CHAPTER 18

Research Universities and sustainable Development with special Reference to India and IIT Madras

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INTRODUCTION

Rapid advances in technology have had dramatic consequences. The environment that moulded life on earth over many millennia is being altered and even replaced dynamically, endangering the very life whose quality science and technology seek to improve. The overwhelming concern of all societies today is that of sustainability of human civilization on this planet. India is particularly at the crossroads having to meet the challenge of addressing two kinds of basic needs of her population: food, shelter and clothing for one part, and energy, materials and communication for the other. In this context educational institutions have a socially important role to play and an economically important opportunity. Of the three components of education, namely knowledge, know-how and character, they have the responsibility, more than ever before, of building character in their students. They have to cope with the problem of dealing with sustainability as a research and education issue, while preserving their core values and maintaining dynamic equilibrium with their local environment. This paper uses IIT Madras (Indian Institute of Technology) as an example to illustrate the role of premier research institutions in this context. The author recalls Mahatma Gandhi cautioning mankind nearly a hundred years ago about the unsustainable nature of human greed and concludes that it is time for us to revisit traditional wisdom, while looking ahead for a sustainable future.

The present has been described as the "best of times" and the "worst of times" (May, 2005). The "best of times" because science and technology have made living more comfortable than ever before. The "worst of times" because our environment is being altered and even replaced dynamically, endangering the very life whose quality science and technology seek to improve. The focus of all nations today is on sustainable development (SD) that alone can save our planet.

The Stockholm Resolution of 1972 And The Rio Declaration of 1992 (Agenda 21) identified rights and responsibilities for sustainable development. The right is simply that of every human being to live a healthy and productive life in harmony with nature by exploiting the State's resources for sustainable development. Among the many responsibilities are: equitable development and environmental protection globally through cooperation among all nations: in conservation, protection and restoration of the health and integrity of the Earth's ecosystem, in transfer of knowledge as well as technologies for SD, in judicial and administrative facilitation and in countering the effects of any environmental disaster. One of the important components in these declarations is the effective participation of indigenous people, especially women and youth in SD.

THE INDIAN CONTEXT

India is no longer a poor country: she is a rich country in which many poor people live. She is the second largest consumer market. She has the second largest pool of scientists and engineers. She offers the most challenging problems in development. For about 40% of our population, the basic needs are food, shelter and clothing; for about 30% of the urban population, the needs are energy, materials and communication (as in developed countries). The challenge is to address both kinds of needs even though addressing the former set is obviously her priority. In a world in which knowledge is power, India cannot ignore the latter set. In so doing our attitudes will need a significant change. Indians will have to learn to be proud of their nation and for good reasons:

- The clean and healthy nationalism of our independence movement;
- The difficult yet wise choices in at least five important post-independence debates: Democracy vs Totalitarianism, Secularism vs Fundamentalism, Globalization vs Self-reliance, Defence vs Development and Centralization vs Federalization;
- The "green", "white" and "brown" revolutions leading to self-sufficiency in food, milk and oil seeds;
- Achievements in defence, atomic energy, space, manufacturing and software.

However a lot remains to be done. The empowerment of women is critically important for sustainable development. India too has taken some steps in this regard: there are nearly a 1000 colleges exclusively for women, there is a National Commission for women to look into legal issues and so on. We celebrate Women's day on 8 March every year. Yet the very existence of such provisions, important as they are, reflects the lack of gender-equality in our society. In the final analysis it is educated women who can make a difference to the status of all women in our society.

THE CHANGING ENVIRONMENT

The all-pervasive nature of technology has resulted not only in a large variety of jobs that require new skills, but also in a rapid obsolescence of traditional skills. Society demands higher education to cater to a much wider spectrum of technical skills and to provide continuing education to upgrade the skills of the older graduates. The competitive nature of Indian society, the increase in consumerism and the information explosion have increased the accountability of educational institutions. The highly competitive and increasingly global economy has forced Indian industry to look for emerging technologies and R&D to provide the global competitive edge. Professional institutions have a socially important role to play and an economically important opportunity in this context.

The changed environment calls for greater flexibility and responsiveness in the university. Coping with these changes while preserving its core values (Strategic Directions Report, Indiana University, 1996) poses a variety of challenges. IIT Madras, for example, has articulated its core values in its Strategic Plan (The Strategic Plan of IIT Madras — Vision 2010): developing human resources to serve the nation, recognizing teaching as a unifying activity, nurturing integrity, creativity and academic freedom and retaining a willingness to experiment with new paradigms. Institutions of higher learning will have to cope with contemporary social realities and influence government policy, especially with regard to sustainable development, while remaining apolitical, autonomous, socially relevant and yet sufficiently detached to serve the need for objective evaluation and constructive criticism. They should also actively protect themselves from all outside efforts to abridge their autonomy and academic freedom. Universities in India must devise ways of providing education for at least four to five times the present student population within the next decade, while maintaining their dedication to excellence and high standards of performance.

Universities have to work out a healthy balance between specialization that caters to a current technological demand and wholeness of knowledge. They should educate students to cope with the confusion of values that follow

from technology's threats to sweep humanity off its cultural feet. Rapidity of change creates a historical attitude. Universities have the problem of identifying and preserving that which is good in its past, while dealing with contemporaneity and relevance. They should create a vibrant community of learning that is willing to articulate, profess and defend its core values, while being open to healthy winds of change.

ENGINEERING EDUCATION

To discuss the challenges in the context of engineering education we briefly describe the three well-defined aspects of engineering education: *knowledge, know-how and character*.

Knowledge enables one to understand what one learns in relation to what one already knows. Each knowledge-area has an invariant core consisting of fundamentals based on universal laws that provide a phenomenological description and an outer layer of constantly improving empirical knowledge of particular systems and of constantly changing applications of increasing sophistication and complexity (Ananth, 1997). The invariant core provides the continuity in education while the applications provide the excitement and the education relevant to the current demands of the industry. Although the fundamental theory is itself invariant, it should be emphasized that applications constantly provide new insights into the working of the theory. The rapidly changing tools (the most obvious one being the computer and associated software) have had a very significant role on our entire approach to education.

Know-how is the ability to put knowledge to work. It requires the purposeful organization of knowledge from many different areas of learning. Know-how is taught through design courses, project work, industrial training and other opportunities for individual initiative and creativity. Elective courses on technology often provide descriptions of successfully implemented know-how, while those on emerging technologies describe attempts at doing so.

Character is the most important component of education. It is easy to recognize, but character-building processes are difficult to define and implement. Character traits such as honesty, truthfulness, integrity, initiative, competitiveness, self-esteem, leadership and the ability to work both alone and as part of a team have an invariant value. In the pre-scientific and pre-technological era preceding the wars, religion played a significant role in character-building even among the intelligentsia. This is no longer true and what compounds the problem is the fact that the intelligentsia have an increasingly disproportionate role in social development. The educational institutions now, more than ever before, have the responsibility of character-building.

EDUCATION AS A SURVIVAL TOOL

Education has become an essential tool for survival (Ananth, 1997). Rapid advances in technology have had dramatic consequences. The environment that moulded life on earth over many millennia was until the last century hardly influenced by the life that it so generously supports. Technology has changed this situation drastically. The environment is being altered and even replaced dynamically. The survival of life in the old environment was governed by a process of natural selection — species that adapted better to the environment survived better than those that did not. The new environment — especially the modern, urban environment in which most of mankind lives — is almost entirely artificial and survival in such an environment is governed by what one might describe as "artificial selection".

The human species in the new environment has two levels of survival. There is, on the one hand, the level of economic survival of the individual and, on the other, that of the civilization as a whole. There is often a conflict of interest between the two levels of survival. During the last decade, capitalism has emerged as the only sustainable form of government and advances in technology have magnified manifold the profit-making capacity of commercial organizations, these conflicts have become diverse and at the same time more subtle.

Thus the tools for the survival of the individual or institution (TSI) are *information, resourcefulness, an elastic conscience and some professional skills*. Information is picked up from many places — television, radio, newspapers, magazines and even conversations with others. This component has increased explosively in this age of information and communication technology. Resourcefulness is picked up "on the street". The urban environment today throws together people with widely different world views and occupational compulsions: the social worker and the marketing manager, the environmentalist and the industrialist, the conservative and the liberal, and so on. It is increasingly necessary for each to be able to appreciate the other's point of view and to develop an elasticity of conscience for peaceful coexistence and meaningful debate. Except for professional skills, formal engineering education has little to do with the imparting of these tools.

On the other hand, the tools for the survival of a civilization as a whole (TSC) are *knowledge, an abiding faith in the power of professional knowledge to improve the quality of life of all people and a sense of ethics, objectivity, aesthetics and history*. Educational institutions have an important role to play in this regard.

The objective of the university is basically to educate and prepare students for a variety of challenging careers. Such an education places powerful tools for the survival of the individual in the hands of the student at an impression-

able age. It should therefore simultaneously attempt to equip the student with tools for the survival of civilization as a whole; it should, for example, inculcate in the student a sense of responsibility, an awareness of the ability of these tools to help society, as well as to cause damage.

The larger aim of institutions of higher learning is to serve the nation by producing value-added human resources through *education*, by creating a wealth of knowledge through *research* and by developing and transferring technology as a *service* in the sustainable development of the country and the improvement of the quality of life of our people.

THE TSC AND TSI COMPONENTS OF PROGRAMME

Courses in the humanities, social sciences and management should attempt to inculcate in the student a sense of history, ethics and social responsibility. The purpose of the humanities component is to persuade the professional to entertain questions regarding ends and values so that he does not lose the human direction in the pursuit of technological development and to caution him that a purely rational view of the world based on the inevitability of scientific progress cannot cope with a fragmented, culturally diverse society full of complex emotional problems. These are predominantly tools for the survival of the civilisation. A keen sense of aesthetics in the approach to and in the solution of technological problems is also largely a matter dealing with TSC. Aesthetics is a concept that varies with time, and today it is important to inculcate in the student the notion that the more eco-friendly and the more sustainable a technology, the more aesthetically pleasing and in the long run more economical it is likely to be.

The "know-how" imparting component should include exposure to real-life problems and teamwork and opportunities for individual initiatives such as participation in research, in seminars or in design competitions. The importance of teamwork, as well as that of individual initiative as tools for the survival of the civilisation cannot be over-emphasised, especially in the Indian context.

UNIVERSITY EDUCATION

The university is recognized as the most traditional of all our institutions and yet it is the major instrument of the change in our social, economic and political systems in the last few decades. Higher education therefore has an important role to play in sustainable development. The most important factors in the new paradigm are:

- Multidisciplinary education with environment as part of all learning;
- Values and ethics as part of all learning;

- Equity, justice, cultural and environmental sustainability should be the prime goals of economy and qualitative change should be a measure of success in development;
- The learning process has to be a lifelong one.

The educational programmes should include courses on sustainability, extramural talks by experts from the government, as well as non-governmental organizations. The most important task of the University is perhaps that of developing the right attitude of the students towards nature.

RESEARCH

Faculty at IITM, as in other research universities all over, are working on emerging challenges such as climate change, loss of biodiversity, resource depletion and deteriorating environmental quality at the local, regional and global levels. The global and interdisciplinary nature of these problems, their complexity and the urgency of the situation make it necessary for premier research and teaching institutions across the world to join hands with each other and with other stakeholders in order to develop solutions to problems of sustainability. The Indo German Centre for Sustainability (IGCS) at IIT Madras (Rajan, Murty & Philip, 2011) has been set up to take up long-term research and developmental studies which would eventually lead to sustainable water, waste, energy and land management practices. The objective of IGCS is to synergize the efforts of Indian and German faculty and students in research, training and policy advocacy in the context of sustainability. As a first step towards achieving this goal, the centre plans to take up research studies in two major areas: water and waste management for the sustainable development of urban river basins. The sub-themes of interest are: water resources management, wastewater management, solid waste management, flood protection and river/stream water quality, management of wetlands and of air quality.

The water resources management sub-theme focuses on evolving macro-level management strategies and practices for efficient (from an economic perspective) and equitable (from a societal perspective) utilization of water resources in the urban and the semi-urban areas of the basin addressing different competing needs, such as agricultural, drinking water supply, industrial and flood mitigation, while preserving the ecological integrity. Other sub-themes will focus on a sub-basin level, but in a holistic fashion. The sub-basin level studies will involve management of (i) wastewater (ii) flood water disposal and water quality in rivers and streams, (iii) air quality, (iv) solid waste and (v) wetlands. Emphasis will be laid on analysing the technical, social, economic and political context of the basin alongside changes in its hydrological and environmental dimensions over the past two decades, in an attempt to arrive at meaningful policies for basin management in the future.

LOCAL SUSTAINABILITY

At a local level the idea of sustainability is built into the vision of IIT Madras (The Strategic Plan of IIT Madras — Vision 2010): *To be an academic institution in dynamic equilibrium with its social, ecological and economic environment, striving continuously for excellence in education, research and technological service to the nation.*

The implementation of this vision is clearly in three parts — activities that strive to achieve dynamic equilibrium with social, ecological and economic environments. The idea of the first part is to try and solve problems for society using appropriate, not necessarily high, technology. For example, IIT Madras has developed affordable import substitutes in medicine, devices for children with cerebral palsy and devices to reduce drudgery in coir spinning. There are about 30 on-going projects in which many faculty and students are involved. Their work is their source of satisfaction not monetary rewards.

IIT Madras is located in a 230 acres (93 hectares) of sylvan forest land with over 400 species of plants, 100 species of non-native plants and over 10 species of invasive plants and 200 species of animals. The second aspect of the vision is about managing this incredibly beautiful, yet sensitive ecological environment. A bio-diversity study by a group of experts, posted on the website of IIT Madras, has helped formulate suitable maintenance measures needed to preserve our biodiversity. Two pocket books, one on animals and one on plants, provide information to the stakeholders in a manner that helps them get involved meaningfully in this activity.

The IIT Madras Research Park, the first university-based research park in India, attempts to help IIT Madras achieve dynamic equilibrium with its economic environment. Innovation and competetiveness are recognized today as being central to any nation's survival in today's globalized world. Louis Pasteur observed that "discovery is the result of chance meeting a prepared mind". The role of university-based research parks in the Silicon Valley during the last decade of the 20th century presents a lesson for others in this regard. Names of Indian students, especially those from the IITs, appear in a significant fraction of the IPR generated during this period. It appears as if the IITs were preparing minds that met "chance" in Silicon Valley! Innovation resulted from bringing together unlike minds: R&D personnel from the industry who understand the value of the ideas in the marketplace, professors who are subject matter experts with a width of vision and students with new ideas and a spirit to conquer the world. The IIT Madras Research Park hopes to play a significant role in making India the design house of the world!

CONCLUDING OBSERVATIONS

Nearly a hundred years ago, Mahatma Gandhi said "nature gives us enough for our need, but not for our greed". With the currently accepted ideas of development (which are beginning to be questioned seriously), what we are asking today is: "Can we be greedy and sustainable?" The answer is most probably a resounding "no". However, it is heartening to note that we are increasingly willing to reframe the question and gearing up to face the answers squarely. I think it is important to try and answer this question with humility which appears to be a highly under-rated virtue today and faith in God. Traditional Indian wisdom holds that the latter two qualities are pre-requisites for human beings to follow the path of "dharma" (righteousness). While looking outward to understand the world around us, it is necessary to simultaneously look inwards to understand one's Self. I believe that it is time for us to revisit traditional wisdom while looking ahead for a sustainable future.

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