:

1. Was there any compulsory practical training during summer at B.Tech level ?	Yes	76.7
	No	23.3
2. Was there an educational/industrial tour as part of the B.Tech Programme ?	Yes	70.5
	No	29.4
3. Was your B.Tech project related to some real life problem of Indian industry ?	Yes	46.9
	No	53.1

Please respond to the following questions on the 5-point scale by ticking the appropriate box. (5 corresponds to maximum and 1 corresponds to minimum)

		Maximum (5)	(4)	(3)	(2)	Minimum (1)	Weighted Average
4.	How useful did you find summer training in learning practical aspects of engineering ?	19.9	29.2	24.5	14.0	12.2	**(3.3)**
5.	How much influence did the summer training have in your decision to work (or not to work) in India ?	9.6	16.3	16.2	17.0	40.7	**(2.3)**
6.	How important do you think is summer training in an engineering curriculum ?	56.8	28.1	9.6	3.3	2.0	**(4.3)**
7.	How important is the role of the industrial tour in creating an awareness of the industrial enviroment ?	36.2	30.6	19.1	8.4	5.5	**(3.8)**
8.	How important is the B.Tech Project in the overall B.Tech programme ?	32.7	35.5	19.6	9.2	2.8	**(3.8)**
9.	How important was the role of the B.Tech Project in your job placement and/or post-B.Tech work ?	7.7	11.4	15.8	18.3	46.5	**(2.1)**
10.	How good was your B.Tech curriculum in inculcating design capability ?	18.0	33.0	26.7	16.1	6.0	**(3.4)**
11.	How strong has been the role of "science based engineering" curriculum of the IIT education in your career ?	27.2	36.8	20.0	10.2	5.6	**(3.7)**
12.	How well is the IIT curriculum designed to encourage entrepreneurship ?	5.8	9.4	21.0	30.5	33.1	**(2.2)**

D. ON IITs AND THE NATIONAL SCENE

The following statements are designed to elicit views on the main theme of this project, viz., **"The Role and Impact of Teaching Curricula in Meeting National Needs: A Case Study of the IITs"**. It is realised that perceptions differ regarding "national needs". However, statements on this aspect have been included to evaluate how IIT graduates view the national needs as well as the role of the IITs. Please indicate your level of agreement with the statements given below on the five-point scale [The five responses are: (a) Agree Strongly, (b) Agree, (c) Undecided, (d) Disagree, (e) Disagree Strongly].

	Agree Strongly (a)	Agree (b)	Undecided (c)	Disagree (d)	Disagree Strongly (e)	Weighted Average
1. The "National Needs" in the context of engineering education are well understood to include achievement of technological self-reliance	19.5	39.6	9.4	24.1	7.1	**(2.2)**
2. The "National Needs" in the context of engineering education are well understood to include application of science and technology to improve the rural life	10.6	25.8	14.3	34.9	14.3	**(-0.9)**
3. The national needs are not adequately defined and hence IITs cannot take them into account in the context of their curriculum.	9.5	30.6	12.3	35.7	11.7	**(-0.5)**
4. The purpose of IITs is not to worry about the national needs but to produce graduates comparable to those of the best institutions of the world	16.5	16.9	6.9	32.8	26.8	**(-1.9)**
5. A top class curriculum in engineering is country-independent and cannot be moulded to suit the national needs of India	10.7	17.3	6.1	42.0	23.6	**(-2.6)**

		Agree Strongly (a)	Agree (b)	Undecieded (c)	Disagree (d)	Disagree Strongly (e)	Weighted Average
6.	The IITs have adopted the correct approach towards curriculum design	6.4	33.9	24.3	29.0	6.2	**(0.3)**
7.	The IIT curriculum needs substantial revision in the light of the nation's expectations from the IITs and their contribution so far	21.2	39.9	12.7	22.0	4.0	**(3.0)**
8.	The contribution of the IITs to the science and technology scenario of the country has been negligible	6.5	21.3	12.6	41.3	18.0	**(-2.4)**
9.	Since the IITs have been in operation for less than 30 years, it is too early to judge their impact on the national science and technology scene	0.6	4.4	9.7	57.6	27.5	**(-5.9)**
10.	IIT education does not create an awareness of the Science and Technology scenario of India	10.9	40.4	8.2	30.7	9.6	**(0.6)**
11.	The overall IIT experience (curriculum, co- and extra-curricular activities and general life pattern) tends to alienate the students from the mainstream of Indian life and work environment	16.0	33.1	8.7	32.6	9.4	**(0.7)**
12.	The IIT curiculum is overly theoretical and science based and plays down experimental work and "shop floor experience"	18.9	39.9	7.9	27.8	5.3	**(2.1)**

	Agree Strongly (a)	Agree (b)	Undecieded (c)	Disagree (d)	Disagree Strongly (e)	Weighted Average
13. The IITs need to consciously increase interaction with industry as the present level of interaction is inadequate	59.6	35.2	2.8	1.9	0.3	**(7.8)**
14. More practical orientation should be given to the curriculum by hiring teachers with industrial background	45.2	39.6	6.7	7.0	1.1	**(6.4)**
15. Teachers should be required to keep in touch with industry by summer visits or longer stays in industry	50.2	41.9	4.8	2.4	0.4	**(7.3)**

E. ANY OTHER COMMENTS YOU WOULD LIKE TO MAKE

If you like you may please give below your views on other matters related to this survey or expand on any matters raised in this questionnaire (Please use additional sheets if necessary).

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
DEPARTMENT OF ELECTRICAL ENGINEERING

Dr. N.C. Mathur
Professor

Kanpur - 208 016, INDIA

Dear Sir,

I seek your assistance in a project entitled "The Role and Impact of Teaching Curricula in Meeting National Needs: A Case Study of the IITs" sponsored by the Department of Science and Technology. The project aims at collecting information through reports, interviews, and questionnaire surveys on the contributions of the IITs to the Science and Technology scenario of the country and the factors relevant to it. It is planned to survey a number of industries through a Questionnaire for collecting relevant data. A copy of the Questionnaire is enclosed.

I write to request you to have this Questionnaire completed by a very senior person of your company who is familiar with both the company's structure (manpower-wise) and company policies as well as the overall industrial scene of the country. It is realized that not all questions are relevant to all the industries. Questions not relevant or on which sufficient information is not available may be left out. But please do send a response. The utility and validity of results of the survey are critically dependent on the number of responses. The filling of the Questionnaire will only take about 15 - 20 minutes. May I request you to have it filled right away and returned to me ?

I am most grateful for your cooperation and help. With best regards.

Sincerely yours,

N.C. Mathur
Principal Investigator

Telephone : (Off) 0512-250151/2413
(Res) 0512-250501
e-mail : ncm@iitk.ernet.in
Fax : 0512-250260
Telegram : TECHNOLOGY
Telex : 0325-296/0325-329

ANNEXURE II

QUESTIONNAIRE FOR INDUSTRY

PART A

Background Information

It is recognised that exact responses to the questions listed below will not be available. Please give approximate figures and skip a particular item if it is not applicable to your company. You may prefer to give a range of values, e.g., 'the company recruits 50-75 engineers every year'.

1. Name of the Company:

2. Name, Designation and Address of the person answering this Questionnaire:

3. How many graduate engineers does the company employ ?

4. Graduates in which branches of engineering are employed (list in order of the numbers employed) ?

5. How many engineers are recruited every year ?

6. Approximately how many of the engineers employed by the company are IIT graduates ?

7. Does the company have a training programme for freshly recruited graduates ? If so, what is its duration ?

8. Does the company have interaction with engineering colleges/IITs through any of the following ?

	Yes	No
(a) sponsored research	☐	☐
(b) consultancy/testing	☐	☐
(c) summer training of students	☐	☐
(d) industrial tour of students	☐	☐

PART B

Performance of Engineers

This part is intended to seek your opinion about the performance of engineers employed in your company who have studied in IITs relative to those who have graduated from other engineering colleges. Please indicate you evaluation in respect of each item for both categories of engineers on a scale of five as indicated below:

	Very poor (1)	(2)	(3)	(4)	Very Good (5)
(a) Initial preparation for job	0	2.6	29.0	55.0	13.0
(b) Progress during training	0	0	12.5	50.0	37.5
(c) Enthusiasm towards assignment	0	0	18.4	57.9	23.7
(d) Problem solving ability	0	0	7.9	63.2	28.9
(e) Initiative	0	0	13.2	65.8	21.0
(f) Self-confidence in handling jobs	0	0	7.9	52.6	39.5
(g) Ability to work in a group	1.7	2.6	44.7	39.5	10.5
(h) Ability to direct an assignment	2.7	8.1	16.2	51.3	21.6
(i) Ability to control subordinates	2.7	10.8	32.4	37.8	16.2
(j) Ability to suggest new ideas	0	2.6	0	57.9	39.5

PART C

The B.Tech Curriculum

The typical IIT B.Tech curriculum has several components. The student is given a certain number of courses in Basic Sciences and Mathematics and some courses in Humanities and Social Sciences. Certain basic courses in engineering practice are compulsory for students of all branches of engineering. Professional courses for a particular branch include certain compulsory courses and some optional courses. There are also other elective courses available which the student can take from any branch.

An awareness of engineering practices and industrial environment is generated through summer industrial training and industrial tours. This part of the questionnaire seeks to get your views on the adequacy of the IIT curriculum and its weaknesses and strengths, based on your experience of the capability of IIT graduates vis-a-vis your requirements. Please tick mark your response on a scale of five as below

		Very poor (1)	(2)	(3)	(4)	Very Good (5)
(a)	Basic knowledge of science / mathematics	52.6	2.6	2.6	0	42.1
(b)	Knowledge of engineering practice	0	0	19.5	58.5	21.9
(c)	Knowledge of latest techniques	0	0	12.2	65.8	21.9
(d)	Knowledge of Indian industrial scene	25.1	23.1	43.6	25.5	2..6
(e)	Specialised knowledge of particular subject	0	4.9	17.1	56.1	21.9
(f)	General awareness	0	4.9	26.8	39.0	29.3
(g)	Communication ability	0	2.4	14.6	51.2	31.7

PART D

The Industry Viewpoint

The total impact of engineering educational institutions on the science and technology scenario of the country depends to a large extent on the relevance of the education to the needs of the country. The industry is the prime employer of technical manpower. The benefits and strength it derives from interaction with the engineering institutions and through employment of their graduates determines the relevance of the education. This part of the questionnaire explores this aspect. Please indicate your response to the following statements on a scale of five as indicated below.

	Agree Strongly (1)	Agree (2)	Undecided (3)	Disagree (4)	Disagree Strongly (5)	Weighted Average
(a) The IITs have made a significant contribution to the industrial development in the country through their graduates and their teachers	16.3	63.3	8.2	12.2	0	(4.5)
(b) The overall performance of IIT graduates in industry is noticeably superior to that of graduates of other institutions	18	52	24	6	0	(5.4)
(c) IITs should invite significant involvement of the industry in the design of their curriculum	45	49	2	2	2	(6.8)
(d) More practical orientation should be given to the curriculum by hiring teachers with industrial background	58.8	35.3	3.9	2	0	(7.8)
(e) Teachers should be encouraged to keep in touch with industry by summer visits or longer stays in industry	64.7	31.4	3.9	0	0	(8.4)
(f) Providing summer training facilities to students of engineering colleges hinders the work of the industry	3.9	2	13.7	62.7	17.6	(-5.1)
(g) Well-planned summer training of engineering students can lead to better interaction to the benefit of both industry and institutions	31.4	60.8	2	3.9	2	(5.9)
(h) The present level of interaction is very inadequate	21.6	58.8	7.8	11.8	0	(4.8)

	Agree Strongly (1)	Agree (2)	Undecided (3)	Disagree (4)	Disagree Strongly (5)	Weighted Average
(i) Some of the factors which inhibit interaction are:						
1. Teachers in engineering colleges prefer to work on theoretical problems	27.4	52.9	15.7	3.9	0	(6.2)
2. Teachers are unwilling/unable to tackle time-bound problems	22	46	22	10	0	(5.1)
3. Teachers do not have a realistic appreciation of the needs of the Indian industry	16	60	16	8	0	(5.0)
4. The industry does not have adequate funds to encourage interaction	9.8	39.2	17.6	29.4	3.9	(1.3)
5. The industry has no confidence in the engineering institutions' ability to tackle their problems	3.9	25.5	19.6	43.1	7.8	(-1.6)
6. Industry prefers to adopt well-developed technologies from abroad	5.7	51	3.9	29.4	0	(2.7)
7. Industry has no significant R & D	18.2	12.7	50.9	3.4	12.7	(1.8)
8. There is insufficient information about capabilities of the engineering institutions	12	54	8	24	2	(2.7)
9. Any others (please specify)						
(j) Some of the factors which will encourage interaction are:						
1. Industry should identify, in collaboration with institutions, problems which can be taken up as B.Tech, M.Tech projects and for Ph.D. theses research	43.1	49.0	7.8	0	0	(7.3)

	Agree Strongly (1)	Agree (2)	Undecided (3)	Disagree (4)	Disagree Strongly (5)	Weighted Average
2. Industry should consciously encourage summer training of engineering students	37.2	52.9	5.9	3.9	0	(6.5)
3. Appointment of senior research oriented industry personnel as Adjunct Professors in institutions	40	40	18	2	0	(7.2)
4. Inviting industry personnel to give a few lectures in chosen courses	46	52	2	0	0	(7.3)
5. Creation of scholarships for students by industry in chosen institutions	19.6	47.1	21.6	11.7	0	(4.7)
6. Arranging continuing education programmes for industry personnel on need basis at engineering institutions	31.8	62.7	3.9	2	0	(6.4)
7. Any others (please specify)						

PART E

General Comments

Your general comments on the theme of this research project will be most welcome. Please use additional sheets for this purpose.

[Please mail completed Questionnaire to the address given below]

Dr. N.C.Mathur
Professor in Electrical Engineering
Indian Institute of Technology
Kanpur 208 016

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
DEPARTMENT OF ELECTRICAL ENGINEERING

Dr. N.C. Mathur
Professor

Kanpur - 208 016

Dear Colleague,

I write this letter to seek your views on some aspects of the IIT education. I have taken up a DST supported project which aims at studying **"The Role and Impact of Teaching Curricula in Meeting National Needs: a Case Study of the IITs"**

The concerns which have prompted me to take up this study aris from the criticism one often hears regarding the performance of the IITs. It is often said that the IIT environment alienates the students from the mainstream of Indian life. Students graduate with very little knowledge of the Indian industrial scene and the opportunities and challenges. It is implied that this is so because the IIT faculty is cut off from the mainstream of Indian industry and R & D establishments and has little interaction with them. The faculty is, therefore, unable to create amongst the students an awareness of the Indian needs, challenges, and work conditions. It is also said that although the various curriculum review committees of the IITs have emphasized industrial interaction by diverse means, the recommendations in this regard remain largely unimplemented.

As part of the project I have carried out a questionnaire survey of alumni of the IITs and industry and government organizations which are the main employers of IIT graduates in India. I am now conducting a questionnaire survey of the faculty of the IITs. I believe that the faculty is primarily responsible for the design of the curriculum and its implementation, for interaction with the industry, for inculcating an awareness amongst the students of the relevant problems and challenges in India, and for serving as a model for all other engineering colleges in the country. The study I have undertaken cannot be complete without input from the IIT faculty.

Enclosed is a questionnaire which I request you to kindly complete and return to me. It contains items both in the form of open-ended questions where you may give your ideas and suggestions and closed-ended questions where responses have to be chosen out of a given set for quick and easy completion. The latter can be answered very quickly. While I would like to have your complete response as early as possible, I realize that you may like to spend some time in articulating your ideas regarding the open-ended questions. I would suggest that you complete at least the closed-ended questions and send back the questionnaire immediately. You may give your considered ideas and suggestions regarding the open-ended questions at leisure by writing to me separately if you so desire.

Thank you very much. With warm regards,

Sincerely yours,

N.C. Mathur
Principal Investigator

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ANNEXURE III

QUESTIONNAIRE FOR IIT FACULTY

PART A

Background Information

This section is designed to collect general background information for the purpose of proper statistical analysis of the data. **You need not give your name if you so desire.**

1. Name :

2. Department :

3. IIT : Bombay 19.6 Delhi 12.8 Kanpur 24.9 Kharagpur 22.3 Madras 20.8

4. Do you have any degree(s) from IIT ? Yes ☐ No ☐

   If yes, please specify Degree(s), Year(s) and IIT

Degree	Year	IIT

5. Have you studied abroad ? Yes 55.1 No 44.9

   If yes, please indicate Degree(s), Year(s) and Institutions

Degree	Year	Institution

6. Please indicate your IIT teaching experience :

Which IIT ?	How many years (rank wise) ?

7. Do you have any job experience other than IIT ? Yes 74.7 No 25.3

If yes, please give details below :

Name of Organization	Years	Designation

8. Have you had any interaction (through sponsored research, consultancy, sabbatical leave, etc.) with organizations other than educational institutions ? Yes 71.4 No 28.6

If yes, please give details :

Name of Organization	Years	Nature of Interaction

8. Have you used a book by an Indian author as a text / reference book in any course ? Yes 70.2 No 29.8

If yes, how many such books have you used ?

As Text ☐ As reference ☐

PART B

IITs and the National Scene:

Different people have different perceptions of the national needs and the role of the IITs in meeting them. This section is designed to elicit your ideas in this regard. In the first part you may choose one of the five responses: (1) Agree strongly, (2) Agree, (3) Undecided, (4) Disagree, (5) Disagree Strongly. In the second part you may briefly give your own ideas.

Part B-1

		Agree Strongly (1)	Agree (2)	Undecided (3)	Disagree (4)	Disagree Strongly (5)	Weighted Average
1.	The "national needs" in the context of engineering education include achievement of technological self reliance	61.3	31.2	1.2	3.8	0.6	**(7.67)**
2.	The "national needs" in the context of engineering education include application of Science and technology to improve rural life.	40.7	42.8	6.5	7.4	1.2	**(6.21)**
3.	The national needs are not adequately defined and hence IITs cannot take them into account in the context of their curriculum.	15.4	25.3	9.5	33.3	14.8	**(-.38)**
4.	The purpose of IITs in not to worry about the national needs but to produce graduates comparable to those of the best institutions of the world.	10.4	13.6	5.6	41.7	25..8	**(-3.2)**
5.	A top class curriculum in engineering is country-independent and cannot be molded to suit the specific needs of India.	9.5	16.6	9.5	42.5	19.9	**(-2.6)**

PART B-2

[Please give your response on a separate sheet]

(1) What is your perception of the national needs and the role of IITs in meeting them ?

(2) What, in your opinion, has been the greatest impact of the IITs on the national scene ?

(3) In what areas, if any, do you think the IITs have failed to have the impact they should have had and what are the reason therefor ?

(4) Are there any areas in your opinion where the IITs have had a negative impact ?

PART C

Faculty, Curriculum and Industry

The faculty plays the most important role in the contribution of the IITs to the nation. It is totally responsible for the design of the curriculum and its implementation and for the interaction with industry (industry in this context includes Government and other R & D organizations) through which the IITs have their impact on the national scene. The questions in Part 1 below elicit your response to the statements made. In Part 2 you may give your ideas about the various issues raised.

Part C-1

	Agree Strongly (1)	Agree (2)	Undecided (3)	Disagree (4)	Disagree Strongly (5)	Weighted Average
1. The present level of interaction of the IITs with industry is inadequate.	27.8	54.7	4.4	9.8	2.3	(5.03)
2. There is a need to make conscious efforts to increase the interaction.	46.4	47.9	1.7	2.0	1.1	(6.89)

3.	More practical orientation should be given to the curriculum by hiring teachers with industrial background.	16.3	41.9	19.6	14.8	5.6	**(3.0)**
4.	Teachers should be required to keep in touch with the industry by summer visits or longer stays in industry.	30.6	47.9	9.2	9.2	1.7	**(5.3)**
5.	Industrial tour of the students is a very important part of the curriculum as a means of exposure of the students to the industrial scene.	44.6	38.6	7.1	6.2	2.3	**(6.3)**
6.	Industrial tour of student should be compulsory and assignment of a teacher to organize the tour and accompany the students in the tour should be a part of the normal teaching load assignment.	39.2	36.0	10.1	10.1	3.2	**(5.5)**
7.	Summer training of students in industry should be compulsory for at least one summer.	53.8	37.8	4.4	1.4	1.4	**(7.4)**
8.	Suitable persons from industry should be invited to give some lectures in selected courses.	48.2	45.8	2.3	1.4	0.6	**(7.2)**
9.	The non-availability of high class text books by Indian authors promotes a feeling in the students that the competence level of the Indian faculty is inferior to that of their foreign counterparts.	20.4	25.8	15.7	27.6	8.3	**(1.3)**
10.	Production of high class text books with an Indian bias will be a long lasting contribution of the faculty	39.8	37.5	12.2	5.4	2.3	**(6.2)**

3 (6.3)

Part C-2

1. What, in your view, are the strong points of the IIT Curriculum?

2. What are the strengths of the IIT education in totality ?

3. What steps can the IITs take to improve the interaction with the industry ?

[Please mail compeleted Questionnaire to the address given below]

Dr. N. C. Mathur
Professor in Electrical Engineering
Indian Institute of Technology
Kanpur 208 016

ANNEXURE IV
List of Persons Interviewed

1. Shri Anil Agarwal (Padma Shri), Environmentalist
2. Dr. Ashoka Chandra, Director, Institute of Applied Manpower Research
3. Dr. N. C. Nigam, Director, IIT Delhi
4. Shri V. K. Agarwal, Vice-President R and D, HINDALCO
5. Shri S. D. Awale, Joint Educational Advisor (T), MHRD
6. Dr. E. C. Subbarao, Tata Research Development and Design Centre, Pune
7. Shri A. K. Seth, General Manager (Engg), Engineers India Limited
8. Shri A. Hussain, Assistant General Manager, TELCO
9. Dr. N. V. C. Swami, Director, IIT Madras
10. Dr. H. Z. Qasim, Member, Planning Commission
11. Dr. D. Swaminadhan, Member, Planning Commission
12. Dr. Jai Krishna, President, Indian Academy of Engineering
13. Dr. S. K. Khanna, Chairman, AICTE
14. Dr. G. Ram Reddy, Chairman, UGC
15. Prof. Yash Pal, Former Chairman, UGC
16. Dr. P. V. Indiresan, Former Director, IIT Madras
17. Dr. C. S. Jha, Former Director, IIT Kharagpur and former Vice-Chancellor, Banaras Hindu University
18. Prof. K. L. Chopra, Director, IIT Kharagpur
19. Prof. G. S. Sanyal, Former Director, IIT Kharagpur
20. Shri Anand Sarup, Former Secretary, Ministry of Human Resource Development
21. Dr. G. K. Mehta, Director, Nuclear Science Centre

In addition, discussions were also held with the Deans and Placement and Training Officers of the IITs. Members of the Project Advisory Committee listed below gave very freely of their time and their views were recorded and used.

Project Advisory Committee

1. Dr. M. P. Kapoor, Director, Thapar Institute of Engineering and technology, Patiala, (formerly Deputy Director, IIT Kanpur).
2. Dr. V. Sundararajan, Professor in Mechanical Engineering, IIT Kanpur (formerly, Dean of Faculty Affairs and Chairman, Undergraduate Review Committee).
3. Dr. S. Gupta, Professor in Electrical Engineering, IIT Kanpur (formerly, Dean of Academic Affairs, IIT Kanpur).
4. Dr. R. K. Dube, Department of Metallurgical Engineering, IIT Kanpur (formorely, Chairman, Student Placement).
5. Dr. G. K. Dubey, Professor in Electrical Engineering, IIT Kanpur (formorely, Coordinator, QIP).
6. Dr. Vijay Gupta, Dean of Academic Affairs, IIT Kanpur.
7. Dr. V. Sinha, Deputy Director, IIT Kanpur.
8. Dr. V. Bansal, Professor in Metallurgical Engineering, IIT Kanpur (Principal Investigator, Brain Drain Project).
9. Dr. (Mrs) A. R. Rajeswari, Advisor (NSTMIS).
10. Prof. Ashoka Chandra, Director, Institute of Applied Manpower Research Indraprastha Estate, New Delhi.
11. Sri Sarosh J. Ghandy, Resident Director, Tata Engineering and Locomotive Co. Ltd.
12. Dr. (Mrs) Purnima Mathur, Professor in Humanities and Social Sciences, IIT Delhi.
13. Dr. M. R. Mukerjee, Professor in Electrical Engineering, Moti Lal Nehru Regional Engineering College, Allahabad.
14. Dr. A. K. Vashist, Director, Harcourt Butler Technological Institute, Kanpur.

15. Sri M. L. Rampal, General Manager, Research and Development, Hindustan Cables Ltd., Allahabad.

16. Sri V. K. Agarwal, Vice President, Research and Development, HINDALCO.