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REPORT ON THE VISIT TO THE NATIONAL INSTITUTE FOR TRAINING IN INDUSTRIAL ENGINEERING (NITIE)

Back to Training Officers Club Packet

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1.- TERMS OF REFERENCE

WORK ASSIGNMENT

Visit the National Institute for Training in Industrial Engineering, Bombay, and prepare a report on its present and potential role in training in advancement of manufacturing technology and the scope for international cooperation in this respect. Based on this and other experience make recommendation to UNIDO on how training for the advancement of manufacturing technology could be fostered in developing countries.

Report to be submitted in English, in three typed copies, length approx. 20 pages plus storage on diskette.

2.- ACTIVITIES REALIZED

DATE	TIME	ACTIVITY
1991		
Thu 12 Dec	2.00pm	Briefing at UNIDO
Fri 13 Dec	9.00am	Preparatory study of Indian political and social situation
	1.00pm	Preparatory study on the Indian Industry: actual situation and development indicators.
Sat 14 Dec	8.30am	Departure from Vienna
Sun 15 Dec	3.00am	Arrival at Bombay
	4.00am	Arrival at NITIE
	10.00am	Attendant at the Symposium SYNERGY 91 under the title "Fine Arts & Quality of Live". Speakers: Dr. Pt. E. Vijayaraghava Rao, Flutist, poet and composer, Bombay Ms. Geeta Radhakrishna, dancer Dr. Suma Chitnis, Vice-chancellor SNDT Women's University Bombay Dr. Sujata Bajaj, Professor of Tribal Arts, Paris Sh D. G. Nadkarni, Journalist, Bombay
	12.00am	Meeting with the director of NITIE: Prof. S. Ramani.
	2.00pm	SYNERGY 91: street plays and miming.
	8.00pm	Meeting with Dr.E. Unni Krishnan, Dean and Professor, Industrial & Safety Engineering, NITIE.
Mon 16 Dec	9.00am	Participant at the opening ceremony of following courses 1. Management performance audit 2. Organization & techniques of training. 3. Yoga based executive health.
	10.30am	Introduction to Yoga
	11.15am	Presentation of NITIE (Film)
	11.30am	Learning to listening (Film)
	12.00am	Discussion with the director and faculty members.
	2.30pm	Visit to the: Ergonomics & Safety Laboratory - Prof. E. Unni Krishnan
	4.00pm	Visit to the: Industrial Automation Laboratory - Prof. N. Sambandam

	6.00pm	Visit to the: Condition monitoring Laboratory - Prof. C. Chowdhury
	8 00pm	Preparation of 1st Presentation
Tue 17 Dec	9.30am	1st Presentation: The Austrian research centre Seibersdorf - Industrial automation and developing countries.
	11.30am	General discussion with all faculty members
	4.00pm	Compile laboratory informations
	8.00pm	Review of laboratory proposals - Prof. N. Sambandam
Wed 18 Dec	9.00am	Visit to the Factory: Godrej & Boyce Mfg. Co. Ltd. in Bombay - Mr. P.N. Surendranath (Dy. General Manager) and Mr. B.J. Mistry (General manager Locks & security Divisions)
	2.30pm	NITIE Director Prof. S. Ramani Review of Godrej & Boyce Mfg.Co.Ltd.
	3.30pm	NITIE Director Prof. S. Ramani Compile possible proposals for NITIE
	6.30pm	Prof. N. Sambandam - Discussion about actual and future situation of NITIE
	8.30pm	Preparation of some improvements on the Curricula of the 12 Week part time certificate program in Computers & Industrial Automation. Asked by Prof. N. Sambandam
Thu 19 Dec	9.00am	Discussion with Prof. N. Sambandam and Prof. E. Unni Krishnan - Compile requirements for increasing NITIE capacities. Request for information on specific costs.
	10.30am	Individual Discussion with selected Students.
	2.00pm	Visit to the Industry: Rolta India Ltd. in Bombay - Mr. Adarshpal Singh (Executive Director) and Mr. Abhay M. Bhatt (Manager Sales)
	7.00pm	Compile report to Rolta India Ltd.
	8.00pm	Preparation of project proposals
Fri 20 Dec	8.00am	Prof. S. Ramani; Prof. E. Unni Krishnan; Prof. N. Sambandam; Prof. Thomas Mathew Discussion of future project proposals for NITIE, the laboratories and the Regional centres. Meeting to review application for UNIDO "Preparatory Assistance"

	3.00pm	Individual discussion with faculty members: Dr. Thomas Mathew (Academic dean of NITIE) Dr. P. Vijayan (Professor in charge of the NITIE-Madras-Centre) Dr. S. Ravishankar Organizational behavior Prof. K. Muthukrishnan Industrial Engineering and materials & manufacturing management Prof. J. Chandrasekaran Industrial Relations Dr. V. Jayasankar Head of computer centre Prof. K.K. Blaggan Oldest Professor
	6.45 pm	Lecture on Flexible Assembly Cells and the importance of Automation and CIM concepts in developing countries. The critical path for the introduction of new technologies and organizational changes.
	8.00pm	Valedictory function for: "12 Week part time certificate program in Computers & Industrial Automation"
	8.00pm	Welcome Address by Dr. Thomas Mathew
	8.10pm	About the Programme, Dr. N. Sambandam (course Coordinator)
	8.20pm	Address by the Director of NITIE, Dr. S. Ramani
	8.30pm	Certificate distribution & Address to faculty members and students
	9.00pm	Discussion with students
	10.00pm	Final review with Dr. S. Ramani
Sat 21 Dec	3.00am	Departure from NITIE, Bombay
	12.00am	Arrive Vienna
Mon 23 Dec	9.00am	Preparation of the Report
Fri 27 Dec	9.00am	Preparation of the Report
Mon 30 Dec	9.00am	Preparation of the Report
Tue 31 Dec	9.00am	Preparation of the Report
1992		
Fri 3 Jan	9.00am	Preparation of the Report
Mon 6 Jan	3.00pm	De-briefing UNIDO - Submitting of Back to office mission report.
Sat 11Jan	9.00am	Preparation of the Report
Sun 12 Jan	9.00am	Preparation of the Report
Tue 14 Jan	9.00am	Submitting of the Report

3.- INDIA: ACTUAL SITUATION

As a part of the preparatory work realized before flying to India, the actual social and political situation of India as well as Indian Industry (situation and indicators) were studied. Therefore mainly two sources were used:

The Economist Intelligence Unit Country Report (No 1, 2, 3 and 4 of 1991)
India Report from UNIDO. (1991)

The short introduction given below was taken from these two sources.

The 1980s have witnessed a new era of industrial growth. A quantum leap in industrial output has been accompanied by a new accent on modern technology. Although limited structural change has taken place within manufacturing, the base of Indian industry has widened considerably with the public sector playing the pivotal role in the production of coal, steal, machine building, shipbuilding, non-ferrous metals, fertilizers, and electronic items apart from power generation. The private sector for its part has revealed its potential for massive investment in response to periodic activation of capital market. Large investments in the automobile, petrochemicals, food processing, engineering and other industries, with foreign participation and an inflow of funds from non-resident Indians have continuously accelerated the pace of expansion.

The bright picture of Indian Industry, however, is not without its blemishes. The number of large, medium-scale and small enterprises that were sick, increased from 93.282 in December 1984 to 159.282 in June 1978. Management deficiencies, inaccurate market forecasting, inefficient use of working capital, labour unrest and cost escalation are cited as key factors affecting industrial performance.

Apart from the fact that the strong domestic market pull tends to improve the relative profitability of internal sales as compared to exports, a host of other, such as high cost of production, low productivity, substandard quality, inefficient marketing initiatives,, etc., inhibit the export drive. The inflow of foreign assistance is yet to produce a favorable balance between imports used and exports achieved.

The Indian steel industry is passing through a dynamic phase, encouraged by the success of the modernization programmes and the diversification of its activities. The non-ferrous segment of the metal industry is not as well placed as its ferrous counterpart. With the exception of aluminium, non-ferrous metals suffer from supply problems.

The automobile industry has witnessed major developments, ever since the government decided to allow expansion of existing capacity, broadbanding of licences, imports of technology and arrangement for financial participation by foreign industries.

With know-how and financial assistance from prominent firms in France, Germany, Italy and Japan, the two-wheeler and light commercial vehicle enterprises have grown in stature.

The expanding needs of industrial and individual consumers have led to the promotion of many engineering enterprises turning out products ranging from razor blades to heavy electrical equipment. While indigenous output has been rising, exports too have been growing significantly. Engineering exports tend to constitute the largest group among non-traditional exports despite the growing domestic demand. Projects exports in the form of turnkey projects reveal the country's achievement in the sphere of heavy industrialization. However, slackness in updating technology and implementing modernization schemes has led to obsolescence in many areas. Heavy investments in facilities are needed for manufacturing sophisticated products and for ensuring flexibility of operations. Suitable technology will also have to be imported and foreign enterprises may be invited to participate in equity capital. The segment of the engineering industry which already has sizeable foreign equity participation has been faring well.

It would greatly help the government 's credibility if some multinationals signed up under the new policy and committed some real money. There are a few signs of movement: Ford is to invest in a radiator project with Maruti (and Sony); IBM is to participate in a 50 per cent, Rs850 mn ($33 mn) joint venture with Tata to produce personal computers and associated software; General Motors is considering a car and car parts joint venture; and Kellogg wants to join a breakfast cereal project; Du Pont is pondering a nylon project in a joint venture with the Thapar group; Coca Cola is resurrecting its stalled soft drink export project; Thomas Cook is to raise its stake in an Indian associate to 511 per cent. Most of these projects still have procedural hurdles to cross, but the signs of interest from critical US investors like IBM are encouraging to the government.

4.- NITIE

This chapter was partially taken from the Annual Report of NITIE for the period 1990 to 1991 and other informative reports given to the expert during the visit.

The National Institute for Training in Industrial Engineering (NITIE) was established as a National Institute in 1963 by the Government of India, with assistance of the United Nations Development Programme through the International Labour Organization (ILO). NITIE is an autonomous body under the Ministry of Human Resource Development, Department of Education, Government of India, and is registered as a society under the Societies Registration Act.

The Campus of NITIE is located in the most picturesque and natural surroundings in North Bombay and is flanked by the Powai and Vihar Lakes. NITIE is accessible by road from principal transport terminals of the city.

NITIE is administered through a Board of Governors representing nominees of the Central Government, National Productivity Council, All India Council of Technical Education, Industry and Workers' Organization, Technical Institutes and professional interest with Raosheb B. M. Gogte as Chairman and Dr. S. Ramani as Director.

The scheme for the establishment of NITIE envisaged that the Institute would undertake the following major activities:

- Conduct short-term courses in Industrial Engineering and allied fields;
- Conduct long-term courses in Industrial Engineering;
- Conduct industry-oriented programmes to suit the specific needs of industries/organizations;
- Evolve syllabi, teaching materials, norms and standards, and give a lead to other institutions engaged in teaching Industrial Engineering and allied subjects;
- Carry out applied research, develop course material, adapt industrial engineering techniques to Indian requirements;
- Collaboration with other institutions/organizations and professional bodies to promote industrial engineering and productivity techniques.

Since 1968-69, the following additional activities have been initiated by the institute:

- Industry based programmes, known as Unit Based Programmes (UBPs);
- Collaboration programmes jointly with other professional bodies;
- Organizing seminars and conferences;
- Development of research programmes;
- Development of new training courses.

The educational fruition of the Institute came with the commencement of the two-year residential Post-Graduate Programme in Industrial Engineering from July 1971 (now reduced to one and half years).

NITIE had identified thrust areas for the Seventh Five year Plan and had built one of the finest Ergonomics and Human Factors Engineering Laboratories. Maintenance and Condition Monitoring, Audio-Visual and Simulation Laboratories are at various stages of development. NITIE has also been recognized as a Quality Improvement Programme Centre.

Various in-depth research projects have been undertaken in industrial engineering and related fields. The projects have been sponsored by various organizations, such as Ministry of Human Resource Development, Department of Science and Technology, Department of Non-Conventional Energy Sources, Indian Council of social Sciences Research, etc.

NITIE is staffed by faculty members, drawn from various basic disciplines, having diverse experience in business, industry and government and thus are able to bring to bear academic concepts to the practical problems through institutional consultancy.

4.1.- NITIE ACTIVITIES

4.1.1.- Courses and Seminars

NITIE offers several different programmes, courses and seminars oriented to students, Managers, Engineers, Administrators, etc. NITIE brochures containing detailed information about this courses and seminars are given together with this report to the backstopping officer. To receive only an impression about them they are listed in the next points.

4.1.1.1.- EXECUTIVE DEVELOPMENT PROGRAMMES (EDPS)

NITIE offers several short term programmes of 1 to 2 weeks duration to practising managers, engineers and administrators.

These programmes are useful for training and education of participants. The Programmes are residential and are conducted in order to meet the topical and current needs of the industry. So far, about 30.000 executives and specialists from various organizations from all over India have undergone these training programmes.

4.1.1.2.- UNIT BASED PROGRAMMES (UBPS)

NITIE conducts special types of programmes tailor-made to suit the specific requirements of individual organizations. Generally, a Pretraining Survey is undertaken by the NITIE faculty to study in detail, the need of the organization concerned before the programme is conducted by the Institute. These programmes are conducted through a blend of Case Studies and Problem Dimensioning Sessions. These sessions, by and

large, centre around the problems and situational analysis as perceived during the pre-training survey.

As an example of this activity a request for a especially adapted programme by an Indian company is included in Annex I.

4.1.1.3.- SEMINARS AND SENIOR EXECUTIVE PROGRAMMES (SEPS)

NITIE conducts Seminars and senior Executive Programmes in various industrial engineering and management topics for the benefit of senior and top level executives. These programmes are conducted either at NITIE premises or in a five star hotel. So far, NITIE has conducted a number of Seminars and Senior Executive Programmes.

4.1.1.4.- POST GRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING (PGDIE)

NITIE offers an 18-month Post-Graduate Diploma in Industrial Engineering, it is equivalent to a Master's Degree in Industrial Enginnering recognized by the Government of India. The programme takes cognizance of the emerging patterns of Industrial Engineering Education, the growth of Technology, the changing needs of organizations and the development of new areas.

Admission is restricted to engineering and technology graduates of various Indian universities or equivalent Institutions. Candidates must qualify through Graduate Aptitude Test in Engineering (GATE). The Industry sponsored candidates must have a First Class degree in Engineering. There are at present 50 seats. Five percent of the seats are reserved for Scheduled Caste/Tribe Candidates. In addition, there are 10 seats provided for industry-sponsored candidates.

4.1.1.5.- POST GRADUATE DIPLOMA IN INDUSTRIAL ENGINEERING (BY RESEARCH OPTION)

This is a masters level programme for external candidates. The objective is to provide an opportunity for candidates with significant practical experience for an indepth specialization in selected areas of Industrial Engineering, and to enhance their capability in the design and operation of man-machine systems.

It is open to candidates with a First Class degree or high Second Class in any branch of Engineering or Technology or equivalent qualification and four years of relevant work experience in organizations of repute. Candidates must be sponsored by the respective organizations.

4.1.1.6.- FELLOWSHIP PROGRAMME IN INDUSTRIAL ENGINEERING

It is open to candidates with a First Class Master's Degree or its equivalent in Engineering or Technology or Business Administration preceded by Bachelor's Degree

in Engineering or Technology or Outstanding Bachelor's Degree in Engineering or technology.

The Fellowship Programme is a doctoral level programme in industrial engineering with the objective to prepare students for careers in teaching and application of Research in Industrial Engineering.

4.1.1.7.- APPLIED RESEARCH

NITIE undertakes Applied Research for evolving and adapting Industrial Engineering techniques to suit Indian conditions and to enhance the professional capabilities for training and education.

4.1.1.8.- COMPUTER PROGRAMMES

NITIE conducts a part-time six month Post-graduate Certificate Programme in Computers and Applications meant for only B.E./B.Tech graduates or B.A./B.Sc./B.Com. graduates with adequate mathematical preparation with good academic performance.

NITIE conducts a part time Certificate Programme in Computers & Industrial Automation meant for Post graduates in Science and Degree or Diploma holders in Engineering/Technology, preferably with shop floor/workshop experience. Preference will be given to Industry/Institute sponsored candidates.

NITIE conducts a part-time ten month Diploma in Computer Application meant for only B.E./B.Tech. or equivalent degree holders, B.A./B.Sc./B.Com graduates, Diploma holders in Engineering with adequate mathematical preparation with good academic records.

4.1.1.9.- ENTREPRENEURSHIP PROGRAMME

A ten month programme in entrepreneurship development with practical application to real life situations, with simulation models is being developed. Further, NITIE is shortly setting up an Advanced Centre for Research and Development in Entrepreneurship.

4.1.2.- Laboratories

An overview of the actual status, objectives, infrastructure available, required equipment and proposal for further development and expansions is included as Annex II for the laboratories of:

a) Industrial Automation

b) Condition Monitoring

c) Ergonomics and Workstudy

4.1.3.- Research work

Research programmes in industrial engineering at NITIE are designed to promote application oriented research in various areas of industrial engineering. Research activities gained momentum at NITIE since 1983 with more thrust given to experimental research for application in Industry. This covers different areas of ergonomics, environmental engineering, harnessing animal power, simulated work system design and computer oriented industrial engineering research. The experimental research in industrial engineering has necessitated development of laboratory facilities at NITIE in terms of equipment, experimental set-up, computing facilities, etc. At the same time, in NITIE research activities , the bulk of the data pertains to live problems from industry from various parts of the country.

Two documents giving an overview of the actual Research Work being done by NITIE are included as Annex III and IV:

Compendium of Research Work by NITIE Faculty members - 1991.

List of ongoing Projects. Stand: 29 July 1991.

4.1.4.- Consultancy

Consultancy assignments are undertaken by NITIE through faculty members as individual/teams, on a selective basis, to meet the following goals, on a self-supporting basis:

1.- Provide service to Governmental Industry by sharing the expertise and competence of experienced NITIE faculty members to diagnose and solve problems objectively in selected areas of industrial engineering and management.

2.- Provide services of interdisciplinary teams of NITIE faculty to apply latest concepts/methodologies/research validated approaches to solve real life problems in government, business and industry.

3.- Help the faculty in developing case studies/course material which can be used, with permission from the host-organization, for dissemination of knowledge to executives/students.

4.- Maintain close linkage and liaison with Government, Business and Industry.

An overview of the Consultancy Assignments on Hand (April 1991 to December 1991) is included as Annex V.

4.1.5.- Facilities and Cultural & Welfare activities

NITIE facilities includes:

- A well equipped Library with more than 36.000 technical books, 4.500 bound volumes of journals, 321 periodical subscription, etc.
- An Audio-Visual Facility with more then 200 training films, different projection facilities and a small dark room for developing. This also includes an Instructional Television facility.
- A Post-Graduate Programme Placement Cell for the benefit of the post-graduate students.
- A Curriculum Development Cell to co-ordinate with other agencies and evolve model curricula for Educational and Training Programmes in Industrial Engineering and allied fields at various levels.
- NITIE publishes quarterly, a professional journal named UDYOG PRAGATI for disseminating information about new developments in Industrial Engineering and allied fields and promoting productivity in business/industrial and Government organizations. A monthly newsletter is also published by the Institute.

NITIE cultural and welfare activities includes:

- An annual celebrated cultural festival with the name SYNERGY, where well known artists are invited and inter-collegiate competitions in different cultural disciplines are realized. The theme of Synergy 91, which finished the first day of my visit was "Fine Arts and the Quality of Life".

4.2.- THE REGIONAL CENTRES

4.2.1.- Activities of the regional Centres

To receive an impression of the importance of the regional centres, a short overview of the activities during 1990 to 1991 are given. Also a Report of the committee for "Review of Working of NITIE Extension Centres" from July 1991 is included as Annex VI.

4.2.1.1.- DELHI-CENTRE

Ten EDPs with a total of 144 participants were conducted.

The first 10 month Diploma Programme in Computer Applications was concluded in August 1990. In view of the good response for the DCA programme, especially from Western Delhi, a new premises measuring 600 square feet was rented. Full-time 12

month and part-time 16 month DCA courses were inaugurated on the 9th of January, 1991.

4.2.1.2.- HYDERABAD CENTRE

Fifteen Executive Development Programmes were conducted, in which 289 executives from various public and private organizations participated. Three Unit Based Programmes were conducted in which 63 participants took part.

4.2.1.3.- MADRAS CENTRE

Twelve Executive Development Programmes were conducted, in which 195 executives from various public and private organizations participated.

Twelve month full time diploma course in "Computers and Applications" and 16 month part-time diploma course in "Computers and Applications" were inaugurated on 28th November 1990. Thirteen and 12 participants had enrolled for these courses respectively.

4.2.1.4.- MUZAFFARPUR CENTRE

One UBP on materials management in which 26 executives took part, was conducted. A one day workshop on Profitability & Productivity in Leather Industry was organized.

Five month part-time Certificate programme in Computers & Applications was conducted and 30 participants attended the programme. A 3 month part-time Certificate programme on PC Applications where 37 participants took part was conducted.

4.2.1.5.- ACTIVITIES AT BANGALORE

Seven Executive Development Programmes were conducted, in which 137 participants took part.

4.2.1.6.- ACTIVITIES AT CALCUTTA

Two Executive Development Programmes for 30 executives from various organizations were conducted.

4.3.- NITIE AS SEEN FROM DIFFERENT POINTS OF VIEW

As a part of the activities realized at NITIE, some personal interviews were carried out. The interviews were realized after acquiring information about NITIE's functioning and after building up an impression of the actual situation.

4.3.1.- The students point of view

The interviews were realized in two sessions, the first on Thursday 19 from 10.30am to 1.00pm and the second on Friday 20 from 9.00pm to 10.00pm.

At the first interview, the students to be interviewed were addressed as a group to explain the general objectives of the mission to NITIE and the specific goals of the individual interview. After this, each was interviewed individually.

It is important to emphasize that most of the students interviewed belong to that one attending the Post-Graduate Programme in Industrial Engineering offered by NITIE. Its is residential programme of 18 month duration, and where only the most qualified students of all India are accepted. As a natural consequence of this, they are very demanding of their lectures, not only in the knowledge but also in pedagogical qualifications.

The general questions posed to them were:

a) Opinion about the level of NITIE in the Indian environment.

b) Quality of the lecturers

b1) Knowledge

b2) Pedagogical capacity

b3) Accessibility outside the lecture hours

c) Quality of accommodations

d) Facilities of NITIE, books, computers, machines, etc.

ANSWERS:

a) All of the students presented no doubts about the level of excellence of NITIE in the Indian environment. But at the same time all of them were absolutely convinced of the necessity of some improvements in all areas of NITIE.

b) The opinion about the lectures was not as good as expected. The answers were given in percentage. To question b1 (knowledge), most of the students gave a percentage of 50 or less of good lecturers. To question b2 (pedagogical)a disappointing percentage of 20 or less of the lecturers were defined as having the expected level. To question b3, a very surprising answer (especially after the percentage given in b1 and b2) of a very high accessibility of the lectures outside the class hours; the answer was the same after specifically asking if this was case by all of them.

After these figures, the students were also asked if they believe that the capacity of the faculty members could be increased by some pedagogical training. The answer was positive for most of the lecturers.

Some of the students also complained about a bad assignment of lecturers to the courses and that most of the good lecturers were only used for Managerial courses and,

as such. were so not accessible for them. Also they asked for a stronger orientation into active learning at the lectures.

c) The quality of the accommodations were defined as very good. Especially the fact that NITIE is the only institution of this type, giving individual accommodation to them.

d) The opinions on faculty quality varied. Referring to the computers they complained of a lack of access time, but not about their quality. Referring to the library the students asked for newer books, but were generally happy on the level and availability.

After this questions they were asked to talk freely and to give some proposals for improving NITIE. The two points mentioned were: to have a better interaction with Industry (although they already organize industrial visits they would like to have more case studies) and to receive more external information from specialist from other countries, or at least other institutions, as well as experienced industrial managers giving specific lessons and telling their experiences.

Finishing this session, and with all the interviewed students together, they agreed to the following points as a resume:

* Increase the pedagogical capacity of the lecturers
* Increase the practical experience of the lecturers
* Increase the interaction with the industry, by establishing more practical cases studies at the industrial level
* Increment the amount of computers
* Higher specialization through visits by specialists in selected specific areas

The students also wished to know why the UN system, as one of the founding bodies at NITIE, plays no role in its continuing operations.

The second session with different student was an informal one where the points worked out at the individual sessions were discussed. This meeting provided wider support to the conclusions worked out in the first meetings.

4.3.2.- NITIE from the point of view at the faculty

During the hole week there was very close working contact with the following faculty members: Director Prof. S. Ramani, Prof. N. Sambandam and Prof. E. Unni Krishnan; especially, but not only, with Prof. N. Sambandam most of the topics of NITIE were discussed in a very friendly and informal way. Additional to this contacts a first contact with the faculty members was organized at Tuesday 17 from 11.30am to

12.30am after my presentation on the activities of the Austrian Research Centre. In addition to this on Friday 20 from 3.00pm to 6.45pm an individual discussion with some of the Faculty members was realized.

The general point of view of all the faculty members interviewed was that NITIE is actually if not the best place in India, at least one of the best places to work in training, education, consultancy and research in all the fields related to Industrial Engineering. This was said in relation to salary, accommodation facilities, working conditions and possibilities of development. Most of these concepts were strongly related with the figure of the Director.

Only two points were mentioned by most of faculty members. The first one heaving more to do with economic realities than critising, was that the expansion into regional centres requires efforts and funds normally used for NITIE Bombay. The second one was the difficulty of founding possibilities to realize some specialization in developing countries. They would like, at least to organize some exchange programs with other institutions of developed or developing countries.

To give faculty members the opportunity to present their proposal for strengthening the Institute in specific areas or as a whole, a questionnaire was designed with the following questions (a copy of the questionnaire is included as Annex VII) :

1. Areas of teaching
2. Areas of research
3. Teaching time per year (total contact hours) for all the types of Programmes and Courses, detailing number, duration and participants at each of them
4. Consultancy activities per year
5. Other activity
6. Facilities or Laboratories used for courses and research
7. If the facilities or laboratories used are found to be inadequate, to what extent they require more.
8. Proposals to strengthen the teaching & research.
9. Additional facilities and laboratory support required for teaching and research
10. Proposals for strengthen all area of teaching and research for the institute.

The Director of NITIE Dr. Ramani promised to forward to me the results of this questionnaire. A short accompanying report will be attached following receipt.

4.3.3.- NITIE from the industrial point of view

Unfortunatelly there were not enough opportunities to contact people from industry. Some informal talks with attendants to the managerial courses were possible in addition to the two visits realized to local companies. The general opinion about NITIE was that

it offers the best training possibilities in India in the field of Industrial Engineering. In the management courses the level of knowledge of the lecturers was considered as one of the highest in India. Asked about other fields of NITIE, they pointed out that there were no doubts about the theoretical knowledge of the faculty members, but that some of them, and this was especially important in relation with consultancy work, lack in practical experience.

4.4.- POTENTIAL ROLE OF NITIE IN TRAINING IN ADVANCEMENT OF MANUFACTURING TECHNOLOGIES

4.4.1.- Perspective plan 1987 - 2000

The perspective plan report was given to the backstopping officer, togheter with this report.

4.4.2.- Project proposals

Following possible programmes to be realized by UNIDO or possible activities where UNIDO could be helpful were discussed:

a) establishment of a Productivity Data Base Centre
b) establishing of a Technology Data Base Centre
c) establishment of a Mashining centre for training and research purposes
d) development of a CAD/CAM centre (closely related with c)
e) establishing of a Computer Aided Industrial Engineering Centre
f) establishing of a cell for Expert Systems in Industrial Engineering
g) strengthening of NITIE (mainly Institution Building)
h) strengthening of the Regional Centres of NITIE (mainly Institution Building and financing)
i) transportation of donated machines/instrumentation from donation site to NITIE.
j) expansions in the Laboratory of Condition Monitoring
k) publication of research work in international Monitors
l) international exchange programmes for trainees.

Also the Director of NITIE specifically asked UNIDO for some help to find a person for an open post at NITIE, as Chair Professor for Applied Research and for imparting training and education in the field of Manufacturing Automation. They are looking for

an eminent person in Manufacturing Automation or related fields who should be at least a Post-Graduate with more than 15 years of experience in Research/Teaching/Industry. The post carries a consolidated salary of Rs. 9000/ per month. Campus accommodation (unfurnished) may be provided on payment of licence fee. The appointment will be for a period not exceeding five years and at least one year.

Details on this proposals were given to the backstopping officer, together with this report.

5.- RECOMMENDATIONS

5.1.- GENERAL RECOMMENDATIONS

The characteristics and situation of NITIE in the Indian environment gives it the best possibilities to be a helpful organization, especially in the area of introduction of new automation technologies and organizational changes in small and medium scaled industries. An introduction to this field and some recommendations for the introduction of modern technologies and organizational changes are given in Annex VIII.

5.2.- SPECIFIC RECOMMENDATIONS FOR NITIE

The role NITIE is playing in the Indian environment was changing in the last years from a "training" centre to a "training-education-research-consultancy" centre. According to the director Dr. Ramani this will continue in the future. One formal step in this direction has already been taken, namely the change in NITIE's name from National Institute for Training in Industrial Engineering to National Institute for Industrial Engineering (the acronym will be still NITIE).

NITIE has been growing very fast in the last years, as can be seen by the increase in the faculty members in the last two years (factor 2). They are using an important part of the own budget for the development of the Regional Centres. These will allow NITIE to expand its possibilities to all India. As a second step NITIE could be converted in the near future into a Multi-national Centre (or Regional centre in the denominations of UNIDO).

This change in NITIE's scale is going on in a firm but slow way and if they do not find any supports, especially for the building up of the regional centres, there is an increasing probability of a critical situation in the comming years. This could affect NITIE in the near future as a drop in the excellence of the formation they are providing,

especially in the longer programs. THis could come about due to the need of using their best faculty members for "pay" work, as for example consultancy or UBPs. This could result in a change in NITIE´s "good name" in the Indian industrial environment, with the consequence of losing a good, well established and well known institution for educational and training activities.

It is strongly recommended to initiate some activities to support NITIE, especially in the development of the Regional Centres (see Annex VIII and additional information given to the backstopping officer, were some relevant cost are included), in the establishing of some additional laboratory (most recommended point a, b, c and f of the list given under 4.4.2) and in helping on increasing the capacity and experience from the faculty members through exchange programmes or training on the job possibilities at similar institutions in developed countries and through some support for increasing the pedagogical capacities.

6.- CONCLUSIONS

A number of potential fields of conflict exist (mainly socio-cultural ones) in connection with the introduction of modern industrial engineering technologies. The adoption of modern automation technologies and new organization structures could be a major hindrance in building up an economy if it is not based on the special needs and peculiarities of a country. But all these technologies, under the name of CIM or FMS or JIT , etc., must not be regarded as the "ingenious solution for production" -this is an idea originating in the massive interests of the components suppliers, to establish new markets for their products.

Much has been said and written about the "workplace killing" effect of organizational changes and modern automation technologies in industry. In my opinion, the main problem must not only be in how to protect the work place, but more importantly on how to increase the "quality of life".

I like to use a model of mankind's future, showing a man walking along a road scattered with stones he has to avoid. Referring to this model, I interpret the "scientific spirit" as follows: Our responsibility lies in supporting all activities which could help smooth the road so that the man can walk without problems and raise his head.

The developing countries especially should be active in this process. This "smoothing procedure" will appear sooner or later all over the world, with or without their help. But if this occurs too fast, without allowing man to adapt himself to the new environment, by making a gradual step-by-step development, he may possibly not be able to walk at all. Moreover, not being prepared for such smoothness, the "developing country man" may only walk with difficulty or even fall down.

Similar to the industrial system, the human system is dynamic and so it is impossible to have a unique, permanently valid description of what this "head raising" means. But this is not really so important, because in "dynamic human systems" the only solution is the continuous search for new solutions to increase the "Productivity of Life" for every single person in the world and not of every single person in the world.

7.- ANNEXES

ANNEX VIII

SOME IDEAS ON THE INTRODUCTION OF ORGANIZATIONAL CHANGES AND AUTOMATION TECHNOLOGIES IN DEVELOPING COUNTRIES

INTRODUCTION

The real history of automation in the manufacturing process began in the early 1950's with the introduction of numerical control (NC) just at the point, where many rising industries in developed countries were concerned about the lack of work forces. At the same time a lot of population development studies, especially in Japan, began to advertise the need for preparing alternative solutions for the fact that in the 1990's the increasing young workers will not keep up with industrial requirements. These studies indicate that industrial automation could solve this problem.

Starting from the application of numerical control at the single machine tool level, the development continued with the integration of more than one machine and auxiliary support devices, such as material handling systems, tool handling systems and so on. The development of industrial robots occurred practically simultaneously with the computer based NC (CNC), but although the first industrial robot was developed 1961, they only began to become important.

With the introduction of the microprocessor the dependant situation between progress in computerized manufacturing and advances in information technology hardware (storage capacity, data processing time, reliability, cost, etc.) changed considerably and interest became focused on developments in software and communication aspects.

The logical follow-up of the manufacturing process is the use of computer technology beginning from the moment of product conception and developing according to market information, up to its final delivery to the customer.

In contrast to traditional automation, in which chains of inflexible, special purpose equipment has to deal with the mass production of relatively homogeneous products, the new automation technology is flexible and applicable to a wide range of machine building operations.

Until now industrial automation has developed very fast and therefore in a very chaotic way. Flexible automation requires a "complete system" idea, beginning at the single production task and extending to the global concept of the plant layout.

Many industries realized studies, showing that the benefits obtainable through technological improvements or work rationalization are reaching an asymptotical value. This means that in future only a great technological jump or structural reform will enable a new increase in productivity. The success of this concept, called Computer Integrated

Manufacturing (CIM), will depend on the way in which all the separate technologies will be connected.

The key to CIM and to reaching economic benefits lies in the understanding of the rules of the game between production objectives, technical components and the organizational structure of the industry.

The introduction of CIM issues, like most new developments, was mostly done in such a way that none of the expected results were reached while new problems have arisen.

The fast expansion of the area and the many general information articles representing CIM as "The Panacea", or "The solution to all your problems", or "The factory of the future", and the marketing statements of industries (which always involve the main idea of selling their own products), have developed a lot of "wrong concepts".

Some of these are:

- The concept is **CIM** and not **CIAM** (Computer Integrated Automated Manufacturing).
- It would be better and more realistic to refer to **CHIM** (Computer and Human Integrated Manufacturing) and not to **CIM**.
- CIM is a concept, its applications are different in each enterprise.
- The first effect in introducing CIM is always an increase in the production cost for a short time.
- Two steps must be taken into account on the introduction of CIM technologies:
  1. The first step must always be a thorough study of the industry's structure and enterprises. This study must be made from the top downwards, beginning at the management level and ending on the shop floor.
  2. The second step should be the acquisition of a decision support software at the management and intermediate levels which will be responsible for the information flow inside the industry, and for support for the medium and long-term production planning.

  Unfortunately, in most cases the first step was the introduction of automation elements at the lower level, without consideration of future development and the need for communicating with a central system, or in cases where this communication exists, without consideration of the compatibility of the different elements. This always leads to very expensive especially developed solution such as protocol adapters, post-processors, etc.

CIM AND DEVELOPING COUNTRIES

Considerable gains in efficiency could be obtained by the adoption of contemporary methods for factory organization, planning and scheduling and production control, as well as appropriate subcontracting policy. In the last few years, the developed countries have been involved in correcting mistakes in the chaotic introduction of automation. Actually, most of the industries in developing countries are still involved in this correction. This is the reason why it is the best moment now to try to learn from these errors and perhaps through technical counselling not only avoid the widening of the technological gap, but reduce it.

The key will be to optimize or change the organizational structure of the industry, trying on the one side to stimulate the introduction of co-operative systems and avoid hierarchical structures and on the other to understand the industry as an entire and complex model, where the bottlenecks and possible deadlocks have to be determined.

With the above mentioned concepts in mind, some important elements to be avoided at the preparation phase are listed below, together with some necessary previous studies and project steps (the points outlined here only represent a general direction because every country has to carry out these actions according to their own socio-cultural context):

To avoid:

(a) Do not simplify the problem by a "machine purchase", this will never be a solution but will only present a bigger problem. If one introduces a computer into a chaotic system, one obtains a "computerized chaos". If one automates the production of a bad product, one obtains a fast production of a bad product.

(b) Do not believe that all the increases in productivity are caused by automation -most of them originate from a change in the organizational structure required for the introduction of a flexible automation.

(c) Avoid a confrontation between capital and labour by creating awareness programmes with trade-union leaders, progressive entrepreneurs and governmental politicians.

(d) Avoid bad reactions caused by the use of wrong terminology. Most of the correct expressions such as CIM, automation, structural change, etc., are charged with a negative connotation.

(e) Avoid short-term programmes that will bring an "spurious" competitiveness based on factors such as low interest loans, tax benefits and so on. The programme must be based on technological changes and better working conditions through a better distribution of the resources.

To study:

Analyze the production market in order to select specific areas and try to:

(a) Assure a "cascade" effect in production.

(b) Introduce advances that could act as a pull-up or motor for the industrial system.

(c) Maximize the direct and indirect benefits in local society.

(d) Promote a local technology development through selected imports.

To do:

(a) Encourage bilateral transfer and communication between industries and universities.

(b) Generate industry clubs to support local technology transfer centres which may be implemented as external institutes of the universities.

(c) Develop training programmes at all levels.

(d) Use practical demonstrations of new technologies (video, PC).

(e) Encourage inter-disciplinary teams.

(f) Create a regional information system to enable better contacts between the existing institutions and projects.

Industry club:

Some of the characteristics of such an "industry club" should be:

(a) Independence of the product, i.e. the system must be capable of adapting itself to the manufacture of different types of products with very small modifications.

(b) Independence of the hardware and software being used: The system should be independent from software and hardware elements with which it interacts. This means that at the system level only resources with determined economic and temporary characteristics and not determined elements will exist. This requires a definition of clear interfaces enough simple to be able to communicate with elements from different suppliers without too much extra effort.

(c) Practically demonstrable: The system must be in a position to manufacture some kind of product. After studying the specific needs of the market, a product must be selected which is flexible enough to be easily produced in different types and different variations of this types.

(d) Flexible software: The software must be easily expandable to allow for a step-by-step introduction into the industry. Its design must therefore be modular.

(e) Flexible hardware. The system to be controlled must be easily expandable.