Science and Technology – The Way Fo

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The stunning advances in various fields of science and technology have had a profound impact on our lives in almost every sphere of our activity, be it health, agriculture, communication, transportation, defence etc. These advances have been driven by an ever-growing volume of exciting discoveries, largely emanating from the science laboratories in the West and their transformation into new products or processes which have flooded world markets, therefore showering vast economic rewards on those nations which have had the courage and vision to make science and technology the corner stone of their development programs. The days when one could depend on agricultural produce or low value textiles, leather etc. for economic growth are long gone. It is only the world's poorest and most backward countries which are barely sustained by such low value-added produce.

The world is today sharply divided by a "technology boundary" which separates the technologically advanced countries from the technologically backward countries. The former have been able to use their scientists and engineers for rapid economic growth while the so-called "developing countries" (which in reality are not "developing" at all) are relegated to the role of consumers of technological products; being almost totally dependent on the advanced countries for most of their needs, be they chemicals, pharmaceuticals, engineering goods, transportation, defense equipment etc.

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onto sharp focus by the fact that the total GDP of the entire Islamic world is only about US$1200 billion which is less than that of France, almost half that of Germany and less than a quarter that of Japan. This is in spite of the OIC member countries having some 70% of the world's oil resources and at least a quarter of the world's natural resources, and comprising one fourth of humanity. The reason that Japan has a GDP over four times that of the entire Muslim world is the highest priority given in Japan to human resource development. There are over 120 universities in the single city of Tokyo alone and over 1000 universities in Japan! Thus Japan has forged ahead in every technological field. What we must realize is that the real wealth of a country is its people – it is the quality of education with which they are blessed and it is the ability of a country to make full use of its educated manpower for development which makes certain nations rich and relegates others to join the community of the poor ones.

In this day and age, the name of the game to achieve rapid economic progress is high technology. We only have to look around us and we will see where our hard earned money is going - to foreign lands. Cars, aircraft, computers, software, house-hold appliances, engineering goods etc. all are imported by us, resulting in a massive transfer of funds from Pakistan to the advanced world. Obviously we have not had a clear vision of the development process and the pivotal role that technology can play in national development. Education in science and technology must be thought of as an essential investment in national development and not as an

roads, bridges or power houses – we must first build our people through grooming their minds by a challenging educational system which can suitably prepare them to tackle key national problems.

It needs to be understood that development is a multifaceted process, and a number of factors must dovetail together before economic growth and progress can occur. In my opinion there are five key components which must come together. Firstly, the foundations of the development process must be laid on a high level of literacy and quality education at all levels. With a population of about 140 million people, surely we have thousands of students who have an IQ in the genius category. In order to unleash their creativity we must expose our youth to a challenging educational environment which teaches them to think and find novel solutions to difficult problems. At present our students are trained to memorize and reproduce facts in examinations, often without getting to grips with the fundamental underlying principles and their applications in real life situations. For this a community of good teachers is the key.

If we can attract our brightest graduates to take up the teaching profession through the introduction of an appropriately attractive salary structure and facilities, this would be a major step in the right direction.

The second important facet for development is to upgrade our universities and research centers to an internationally compatible level of excellence through development and retention of world class researchers and provision of appropriate research facilities. They must become focal points of creation of new knowledge. It is only when we

the cutting edge of knowledge will we have the capacity to absorb frontier technologies and adapt them for our use. It must be understood that basic and applied researches go hand-in-hand, being two sides of the same coin and one must not be ignored at the cost of the other.

The third important facet of the development process is concerned with applied research and technology development. This involves the establishing of pilot plant level facilities to determine the economic feasibility of various processes. This is a complex issue involving the interaction between technologists and economists to optimize the production process on a reasonably large scale so that the financial feasibilities could be properly worked out. This is where science in Pakistan has failed. The few products and processes which are developed in organizations such as P.C.S.I.R cannot be marketed because there has been inadequate financial support for development of each process at the pilot plant level and the economic feasibility of the processes could not be adequately demonstrated.

The industrialists in our country are very discerning. They would rush to buy a good patent if they were convinced that there was money to be made. However they need to be first shown that the project is feasible and will provide a good rate of return on their investment.

For technology development we need to have a certain minimum number of trained engineers and scientists, and these are largely missing. The requisite manpower must be developed with a sense of urgency if we are to succeed.

The fourth facet of development involves government policies and

indigenously developed products and processes. These include tax incentives, provision of risk capital by venture capital companies, protection of intellectual property rights, rationalization of import duty structures, banning of smuggling to protect local industry, and creation of investor confidence through stable and long term policies. Strict steps needs to be taken against smuggling, and the government is taking appropriate action in this respect. How can our industry operate if it has to pay heavy duty on raw materials while finished goods are smuggled duty-free on a massive scale?

The most important fifth factor for success is the involvement of the most creative people at all levels - in other words the operation of a merit-based system in which only the brightest people are allowed to go up the ladder, and suitable reward/punishment system is incorporated as an integral component of a highly transparent but demanding accountability system.

Pakistan has a GDP of about US$60 billion with about a quarter of it being contributed by the agriculture sector. A sizeable growth in the agriculture sector would take us from US$60 billion to about US$63 or 64 billion but it would not raise our GDP to US$200 billion or above. For this we have no other option but to invest in the production and export of high value added technology goods. Knowledge-based growth must become the driving force of our development. Science and technology must be allowed to come to our rescue. There is therefore no way out but to uplift our universities and research centers such as PCSIR and establish strong industrial

hold of foreign debt.

Let me give two examples here of what modern technology can do for economic development – that of Information Technology and Biotechnology. The developments in the field of information technology have occurred at a mind-boggling pace. From only 3 million global internet users in 1994, the number has grown to 300 million users now, an 80% increase in the last one year alone. Some 1 billion web pages can now be accessed through the web, with 3 million new pages being added each day! In the US the benefits of IT to the economy have been remarkable. Real business investment in IT equipment has more than doubled from 1995 and 1999 (from US$ 243.5 billion to US$ 510 billion)* with the software component increasing from US$ 82 billion to US$ 149 billion. Although IT capital contributes to only 6% of private business income in USA, it contributed to half or more of the acceleration in US productivity growth in the second half of 1990s, and to nearly a third of the real economic growth in the US between 1995 and 1999. The enormous riches showered in the U.S. by the software industry is highlighted by the fact that there are more billionaires in this field alone than those produced by the pharmaceutical and chemical industries taken together. Indeed among the world's 40 richest people, six are from the Software industry. In the Silicon Valley (San Jose) the number of millionaires has grown by over 40% in the last three years and there are estimated to be about 60,000 millionaires presently living in this area. The Software Industry has been a large job creator in the U.S. and there are over 2 million Software

equipment etc.

It is an unfortunate but painful reality that the Islamic world, in spite of its oil and mineral wealth, continues to remain in a state of paralysis as far as knowledge based technological growth is concerned. This fact is brought pivotal role that technology can play in national development. Education in science and technology must be thought of as an essential investment in national development and not as an expenditure. This investment is far more important than building development and retention of world class researchers and provision of appropriate research facilities. They must become focal points of creation of new knowledge. It is only when we have high quality basic research in various fields and can work at missing. The requisite manpower must be developed with a sense of urgency if we are to succeed.

The fourth facet of development involves government policies and mechanisms to encourage investment of entrepreneurs in Science and technology must be allowed to come to our rescue. There is therefore no way out but to uplift our universities and research centers such as PCSIR and establish strong industrial linkage before science can help to relieve us from the strangle-

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fields are being created each year. The U.S. Bureau of Labor Statistics estimated in 1998 that demand for computer scientists, computer engineers and system analysts would constitute the fastest creating job market in the next few years. The major problem in this industry all over the world is the lack of trained manpower. If Pakistan is to make a headway then it must embark on a process of massive human resource development, provide universal internet access, and deregulate in order to provide an enabling atmosphere for local entrepreneurs. It is also necessary for Pakistan to establish commercial linkages with software user companies in foreign lands so that the software developed by our trained manpower is appropriately utilized.

The second example is that of biotechnology. Just as the last century was regarded as the century of micro-electronics and computer science, the current century will be known for the startling progress in biochemical sciences. It will lead to dramatic changes in the quality of life, for example through the development of new pharmaceuticals for tackling cancer, heart diseases, delaying the aging process and leading to fantastic increases in the yields of agricultural produce through genetic manipulation. Gene based medicine and plant tissue culture technology are just two examples which would result in economic prosperity for countries which invest in this field.

In Pakistan there has been a criminal negligence of our science and technology sector. This is illustrated by the virtual collapse of our largest S&T organization i.e. Pakistan Council of Scientific and Industrial Research (PCSIR). This organization, which is spread in several cities of Pakistan, once had a work force of 280 Ph.Ds in the 1980's. This should have grown to over a thousand Ph.Ds if the organization had been allowed to flourish. Alarmingly, the number has diminished to only about 70 Ph.Ds and the institution has been allowed to collapse. About 99.7% of the government contributions in P.C.S.I.R. go to the payment of salaries, utilities etc. and less than 0.3% of the funds go to actual research! We must uplift this organization along with many others through induction of fresh highly qualified Ph.D. level manpower and through provision of an internationally compatible infrastructure and entrust the scientists to undertake meaningful goal-oriented projects. Similarly our universities have budgets which on average are only about 20% of the universities in Bangladesh. The Ph.D. manpower retiring for the last ten to fifteen years is not being replaced so that most of our universities are faced with a monumental manpower crisis. As a result, the already low standards are being further eroded, and our universities have in many cases shrunk to the level of high schools.

However all is not dark and there is light at the end of the tunnel. Now with the recent public commitment of the Chief Executive for a sizeable share of national GDP going to science and technology and in particular to information technology, it is hoped that a significant change will be visible in the near future.

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