A CHANGING SCENARIO OF TECHNOLOGICAL ENVIRONMENT IN INDIA AND THE NEED FOR RE-ORIENTATION

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INTRODUCTION

With the inflow of hi-technology and products, the technological environment in India is undergoing a sea-change. Industries are aware that they are passing through a critical phase of competing with the global market and their products must meet international quality standards. Their survival will be at stake, if conscious effort is not put to meet these challenges, in the days to come. Our education system must produce high quality engineers and technicians so that quality services could be rendered to technological community around. Planners and educators alike must take stock of situation so that faculty up-gradation and institutional modernisation can both be thought of. A programme of training the trainers may have to be undertaken on a massive scale, as many present day trainers, themselves have become obsolete and outmoded.

As liberalisation and globalisation implies free flow of hi-technology, products, into this country within 3-5 years, the number of such products will increase as a consequence of various industrial and technical tie-ups and collaborative efforts. In the initial period, the technical environment may appear to be very attractive, as we would have successfully transplanted high-tech machineries and systems amidst ourselves. Once the honeymoon is over, the realities will unfold one after the other. This situation is similar to a person with a transplanted kidney in his body and wanting to lead a normal life.

Even for smooth running of these machineries and installations, we would require more number of suitably trained manpower. Once the machinery or hi-tech system starts giving problems, it will be very difficult, in the absence of a suitably trained professional to run any plant with confidence. There will be psychological apprehension, apathy and inability to come out of the cob-web, with a probable total surrender to technical colonisation. All these emerging situations are pointers indicating the need for re-orientation of our industrial outlook. As universities and institutions are responsible to change the educational systems, specifically to cater to the emerging environment as above, a review of the situation becomes mandatory, to re-orient our educational systems, methodologies of imparting professionalism and the need to generate industrial infrastructure, commensurate with the emerging situation.

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INDUSTRY OUTLOOK - FUTURISTIC

All industries are primarily motivated by profit and none can deny this fact. Industrial expansion, however, can be dictated by the need to exploit allied capabilities generated by the mother-industries. Ancillary industries can thus be set-up for diversification of products, originally intended for manufacture but subsequently resorted to, for exploiting the technical know-how generated over a period of time, by huge industrial establishments. Financially, sound industrial houses will have no problem in respect of men, materials and resources, because they would have already established adequate infrastructure and specialised technical man-power to undertake these diversification.

It is a smooth flow of technical exploitation or upgradation or diversification of their choice. The management will announce their policy of setting ancillary industries only when they are sure that the technical aspects are fully geared for the venture. On the other hand, when the transplanted hi-tech systems and products require urgently replacement of parts, after a lapse of time, either the system will be kept aside as unserviceable or un-usable or cannot be put to operation for want of spares. That is the time, under a crash management programme, a review will be undertaken and it will be decided to 'make' the item'in-house', to tide over the difficulty.

Let us now consider what will be the situation when after 5 years of time many industries would have started manufacturing, let us say, hi-tech products with the collaboration of their counter parts from abroad. There will be many industries from very many foreign nations operative under the name of 'collaboration' in India. Everyone of them would like to 'dump' all spare items into this country providing an easy outlet to advanced countries' industrial products. Indian counter-parts, on the other hand, will be very happy to replace parts from the stock into hi-tech product so that trouble free operation is assured. That is to say, industrial houses would have celebrated their achievements. The reality is that this situation cannot last long. A day will come when the spares are no more available and then, there will be several 'crash programmes', to manufacture the items, locally. Such a venture is bound to become a failure because all items will have to be manufactured to ISO - 9000 specification. Both the processes by which an item is made as well the items itself, will have to meet ISO - 9000 manufacturing and specification criteria. What will happen if such a Total Quality Management is not existing at that time. Every industry will face this problem sooner or later because of international competition - which, if the participants are not ready to face, they will have to become extinct, by choice.

Is it really possible and profitable for all industries to pump all their profits and try to upgrade and concentrate on innovation ? Certainly not. Is it the job of a Government to undertake such adventures ? No. Then who will bell the cat ?

Industrial co-operative venture are the only means by which such innovative jobs can undertaken. Such ventures must be supported by Government, not by pumping money into the programme but by deputing highly talented scientists and engineers from advanced laboratories like BARC, TIFR and other National Laboratories.

Experience of Bell Laboratories in the U.S. would show that a vigorous and productive interaction between industry and research is the only way by which we will be able to upgrade and innovate a product into industry. It is significant that I highlight the efforts of Technology Transfer Group at BARC. It concentrates on the transfer and absorption by industries a variety of technological products and hi-tech systems developed at the centre as spin-off effort to Nuclear Energy programme. Presently, the success rate is sub-optimal as the industries are not interested in those products for which the technology is offered. On the other hand, industry is looking for some lab, to develop products of their interest. If a joint industrial venture, as above is formulated and talented and available expertise from the above National Laboratories are attracted and targeted to this national task of building industrial infrastructural base for undertaking development of items, components, subsystems and systems for industrial avenues, then such a 'melting pot' could provide an ideal and challenging industrial base.

I would like to quote ' The Science Advisory Council' to the Prime Minister, in its paper on " An approach to a perspective plan for 2001 AD; Role of Science and Technology Recommendation For Action" (Nov. 1988), observes as follows :

"One of the recommendation that we make is that the industrial sector should fully make use of the available R & D capability and become export oriented so that it can earn more resources for the country."

In this country, we have pockets of excellence unexposed to industrial needs. We also have another set of pockets in industry. They allocate a due share to R and D not for any tangible results but to attract tax-exemptions. Thus, we have many scattered pockets in the form of islands-such pockets continue to exist as independent entities, not in any way concerned with what is happening in the surrounding. Their vision is blurred and they cannot see beyond a point : Probably our Hindu Philosophy of "doing one's duty without expecting a return" has become very handy in generating and perpetuating isolation amongst intelligentia. Such an attitude speaks volumes about why R and D is not the culture of this country except in bigger islands like BARC. Thanks to great visionaries like late Dr. H. J. Bhabha and Pt. Jawaharlal Nehru, the combined effort of both could nurture R and D culture at Trombay and nucleate many individual talents. When I look back over the past 35 years of my association with BARC, I am convinced of the sincerity of purpose, conviction and courage, with which the planners in 1940s and 50s had set out to achieve the targets which are bearing fruits today. It is commonly said that you name any field of research, you will find some one-either doing it silently or pursuing vigorously at BARC. There are also dissatisfaction and criticism, circulating there. They arise as a consequences of mental vigor and intolerance to mediocre R and D.

The above background would suggest that experienced and intelligent scientists from BARC could play a key-role in joint industrial R and D venture, for the purpose of generating Hi-Tech systems for various industries. Being Government servants, they may have to be deputed on duty to such ventures,

with attractive perquisites tenable for 3-5 years, on a defined task.

COMPLEXITIES INTRODUCED BY HI-TECH PRODUCTS AND SYSTEMS

Electronic systems are becoming more complex day by day. Hi-Tech product or the Electronic systems are designed with advanced functional capabilities. Such systems are used for controlling various operations in industrial plants, equipments and installations.

In all industrial sectors such advanced products are making inroads. For example, in telecommunication industries - Pagers, Cellular Phones and Video phones are technologically and functionally more intensive. Due to compactness of component and functional sub-systems, the packing density of all these products is very high. Many VLSI products are finding place in the above systems and several functions are integrated into a single chip.

In the past, computer based systems had different identities. Modern Instrumentation systems are designed around Micro Controllers, Programmable Logic Controllers, Distributed Control Systems and the like. The operation of a Plant is itself envisaged at the design stage and supervisory aspects of Plant operators also introduced into the design aspects what is called a Supervisory Controlled Digital Data Analysis and Controlled System.

Such systems, as above, are the hi-tech products to flood this country in 3-5 years time. There would be a wild gap between the level of expertise of graduate engineers coming out of the teaching institutions and what would be required to upkeep, maintain and run these hi-tech products. We cannot simply blame the students for the present state of their technical level and expertise. In today's technical environments, test and calibrating instruments like multichannel logic analysers, microprocessor based simulators and software debuggers, computer based Test and Measuring system and like would be common. As our present education system is not geared to generate suitable engineering professionals of that calibre, we have to take stock of the impending situations now.

GRADING OF EDUCATIONAL INSTITUTIONS

A rational approach would be to explicitly grade teaching institutions and create a healthy competition to upgrade them. This is a slow process and may take decades to improve. But it is time we introduce such a system.

Table - 1 shows a scheme whereby students, faculty and institutions are assigned credit-points so that cumulative index is taken for an institutional rating.

When an institute runs, several branches in engineering discipline each branch will be assessed separately for credit generation and the average credit for all the courses put together will be assigned to the institute. Examinations conducted at the end of each year or the average of two semesters will be assessed on differential basis for the purpose of continuous assessment of the same set of students as they progress during the entire course of studies at an institution. Pass percentage for each year will be quantified and indexed. Such an assessment carried out for a batch of students who complete the course in minimum prescribed period also yields a figure called "throughput rate" for the course at an institution.

Thus, throughput of an institution be pin-pointed, both in terms of pass percentage and with higher classes with distinction.

Institutional characteristics are the infrastructure, monitoring and control of both students and faculty, promotional and professional ethics adopted by the institution, effective monitoring of students instructions and performance in various forum and such other indices are included for credit generation.

No institute will willingly generate these indicators as it involve past performance. However, institutes in their own interest, must generate such indices and generate an open system of 'Grading' in future. Such a step will pave ways for credit-worthiness and accountability of teaching staff and institutions alike. Thus, the market forces will determine survival of the fittest. Industry will then be able to concentrate on merit worthy institutions for purposeful R and D activities by entering into partnership. AICTE must recognise the need to generate credit-worthy institutions.

The Universities on their part, must introduce compulsory in-house, professional/industrial training for all engineering courses on the lines followed by medical profession (Internship-Houseman) and also promote R and D culture amongst all teaching institutions. Autonomy as a routine, must be given to all institutions but withdrawn if credit-worthiness is not discernible. They can also be debarred from running educational courses. As market forces are operative, water will find its own level. A lot of dexterity is required on the part of the University to implement such an innovative scheme and to emerge as progressive institutions.

(See Table on Next Page) ★

TABLE - 1

Performance Indices and Credits to be given to various educational institutions for the purpose of grading.

Institutional Performance Index (25 Credits) (Each 2.5 Credits)	Faculty dependent Performance Index (25 Credits) (Each 5.0 Credits)	Students Performance Index (50 Credits) (Disciplinewise)	Max. Credit
1. Discipline] Upkeep & cleanliness of the Institute	1. Regularity in conducting Lectures /Practs.	1. Pass percentage in final year w.r.t. the no. of students enrolled in the 1st year	
2. Regularity]			
3. Punctuality]			
4. Adequacy of Staff	2. Completion of Theory/Practs.	2. No. of students who excelled getting 1st Class + Dn. in % as in (1)	8
5. Staff improvement	3. Supervising/ Counselling.		8
6. Job satisfaction of staff/faculty.	4. Monitoring of academic activities	3. Percentage of students selected during campus interview	8
	5. Staff satisfaction	4. Industry, Institute Interaction, Seminar/ Symposia, Guest Lectures organised.	8
Amenities at the Institute			
7. Library Facilities		5. No. of industry sponsored projects carried out by the students	8
8. Canteen Facilities			
9. Playground Facilities		6. No. of University Rank holders /Univ. Co-curricular champions/prize winners at State level/National level	10
10. Common Room Facilities (for staff and students)			

TOTAL : 100 CREDITS (MAX.)

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