सत्यमेव जयते

INDIA as knowledge superpower

strategy for transformation

TASK FORCE REPORT

Planning Commission
Government of India
New Delhi, JUNE 2001

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K.C. PANT

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DEPUTY CHAIRMAN
PLANNING COMMISSION
INDIA

30th April, 2001

Foreword

Taking cognizance of the mission given to the country by our Prime Minister to build knowledge based activities as a major economic and social resource, the Planning Commission set up a Task Force to prepare the road map that would make India a major knowledge power within this decade. This was by no means an easy task. There is no straight and smooth road to the last mile. However, achievement of global acclaim in the field of computer software in the last few years has given us the confidence to aspire to achieve higher goals in all fields.

It is important to recognize that India today has a population of 700 million young people below 35 years. This is a magnificent force. How to ignite these young minds? Launching the vision of a knowledge society with which their future is vitally linked has the capacity of inspiring them.

India is an ancient civilization with a rich heritage. It has a vast storehouse of knowledge in various fields, but general awareness of much of it is inadequate. Our traditional systems of medicine, evolved over hundreds of years, offer relief to millions, specially in the rural areas. They are now finding wider recognition both at home and abroad as they are being technically standardized and effectively marketed. Similarly, our vast bio-diversity is an invaluable asset capable of supporting rapid advances in the exciting and richly promising field of Bio Technology (BT) but very little of this potential is known to the policy makers let alone the general public. Our achievements in areas like agricultural science, nuclear science, space oceanography and defence technologies are also noteworthy. The industrial base built up over the years is equally an important foundation for economic growth. We also have the advantage of possessing the second largest pool of English speaking manpower in the world. We had 4,00,000 Information Technology (IT) professionals at the end of 1999-2000. The growth of technical personnel at all levels is currently around 1,00,000 per year. India has carved a key place for itself in IT. IT, BT and other core competencies of the country play a crucial role in the realization of a knowledge Society. We must tap that potential to the maximum.

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While a knowledge society has a two-dimensional objective of societal transformation of wealth generation, a third dimension emerges as India transforms itself into a knowledge superpower. Knowledge protection is the third pillar on which the knowledge society rests.

The Task force, after detailed consultation with various experts, has attempted to show the way to make all this happen. The strategy proposed and the solutions suggested are not meant to be exhaustive. What is important is that they lead to a larger debate on the issues of designing and realizing a Knowledge Economy and Knowledge Society.

A major part of the report is devoted to IT and how it can be deployed to give a thrust to the Knowledge Economy. The advantages of connectivity have been highlighted and the need to ensure information security and protect and safeguard our knowledge has also been emphasized. Connectivity will not only help to advance a wide range of areas of the economy from agriculture to commerce but will also serve to promote tele-education and tele-health care. To make all this happen, however, changes in governance are needed which have also been touched upon in the report. Successful national and international experiences have been cited to show how new and innovative uses of Information Technology for e-governance, e-education and e-commerce are making a difference to the lives of people.

The report has also highlighted how BT research and development will further help in the spheres of agriculture, health, environment and industry. The human resource development programmes in this sector would lead to an excellent resource base across the country, ensuring location specific technologies for different regions, helping transfer of technology and employment generation in many fields. Biotechnology is poised for rapid advance in research in emerging areas like gene therapy and functional genornics, environmental pollution abatement, new generation vaccines etc. The vital importance of patenting our knowledge in biotechnology and ensuring biosafety, needs to be underlined in view of increasing globalisation.

The report emphasizes how not just IT and BT but multiple technologies and management structures will have to be woven together to create a Knowledge Society. This is the basic difference between an IT driven society and a broader knowledge-driven society.

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India is well placed at the dawn of the Knowledge era. We should not miss this opportunity. Our culture and civilization have been enriched over the ages by great thinkers who have always taken an integrated view of life as a fusion of mind, body and intellect. Their vision of knowledge has blossomed in the form of many spiritual centres and epics. The coming decades will see a confluence of civilizational and modern technological streams.

This report, which is the outcome of concerted efforts by a committed team of experts, shows the path. It is now for all of us to jointly make it into an Action Plan that will take the country forward in all spheres of Knowledge Economy and the Knowledge Society in a balanced manner and with great speed.

As the Chairman of this Task Force, I greatly value the contribution of every member of the Task Force and especially of the Steering Committee presided over by the Dr. APJ Abdul Kalam and of Dr. R.A. Mashelkar, DG, CSIR and Secretary, DSIR, and Prof. Ashok Parthasarathi, Jawaharlal Nehru University and Dr. K. Venkatasubramanian, Member, Planning Commission, who was the convener of the Task Force in the integration of ideas, thoughts and reports received from many sources and subjected to intensive discussions at meetings which were held at Yojana Bhawan from time to time.

(K.C. Pant)

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Task Force

Composition

1.	Shri K C Pant Dy. Chairman, Planning Commission	Chairman
2.	Dr K Venkatasubramanian Member, Planning Commission	Member Convenor
3.	Dr APJ Abdul Kalam Principal Scientific Adviser to the Govt. of India	Member
4.	Dr RA Mashelkar DG, CSIR & Secretary, DSIR	Member
5.	Shri MK Kaw Secretary, Deptt. Of Secondary Education & Higher Education	Member
6.	Dr (Mrs) Manju Sharma Secretary, Deptt. Of Biotechnology	Member
7.	Smt. Kiran Aggarwal Principal Adviser (Education), Planning Commission	Member
8.	Prof Ashok Parthasarathi Professor, Centre for studies in science policies, JNU	Member
9.	Shri NR Narayanamurthy Chairman & CEO, Infosys Technologies Ltd.	Member
10.	Dr Hari Gautam Chairman, UGC	Member
11.	Prof JS Rajput Director, NCERT	Member
12.	Dr N Vijayaditya Acting Director General, NIC	Member
13.	Dr VP Garg Joint Adviser (Edn.), Planning Commission (15-2-2000 to 08-05-2000)	Member-Secretary
14.	Shri RC Jhamtani Joint Adviser (E&F.), Planning Commission (09-05-2000 onwards)	Member Secretary

Co-opted Members

15. Prof. N. Balakrishnan
    Professor, IISc
16. Dr. M. Vidyasagar
    Exe. VP, TCS
17. Dr. M.S. Vijayaraghavan
    Adviser, O/o. PSA to GOI

Steering Committee

Composition

1.	Dr APJ Abdul Kalam Principal Scientific Adviser to the Govt. of India	Chairman
2.	Dr K Venkatasubramanian Member, Planning Commission	Member
3.	Dr RA Mashelkar DG, CSIR & Secretary, DSIR	Member
4.	Shri MK Kaw Secretary, Deptt. Of Secondary Education & Higher Education	Member
5.	Prof Ashok Parthasarathi Professor, Centre for studies in science policies, JNU	Member

CHAPTER 1

Profile of Indian Knowledge Society

1.1 Prologue

Twenty first century will be the century of knowledge. Only those nations will survive and succeed, which will build themselves by understanding the dynamics of knowledge and create true knowledge societies. What is a knowledge society? It has the following distinct characteristics.

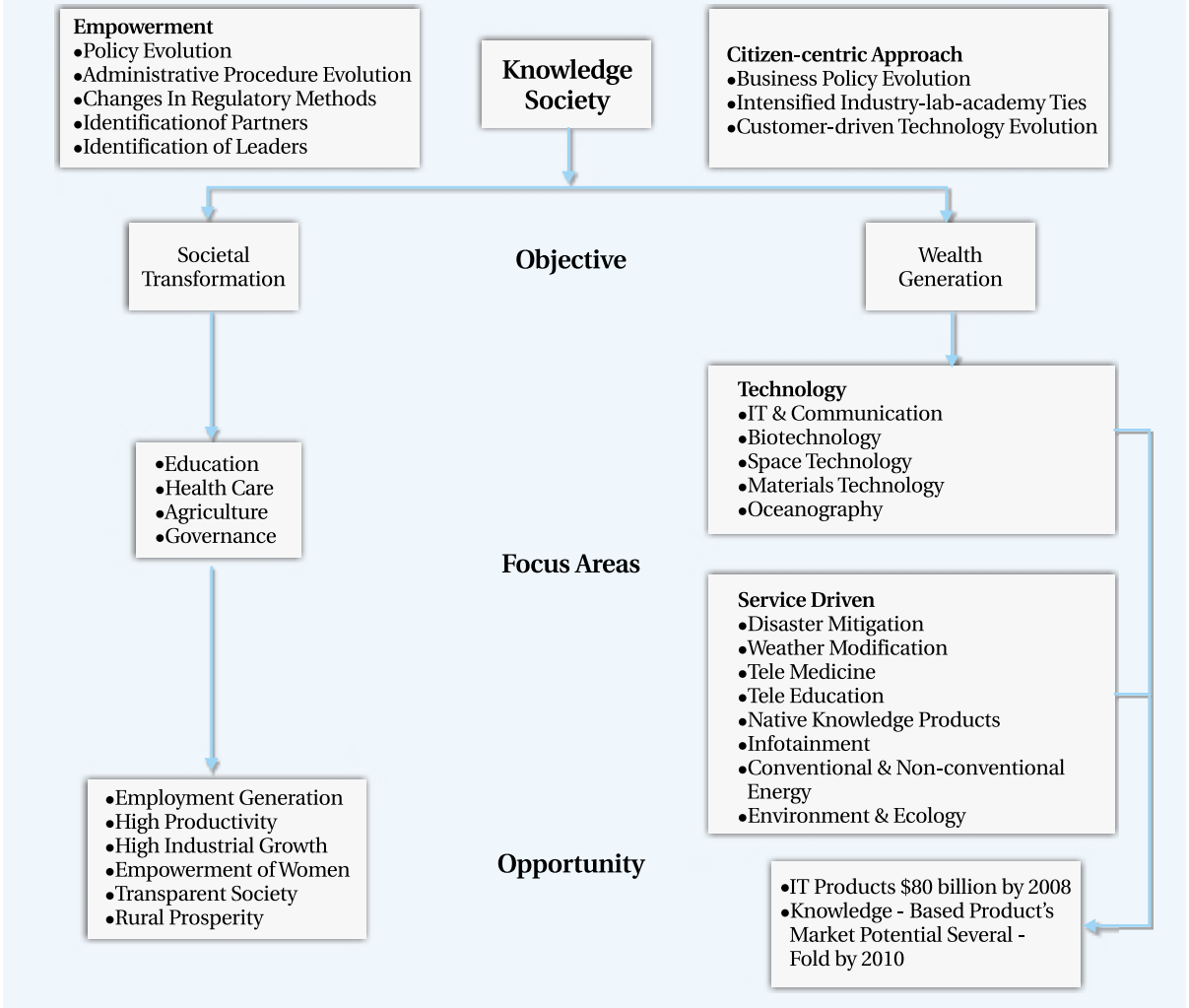
i) It uses knowledge through all its constituents and endeavours to empower and enrich its people.
ii) It uses knowledge as a powerful tool to drive societal transformation.
iii) It is a learning society committed to innovation.
iv) It has the capacity to generate, absorb, disseminate and protect knowledge and also use it to create economic wealth and social good for all its constituents.
v) It enlightens its people to take an integrated view of life as a fusion of mind, body and spirit.

A view of the impressive achievements of the Indian civilization over three millennia reinforces the belief that India was a leading knowledge society in the millennia gone by. There was a continuous process of intellectual renaissance through some awe inspiring contributions by our saints, poets, philosophers, scientists, astronomers and mathematicians to new thoughts, principles and

practices. The decline, especially during the colonial period, set India back. However, India has the potential to capture its past glory, learn the key role of knowledge in development and become a leading knowledge society. What gives us this confidence?

India has a number of strengths. India enjoys a broad based and diversified Science and Technology (S&T) infrastructure. Development of technology in space, defence and atomic energy inspite of regimes of denial and control by other nations, our achievements of self-sufficiency of food, the strong position of our drugs and pharma as a net exporter developed entirely on the basis of indigenous Research and Development (R&D) are some of the achievements that we can be truly proud of. It is the Indian minds today, which are making waves internationally in knowledge based industry; India having become the most sought after destination for software being just one example of this emerging scenario

Fig. 1.1



in this century. Recognizing fully that comparative advantage in the new world economy will be shifting to those with ability to absorb, assimilate and adopt the spectacular developments in new knowledge and harness them for national growth, this report lays out the new vision of the Indian Knowledge Society and shows the road map on how to achieve it.

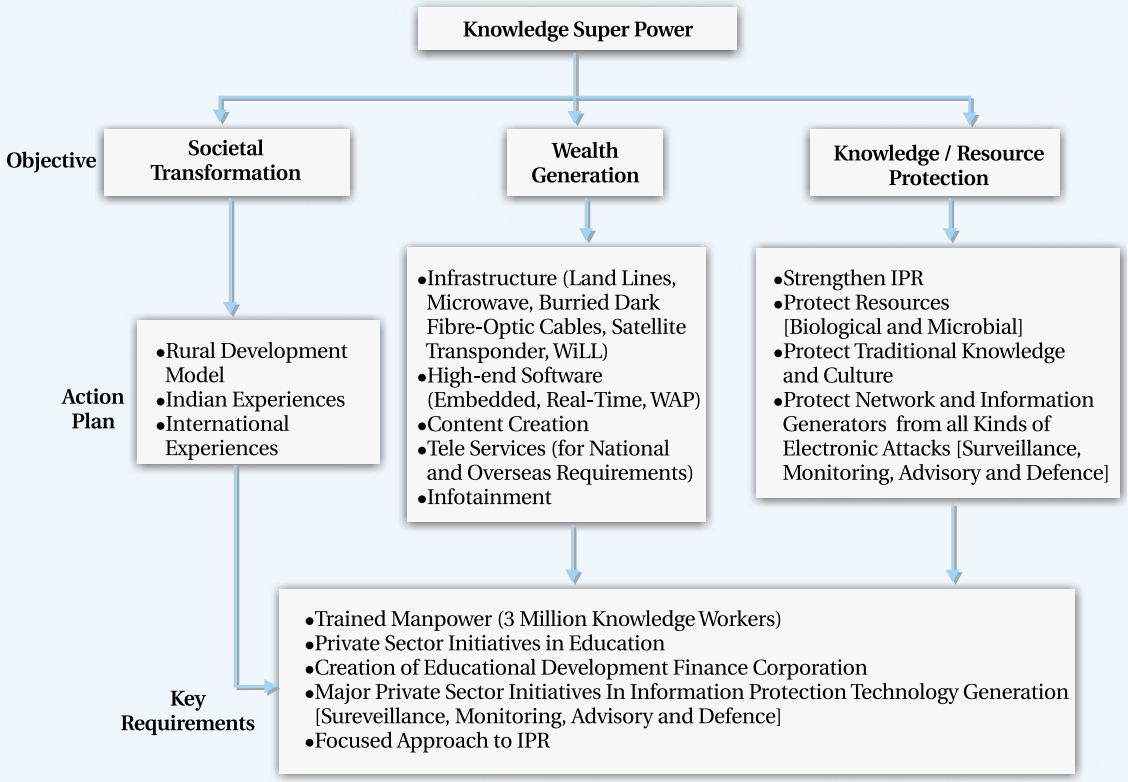
The Key Drivers

1.2 Knowledge society in this century will have three key drivers. The first will be driven by societal transformation for a just and equitable society and the second by wealth generation [Fig.1.1]. The third will be driven by protection of knowledge, not only the one generated in its research laboratories but also its traditional knowledge, generated by our communities over centuries in laboratories of life [Fig.1.2].

Societal Transformation

1.3 As regards the first, the societal transformation will primarily be centred on education, healthcare, agriculture and governance. This transformation will encompass higher employment generation, higher industrial growth, higher

Fig. 1.2



national efficiency & productivity, higher empowerment of women, creation of a truly transparent society and generation of significant rural prosperity.

1.4 The present level of per capita realization or value addition for the software being developed in the country is rather low. In order to meet the stated target of $ 80 billion by 2008 for IT products, our per capita realization has to be increased several fold. Opportunities to meet these lie in extending our domain of embedded and real-time software. The wealth created through this unique business opportunity would be ploughed back to benefit programmes designed for rural upliftment.

1.5 This report also discusses the type of empowerment needed to usher in a societal transformation in our society. Evolution of innovative administrative procedures and policies, change in mindset at all levels, changes in regulatory regimes to create a 'hassle-free' environment in which the society and business can function, identification and clustering of partners and most importantly, creation of young and dynamic leaders are essential fundamental prerequisites of this transformation. Wealth generation has to take place through an economic activity spread across the land with the coexistence of mass production as well as production by masses. Application of new knowledge will be centred on this twin objectives. It is essential that simultaneously a citizen-centric approach to the generation of user-driven technology and intensified industry-lab-academy linkages are also established to enhance the wealth creation potential of the nation.

Wealth Generation

1.6 As regards the second, India's economic development will depend upon its ability to generate wealth and share it equitably. This wealth generation has to be powered by generation, dissemination and creative use of knowledge, not in isolated pockets, but across the nation. But it has to be woven around national competencies. The core areas that will spearhead our march towards a knowledge society would be both technology as well as areas that are service-driven. The technology areas will include information & communication technology, biotechnology, oceanography, space technology, materials technology, environmental technology, etc. The service-driven areas would include, among others, disaster mitigation, weather modification, telemedicine, teleeducation, native knowledge products, conventional & non-conventional energy, sustainable utilization of bioresources, teleservices for national and overseas requirement and infotainment, which

is an emerging area resulting from convergence of information and entertainment. These two technology and service-driven core areas can be interwoven by information technology.

1.7 India has a comparative advantage in creation of wealth due to its superior intellectual infrastructure and several natural endowments, including its rich biodiversity and varying agro-ecological conditions, which need to be leveraged and harnessed. India is seeing newer opportunities on the horizon. For instance, tomorrow's drugs are going to be genotyped and pharmacogenomics is going to be the new R&D focus. Development of any personalised medicine based on genomic knowledge will need clinical trials. Due to its vast genetic diversity, extensive clinical research potential and comparative cost advantage, India is uniquely placed to take up major initiatives in this highly capital-intensive area. India's rich biodiversity and traditional knowledge can be harnessed to create a niche in the multi billion-dollar herbal product market. India's rich S&T infrastructure offers an opportunity to convert it into a global research, design & development platform, especially since knowledge-intensive products are going to dominate the global market. Similarly industries such as microelectronics, designer-made materials, etc., are major growing knowledge industries, which stimulate other industries, in turn to become knowledge based. For example, new knowledge embedded in three-dimensional acoustical sounding, horizontal drilling and deep offshore drilling is turning oil industry into a knowledge industry. Such knowledge industries have to operate in a highly competitive environment with great demand on the speed of response to dynamic market conditions. A high operational and functional efficiency will be crucial for such industries.

1.8 Multiple technologies and management structures will have to be woven together to provide a strong foundation to a knowledge society. It has to be recognized that the difference between an IT-driven society and a knowledge-driven society resides crucially in the role of multiple technology growth engines. This means knowledge from multiple sources and areas would be propelling our knowledge society. In other words using IT, the great integrator of technologies, multiple technologies can be interwoven to realize a knowledge-propelled society. Further, use of IT even in traditional sectors such as construction, tourism, steel, petroleum, transport, railways, etc. can facilitate conversion of these sectors to knowledge-intensive sectors through embedding new knowledge in multiple technologies. With India carving a niche for itself in IT, it is uniquely placed to fully capitalize the emerging opportunities

to quickly transform itself into a knowledge society. This report will discuss the methodology to capitalize several-fold potential that exists for Indian knowledge-based products.

Knowledge/Resource Protection

1.9 As regards the third dimension of protection of knowledge, there is a responsibility to design and implement an Intellectual Property Rights [IPR] system, which will protect India's vast biological and microbial wealth, the indigenous innovations and traditional knowledge of its people. While protecting what we have at the present and what we were endowed with in the past, we need to look at the future opportunities, such as in genomic research. The knowledge of human genome is coming in the public domain today. Discovery and prospecting of new genes and new molecules for drug development and administration with full IPR protection is very vital. Otherwise, people of India will not benefit from this new knowledge although Indians would have contributed in all the three niche areas – providing creative IT solutions, providing genetic material and creating leaders in pharamacogenomics for the rest of the world. We need to do value addition ourselves to generate IPR in these areas and not encash tomorrow's wealth today by just providing low cost services.

1.10 Our traditional knowledge and culture should also be protected in the face of multiple threats emerging from vested interests and media. Concurrently, institutional support needs to be provided to the creators and possessors of traditional knowledge, since the process of globalisation is threatening the appropriation of elements of collective knowledge of societies into proprietary knowledge for the commercial profit of a few. It should be our endeavour to see indigenous innovation, enterprise and investments are linked. A knowledge superpower needs to focus on the twin objectives of economic prosperity and national security. Thus national security concerns require utmost attention. Our electronic communication network and information generators need to be protected from electronic attacks, including in cyberspace, through surveillance/monitoring and building technologies that are developed and deployed indigenously.

Learning from Others

1.11 A knowledge society is a learning society. Therefore, with an open mind, India needs to learn from others. For example, the Australian experience [see chapter 6] seems to have many distinctive features, which need to be studied in depth. Australia has achieved a considerable degree of transparency, particularly in government departments, as a result

of introduction of one-stop departmental portals and kiosks that reduces the total number of government departments needed to provide public service. The Australian experience also shows how a large number of teachers can be prepared and schools provided with PCs in the ratio of students, teachers and schools. Such experiences are reported in UK and USA too, who are spearheading the move into creating even more powerful knowledge societies.

1.12 The experience in Japan, Singapore, Malaysia, Korea, China and few West European countries, who have the potential to become key players in the global set up, is also worth examining. It is seen that in spite of shortage of manpower, inadequate mineral resources and physical space, Japan is economically strong. In the case of Singapore, despite being dependent on other countries for a whole slew of resources ranging from manpower to materials, it has managed to join the ranks of developed countries. China, which is very similar to India, in terms of endowments – both natural and human – has been able to capture the opportunity unfolded by the Industrial era but has not been as successful in the Information era due to a variety of issues.

Connectivity: Reaching the Unreached

1.13 A reflection on the current outreach of IT in India shows that especially poor rural connectivity as well as low bandwidth has restricted IT having an impact in urban areas and in not reaching the rural areas on a large scale. But encouraging success stories are beginning to emerge in Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Karnataka. Here we have seen isolated examples of how electronic connectivity can benefit the farmers by giving them better and quicker information on market conditions thereby eliminating the middlemen and by securing better prices for their produce. Speedy and accurate issuing of land records through IT is another example that has captured the imagination of rural population. However, the spread is low. Therefore, methods for taking the technological benefits to the rural population have to be explored far more urgently, and vigorously. Sustaining these initiatives, spreading them widely within these states and emulating them in other states can alone make a real impact on our rural population.

1.14 A winning combination of physical and electronic connectivity can indeed enable our rural areas, which have been excluded so far, leap frog and be active participants in the knowledge revolution. Towards this end, a unique model called "Rurbanisation" has been suggested which advocates clustering of villages for establishing schools, health centres and service facilities and connecting them by road and Internet. This proposal has been discussed in

detail in Chapter 7. Improving the connectivity will involve urgent and extensive augmentation of the existing infrastructure like land lines, micro-wave communication etc. and also making the full use of buried dark fibre optic cables, satellite transponders and wireless technology.

1.15 In a knowledge society, only those people who are able to convert knowledge into skilled action become its real capital. Therefore, generation of trained and skilled human resources is a key challenge. The Task Team has identified a requirement of more than three million knowledge workers in multiple technologies. It is also essential to encourage domestic private sector and people of Indian origin living in other countries to invest in a massive way in education in our country, particularly in technical education. The Task Team has also recommended the establishment of Education Development Finance Corporation. This should assist all people irrespective of the strata of society they come from.

Finally

1.16 A vibrant and dynamic knowledge society has to touch every member of the society, including the farmers and housewives. Therefore every strata of society should become consumer of knowledge products that will make them an integral part of a prosperous society. Thus, the basic constituents of the knowledge society would be the knowledge workers who create quality knowledge products and the enlightened citizens who consume such products. The knowledge society benefits by an appropriate level of feedback and driver mechanisms that contribute to the multiplier effect. This, in effect would demand the movement of our knowledge products towards those based on innovation and ultimately, wisdom.

1.17 We missed the industrial revolution but we should not miss the information and knowledge revolution. This can happen only if we properly synergise our competencies with innovative planning, use all our natural endowments and leverage these by the use of IT. Indeed, the nation has not secured the fullest returns possible from the industrial, electronic and computer revolutions. Leap frogging into knowledge era looks eminently possible today for our societal transformation in the twenty-first century, which is going to be the century of hope for India.

CHAPTER 2

Education: The Foundation

2.1 Introduction

A knowledge super power can only be built upon a foundation of a civil society that is nearly 100 per cent literate and has a capacity to absorb new and relevant knowledge. People are the capital in a knowledge-driven economy. Therefore a constant development of human capital with thrust on skill upgradation, generation, assimilation, dissemination and use of knowledge needs emphasis. It is essential to first focus on assessing our preparedness in this context.

Some of the strengths and weaknesses of the present educational system are shown in fig.2.1 and fig.2.2. While some initiatives have been taken by the government to encourage development of knowledge industries, an overall strategy to assess and build the intellectual capital that will sustain the knowledge economy has to be evolved. In contrast

Fig. 2.1 Enhancing India's Educational System: Strengths

- Tradition of acquiring knowledge for its own sake, spanning several millennia
- Widespread primary and secondary education of relatively high standard
- The facility with students for handling multiple languages etc.
- Widespread teaching of the English language in the area of S&T

Fig. 2.2 Enhancing India's Educational System: Weaknesses

- Separation of undergraduate and post-graduate education
- Undergraduate students get no exposure to top researchers
- Inability to attract better teachers to degree colleges
- Necessity to improve education in basic sciences at the undergraduate level (Physics, Chemistry, Mathematics, Biology etc.)
- Need to raise quality of engineering education and reduce the gap between the IITs and RECs

the neighbouring countries in the Asia Pacific, especially China, Korea and Singapore have developed specific strategies for building knowledge driven economy.

Whereas, primary and secondary education is very fundamental to building the knowledge society, its present state is a matter of concern, when one considers that:

- Only 50 per cent of school-age children in India ever go to primary school.
- Of those that go to primary school, only 27 per cent (1992-93) appear for the 10th standard public examination.
- The nation-wide pass percentage in the 10th standard public examination is only 47.95 per cent (1994).

Multiplying these three ratios (0.5, 0.27, and 0.48) shows that out of 100 children of school-going age, only six to seven will pass the 10th standard examination after ten years. It is clear that the only remedy is to achieve universal elementary education and near-universal functional adult literacy by 2010 A.D. This chapter sets out a methodology to achieve this.

It is often claimed that India has one-third scientific manpower in the world. However, when it comes to per capita, we fair poorly. For example, per million of population, India has scientists which are far lower than other developed countries. Added to this is the problem of the quality of the existing scientific manpower. We thus have to focus on improving the quality of undergraduate education apart from focusing on primary and secondary education to become a knowledge super power.

2.2 Primary Education

The literacy rate in India climbed rather slowly from 18 per cent at the time of independence in 1947 to an estimated 62 per cent as per NSSO sample survey in December 1997. Even this slow progress has been achieved largely by adopting a very generous definition of "literacy", whereby a person is considered to be literate if he/she can sign his/her name. Female literacy continues to hover at roughly half the male literacy rate.

From independence till the late sixties, most children attended schools run by various state governments, and the number of private schools was rather small. However, soon it became clear that various state governments simply did not have the funds to build enough schools to make the society fully literate. This led to private schools being recognised to offer primary and secondary education, which in turn led to

an explosion in the number of private schools.

While forty years ago even children from middle class families attended government-run schools, today it is not uncommon to see children from low income group (in cities) attending private schools. This has led to the "commoditization" of education, whereby education is sold as a commodity to those who can pay the price. The biggest losers in this bargain have been children in rural areas. In many states there is a deficiency of schools, with almost all the deficiency being in rural areas. Setting up new schools is a very expensive proposition, with nearly 90 per cent of the budget going towards salaries, leaving little money for essential new-age amenities such as computers and library books.

One solution is to adopt distance education as a means of bringing education to every school-aged child, together with innovative schemes such as hot lunch programmes to entice poor children to attend the school. One full satellite transponder gives adequate bandwidth to provide a full range of curriculum from pre-school and nursery to the 10th Standard, using MPEG II standard of 2 Mbps bandwidth for video streaming and 64 Kbps for audio. In this way, distance education can be based on the model of two-way audio and one-way video. If the Ku band is used to broadcast these signals, the antennas needed to receive these signals will be small, compact and affordable. By exploiting the fact that the traffic on the internet is highly asymmetric in nature (since URL addresses are very small, whereas the contents being downloaded from the web are quite large.), it will also be possible to provide internet access in a broadcast mode to each school at a reasonable bandwidth. The other possibilities include the use of multi casting capability of the internet and the ease of distribution of course materials through CD ROMs. Of course e-learning has to be combined with face-to-face learning and therefore teachers are inevitable.

For distance education to succeed the message is as important as the medium and this calls for a nation wide coordinated movement to generate quality education material. This would also help in creating a dynamic and responsive education system that introduces new subjects as and when needed and sheds outdated subjects. This will also help in achieving uniform education standards across the country. For a one-time minimum investment, it will be possible to construct a building of twelve classrooms, complete with solar power (to cater to situations in which a village might have poor unreliable power supply), and computers in each classroom. Even this amount can be reduced if philanthropists (such as IT companies) were to donate the computers. As mentioned above, about 90 per cent of the cost of running a school consists of salaries, so if each of such schools is manned by a skeleton staff of just a few teachers (mainly to supervise and to answer some questions), then the running costs of the school will be considerably reduced.

Due to the support provided by the technologies, the teacher becomes more

efficient and can assist in training large number of students thus utilising the infrastructure more effectively. In places where there is a dearth of teachers, distance education would still be necessary [fig.2.3].

While classroom learning is important, what the child learns by self-observation outside the classroom is equally important. A child must become an active participant in the process of learning through observation, field studies, experiments and discussions. A child's individuality and creativity needs to be given due importance in our education. Further, in addition to innovation in curriculum, priority needs to be given to the reorientation of the outlook of the teachers and overhauling of the examination system so that it recognises and evaluates creativity and new thinking rather than memorisation of facts. The schools must move from becoming educational centres to knowledge and skill centres.

The mission-mode programme of "Sarva Shiksha Abhiyan" launched by the central government for universalising elementary education must be fully supported to meet all these objectives.

Fig. 2.3 Improving Primary Education in India

- Conventional teaching coupled with distance education through state-of- the-art connectivity will be cost effective and can speed our country towards near 100 per cent literacy and improve education
- Methods of teacher training, school construction etc. need to be tuned to the new technologies
- The mission-mode programme of "Sarva Shiksha Abhiyan" for universalizing elementary education must be fully supported

2.3 Undergraduate and Postgraduate Education

The separation of undergraduate education from postgraduate education is generally prevailing in India. In countries such as the U.S.A., U.K., France and Germany, the leading academic institutions conduct both undergraduate and postgraduate education together. The availability of high quality faculty in post-graduate institutions would also enrich the quality of under-graduate teaching and build proper academic attitudes among the under-graduate students if both the type of education were to coexist. Therefore there is a need to have a compact undergraduate programme in existing institutions offering solely postgraduate studies.

The universities receive inadequate funds from the UGC and they are not permitted to raise their fees. Thus most of them operate on a shoestring budget that has no room for modernising laboratories, subscribing to research journals, or even providing adequate Internet access. Therefore universities, including those supported by UGC, should be permitted to set their own fees keeping in view quality of education imparted.

Our educational system has remained outside the expanding social and economic systems. On the contrary, it should have become a driver for creating the new social and economic system and thereafter develop a close linkage with this system. This further means that we must build a new social contract between the universities and the society. This will

require an innovative approach, which is not a mere derivative of the past.

Distance education through invoking IT should eventually lead to the establishment of cyber universities imparting anytime, anywhere and anyone education.

It is often heard that youngsters in India are not any more inclined to pursue a career in basic sciences. There are several reasons for this. One of them is that while there are about 40 to 50 engineering colleges in the country that offer excellent education, and about 200 to 300 others that offer good engineering education, the situation in the basic sciences is radically different, in terms of lack of schools of reasonable standards in basic science.

While the situation in engineering is better than in the basic sciences, even here the situation is far from ideal. The drop-off in quality between the IITs and the Regional Engineering Colleges (RECs), and between the RECs and other engineering colleges, is far too steep.

The following steps are suggested towards achieving excellent undergraduate and postgraduate education [fig.2.4]:

- Postgraduate institutions must also have a small and compact undergraduate programmes in their offerings. This would enable enrichment of undergraduate teaching due to availability of high quality faculty in these institutions.
- For quality education, quality teachers and faculty is a must. The teaching job may be made more attractive to encourage inflow of good faculty.
- Higher education, general and technical, must have links with and have relevance to all industrial and societal endeavours. A large number of centres of excellence in areas having such relevance need to be established in several of our educational institutions to meet quality manpower demands arising out of technological changes, users' needs and globalisation of economy.
- A highly interactive academy - R&D - industry/agriculture interface is essential for imparting practical knowledge at all levels. This will also result in faster commercialisation of knowledge. Towards this end, the service rules should be made flexible enough to make free flow of knowledge workers across the three sectors and also promote entrepreneurship.
- All private initiatives, either from within India or from NRIs / PIOs, in

Fig. 2.4 Improving Undergraduate & Post Graduate Education in India

- Existing institutions that are solely post-graduate should include compact undergraduate programs in their offerings
- RECs should be upgraded to the level of IITs in terms of level of government support, their governance and provided autonomy
- Private-sector initiatives in education should be welcomed, with a minimum of bureaucratic interference and maximum of autonomy
- Existing universities, even UGC-supported ones, should be permitted to set their own levels of fees keeping in view quality of education imparted

the field of education should be welcomed, with a minimum of bureaucratic interference and a maximum of autonomy towards increasing access & availability of education as well as for improving quality of educational efforts.

- Universities, including those receiving support from the UGC, should be permitted to set their own level of fees. However it must be ensured that these institutions keep in view the needs of weaker section and meritorious students as well as efficient performance in terms of excellence in institutional functioning.
- To ensure that poor but meritorious students do not miss out on an opportunity for university education, a special scholarship fund shall be set up. This scholarship fund should be disbursed purely on the basis of financial need, without any other considerations entering the picture.
- The establishment of an Education Development Finance Corporation through private sector initiative has to become a reality eventually. In this context the launching of a new comprehensive Educational Loan Scheme by the Indian Bank Association, as announced in the union budget for 2001-2002, is a welcome step.
- Demand-driven non-formal institutions in diverse areas must be encouraged. The programmes of these institutions must be linked with those of the formal educational system through credit transfers, vertical mobility, bridge courses and other mechanisms.
- In order to develop innovative and flexible educational programmes of studies on a self-financing basis, it is imperative to liberalize further the system of Deemed-to-be University.
- Educational networks must be encouraged towards resource sharing and for synergistic development of the educational system.
- Fast decision-making processes have to be evolved through setting up an empowered co-ordinating mechanism between MHRD, AICTE and UGC. The operation of this mechanism should be decentralised and needed powers delegated.
- RECs should be upgraded to the level of IITs in terms of their salary, administrative structure and in the level of support offered by the Government.
- RECs should be fully autonomous, like the IITs.

2.4 Life Long Learning

For India to become a knowledge society, it has to be a learning society first. The time in which knowledge doubles up is reduced to less than ten years now. It is, therefore, important that continuous opportunities for improving individual's knowledge, skills and competence are provided so that the individual will continue to remain relevant and productive in the changed settings of his office, factory, farm or a society. For life long learning, it is not only the settings of formal education to which we have made a reference to so far that are important, but

also the settings of the home, the workplace, the community and the society at large are as important.

For a pervasive life long learning movement in India, we will have to strengthen the learning foundations, provide a broad range of learning opportunities and recognise and reward learning regardless of where and how it takes place. Policy initiatives on life long learning, besides this, should fundamentally focus on four key components. The first is to provide motivation for the individuals to learn on a continuing basis. Second is to equip them with necessary cognitive and other skills for self-directed learning. Third is to provide economic as well as easy access to opportunities for learning on a continuous basis. And the fourth is to create several incentives so that the individual will find it worthwhile to participate wholeheartedly in the process of life long learning.

Multiple opportunities are opening up for even global access to contemporary knowledge for life long learning. To avail such opportunities, easy and economic access to internet needs to be provided.

2.5 Research and Development

Tomorrow's world will be driven by superiority of intellectual assets, and not merely by superiority in military arms, natural resources, or any of the other traditional areas of power. In order for India to achieve a standing in the technological world, two steps are essential:

- The high-quality research and development work being carried out in our R&D establishments must be translated into commercially successful products.
- An environment must be created in which budding entrepreneurs receive adequate support for their commercial ventures during the initial stages.

India has over the years demonstrated its technological leadership in areas such as missiles, atomic energy, space, agriculture etc. A mechanism that will mandate conversion of such research into national wealth should be found. Further, India has built a massive physical and intellectual infrastructure through the extensive support extended to a chain of publicly funded R&D institutions. The intellectual property generated in such government-supported laboratories should be utilised for the social and economic benefit of the nation.

2.6 Entrepreneurship

For an aspiring entrepreneur in India, problems of setting up a suitable infrastructure to get going can be daunting. Basic requirements for an entrepreneur such as electrical connection, telephone, and Internet connection, have to be met quickly. Entrepreneurs should spend minimum energy in tackling purely non-technological issues. Thus we must create a hassle-free environment so that the creative entrepreneur can focus his energies fully on his main task and not fritter it away. By setting up Technology Parks and Incubation Centres in which an

entrepreneur is able to get access to the basic infrastructure at nominal cost, society would ensure that entrepreneurs succeed or fail on the merit of their ideas, rather than due to extraneous factors. Technology Parks should also bring venture capitalists and entrepreneurs together as well as provide legal advice at affordable terms. Ideally the technology parks and incubation centres should be co-located with research and academic institutions. This, in addition to attracting aspiring entrepreneurs, would also enable imparting quality entrepreneurship programme as a part of the academic curriculum.

Translating potent ideas from researchers and budding entrepreneurs to commercial success is the key. Developed countries have shown how this can be done. The service rules for scientists in publicly funded institutions and academics should be modified so as to promote entrepreneurship and facilitate the migration of technologies from government-supported institutions to society at large. A system must therefore be put in place whereby entrepreneurs will flourish and create wealth for themselves and for the society.

CHAPTER 3

Connectivity

3.1 Introduction

For a country as large and as diverse as a continent like India with rich diversity of lifestyles, culture, traditions, languages and so on, it is the connectivity that can provide the powerful binding force. If the entire nation were well connected then problems of regionalism, linguistic fanaticism, and other such negative aspects of our nation would be greatly reduced over a period of time, merely by the fact that people would be exposed to the way of life of their counterparts in different parts of the country as well as different parts of the world.

Connectivity can either be physical or electronic. Physical connectivity implies good highways, railways, airline and waterways routes, and the like, to enable people to travel from one part of the country to another. However, during the past few decades, electronic connectivity has come to assume at least as much importance as physical connectivity. Perhaps the earliest form of electronic connectivity was the wireless, but it was not interactive in a real-time sense. The invention of the telephone permitted, for the first time, persons who were not at the same physical location to interact in real-time. Subsequently long-distance telephony, television, and now the Internet have removed all barriers of space and time, so that one can say with confidence that “Geography is now history.”

Fig. 3.1 India's Connectivity: Challenges

- Inadequate connectivity through conventional media, such as:
  - Roads
  - Railways
  - Air
  - Water ways
- Inadequate quality-consciousness

While these exciting developments have been taking place worldwide, in India we have a long way to go to catch up with the rest of the world. Some of the challenges to improving India's connectivity are brought out in fig.3.1. While long distance rates have been dropping everywhere else in the world, Subscriber Trunk Dialling (STD) rates in India are still very high compared to the rates prevailing in the world due to governmental monopoly over long distance telephony. Everywhere in the world it is well-recognized that long distance telephony is quite cheap compared to inter-city telephony. Now that the Prime Minister has announced the opening up of the national long distance market to the private sector, it would now be essential that rates paid by Indians for both inter-city as well as international will approach those prevalent elsewhere in the world. It would, therefore, be necessary

Fig. 3.2 Improving India's Connectivity

- At present, India's bandwidth (both international and domestic) is not adequate
- Liberalizing ISP gateways has helped ease the bandwidth constraint in international connectivity
- Much more needs to be done to enhance domestic bandwidth

that there are reasonable licence and entry fees as prevailing earlier in the case of private telephone and private cellular operations.

3.2 International Connectivity

Coming now specifically to the Internet and its role in promoting connectivity within the country and world-wide [fig.3.2], one can identify two distinct types of connectivity, namely:

- Connectivity within the country, or domestic connectivity
- Connectivity of India to the rest of the world, or international connectivity

Let us take the second point first. Until the middle of 1998, VSNL enjoyed a monopoly on Internet connectivity. As a result, the entire country had a bandwidth of just 32 Mbps to the Internet, and the number of e-mail addresses in India was a meagre 50,000. In July 1998 the IT Task Force recommended that the VSNL monopoly should be ended, and in response, the Department of Telecommunication (DoT) constituted a small committee to draw up the terms and conditions under which private Internet Service Providers (ISPs) could set up their own international gateways, with special attention to security-related aspects. Based on the recommendations of this committee, eventually the Government permitted private ISPs to set up their own access to the Internet, even though this was restricted to earth stations connecting to satellites. In other words, private ISPs were prohibited from using submarine

cable to access the Internet. Even with this limited opening up, the effects have been dramatic. From 32 Mbps in 1998, the nation's Internet connectivity has gone up to around 1.5 Gbps as of now. Once all the approved private gateways come into existence, the international bandwidth will increase to around 2.5 Gbps. The number of e-mail addresses has now crossed 3 million. Currently there are approximately 2.6 million internet users, predominantly located in urban areas. There are quite a number of private ISPs and e-portal services coming up. The number of Internet users is a modest number, when one considers India as the largest free market of nearly a billion people (Note that in India the same e-mail address is used by more than one person, which is the reverse of the situation in say U.S.A. wherein one person has several e-mail addresses. This considerably increases the number of internet users in the country). Very recently the government has announced that the VSNL would not have monopoly on access through submarine cable. This is a very welcome development, as it represents the final step in opening up Internet access to private operators. As and when private ISPs are able to offer submarine connectivity, the number of Internet users will undoubtedly reach 100 million. Hence it can be said that the situation with regard to the international connectivity of India is going to be quite satisfactory.

3.3 Domestic Connectivity

In the case of domestic connectivity, the situation is far from satisfactory. There are just 32 million telephones in our country of one billion people, one of the lowest telephone densities in the world. The number of cellular telephones is just over 3.5 million, compared to about 100 million in China. The lack of growth of telephone connectivity can be attributed solely to the absence of multiple service providers to bring in competition. The process of providing leased line or an ISDN line for an ISP has to meet commercial demand. The STNET being proposed by the Ministry of IT has been waiting for two years for 2 Mbps lines between various major cities of India. Similarly, the growth of cellular telephony has been hampered by the connectivity charges that DoT insists on charging the cell phone operators. Finally, even in the case of the Internet, the connection charges to the ISP are now several times more than the Internet access charge paid to the ISP. (For example, VSNL charges about Rs.10 per hour to connect to the Internet, whereas the connection charges to VSNL via a telephone line is about Rs.25 per hour). DoT with its monopoly status needs to introduce latest technologies such as ADSL (Asymmetric Digital Subscriber Loop) that permits an ordinary copper pair to carry traffic at rates of 2 to 3 Mbps. Our telephone lines continue to chug along at 28.8 Kbps. Thus it is imperative that a viable alternative must be found to meet the growing demand. Though private telephone operators are permitted to operate in several states in India, in actuality only two states seem to have witnessed any significant activity by private operators, namely: Madhya Pradesh and Andhra Pradesh. In MP, Bharti Telecom has been very active and has a large number of

Fig. 3.3 Information Super-Highway: Elements

- Wide-area high-speed backbone, including:
  - Optical fibre backbone
  - Satellite transponders
- Last mile connectivity, including:
  - ADSL *on demand* to individual subscribers
  - WiLL for low-cost connectivity
  - Cellular telephony to complement land lines
- User tools to promote content creation

subscribers. In AP, Tata Telecom has adopted the WiLL (Wireless in Local Loop) methodology to provide a large number of telephone connections in those areas that are served by it. Many more such initiatives are required.

3.4 Indian Information Infrastructure (I^3)

Several years ago the then DoE drew up a plan for a National Information Infrastructure (NII), which envisaged that the entire nation would be connected together through optical fibre, microwave links, and satellite transponders. However, the NII has not taken shape. There is therefore an urgent need to put in place an Information Superhighway. The elements of such a superhighway are as given in fig.3.3. Subsequent years have witnessed a dramatic change in optical fibre technology, whereby the latest generation cables are able to carry traffic at rates of tera-bits per second, and even the old buried "dark" cables of DoT can carry traffic at giga-bit speeds. It is estimated that DoT has more then 250,000 route kms of optical fibre cable as of today. In addition, both public and private sector industries such as IRCOT, Power Grid Corporation, RITES, IRCON, GAIL, Reliance, Zee Telefilms, TEC etc., have equal length of optical fibre cable either existing or planned. The present status with regard to other elements of this superhighway is shown in fig.3.4.

Fig. 3.4 Information Super-Highway: Present Status

- Satellite transponders
  - One satellite contains about 15-18 transponders of 36 Mhz bandwidth, or a speed of about 500 Mbps
  - Total available bandwidth on four existing satellites is about 1.8 Gbps
  - We still have unused satellite "slots"
- ADSL (Asymmetric Digital Subscriber Loop)
  - Not much happening on this front
- Wireless in Local Loop (WiLL)
  - We are at the forefront in this area (e.g., Telematics Group of IIT Chennai)
  - We should exploit the advantage to provide *low-cost, wide-area coverage* in both urban and rural areas
- Cellular telephony
  - Penetration potential is significant
  - We should use it to promote rural connectivity

Once all of these planned initiatives become a reality, the backbone bandwidth of India should be around 25-40 Gbps, which is quite adequate for the time being. The formation of multiple networks is to be encouraged, since in such a situation no one backbone carrier would be able to take its clientele for granted and would have to strive constantly to provide high-quality service. The fact that there are atleast two (and possibly more) private sector initiatives to set up broad band networks, is a welcome sign. At the same time, it is desirable that all of these initiatives should function in some coordinated fashion. For instance, the Ministry of Information

Technology (MIT) can put together a set of standards that will enable users of any of these networks (existing or planned) to communicate in a seamless fashion with other users. The entire set of networks can be called the Indian Information Infrastructure (I^3), and it can be a blueprint for the broadband network of the future so far as India is concerned [fig.3.5].

Fig. 3.5 Improving India's Connectivity: Opportunities

- Near world-class technologies in WiLL to solve the problem of "last mile" connectivity
- Availability of several thousand Kms of buried "dark" fibre
- Judicious combination of these to quickly provide massive connectivity

3.5 Last Mile Connectivity

In order to be meaningful, all of these initiatives must reach out and touch all Indians, not just the city dwellers. Laying conventional telephone cables to rural areas is expensive and not cost-effective, which is why most villages in India do not have any telephone connectivity at all. Fortunately, newly developed technologies such as Wireless in Local Loop (WiLL) greatly reduce the cost of last mile connectivity, and should be pursued vigorously to enable even villagers to benefit from the internet and IT revolution. There are about 128,000 rural post offices whose operators are not employees of the Post Office, and who are therefore not bound by government service conditions. These rural postmasters should be encouraged to strike out on their own to use their premises as not only post offices but also telephone and internet kiosks, with some sort of profit-sharing formula so that they have an incentive to earn money. As pointed out earlier, the number of cable television connections in the country is three times the number of telephones. These cable operators can be encouraged to offer Internet connectivity to their subscribers by satellite transponder-based asymmetric access to the Internet (in a broadcast mode).

3.6 Content Creation

Creating bandwidth is only one aspect of fostering connectivity. The other important aspect is creating content that is transmitted across the bandwidth. Experience elsewhere has shown that once adequate bandwidth is in place, content emerges more or less automatically to fill up the bandwidth. In the case of India, the situation is a little more complicated, owing to the fact that less than 5 per cent of our population speak English, and the multiplicity of not only languages but also scripts that are in use. It is imperative that appropriate Indian language user interfaces are developed, that operate either through conventional GUIs (Graphic User Interface) or more recent techniques such as speech processing. The development of such content creation tools specifically tailored for Indian conditions requires a considerable amount of basic research, development, product prototyping and standardisation. In particular, an array of storage and utility devices can be assisted by multi lingual technologies. People who are not

accustomed to English language for instructions on their devices like printers, scanners, photocopiers, microwaves, ATMs etc., can be supported with custom-built Indian language-based interfaces. A development platform can be used to develop such interfaces for specific devices. If content is the king, then applications are the war horses. Using a development platform, many applications need to be developed such as multi lingual word processors, spell and grammar checkers, speech to text facilities, multi-lingual search engines, chat, email, browsers for the Internet, unicode based translation facilities for all Indian languages etc. The MIT can play a very useful role here by delineating standards so that those Indian language tools created by different vendors can communicate with each other in a seamless fashion. These standards should be based on the unicode standards, and should be similar to the "kterm" standards developed for Chinese, Japanese and Korean languages, which are supported on a wide variety of platforms.

3.7 Rurbanisation Model

As said before, rural prosperity is an essential element of a knowledge society. Generation of employment and thereby wealth together with societal transformation are the hallmarks of rural prosperity. To realise this, it is essential that approach to national development is through integrating physical and electronic connectivities. As the country is predominantly rural, a model for rural development called "Rurbanisation" has been presented that has the potential to bring in rural prosperity integrating these two connectivities. This model builds on local competencies and integrates them with transportation, road, communication, storage and marketing.

3.7.1 The fact that there is net migration from villages to cities indicates that, in the opinion of the rural people, cities are better places to live. Ideally, both rural and urban areas should be equally attractive with no net migration either way. Near zero net rural-urban migration is a mark of completed development. How can we achieve that happy state of affairs? Rural development is the solution and the details are described as a process, which:

(a) provides rural areas with all desirable amenities that are currently available only in cities;
(b) will generate as a consequence employment on the same scale, and at the same level, as cities do;
(c) will provide these benefits at a small fraction of the financial, social, cultural and ecological costs the cities have to bear.

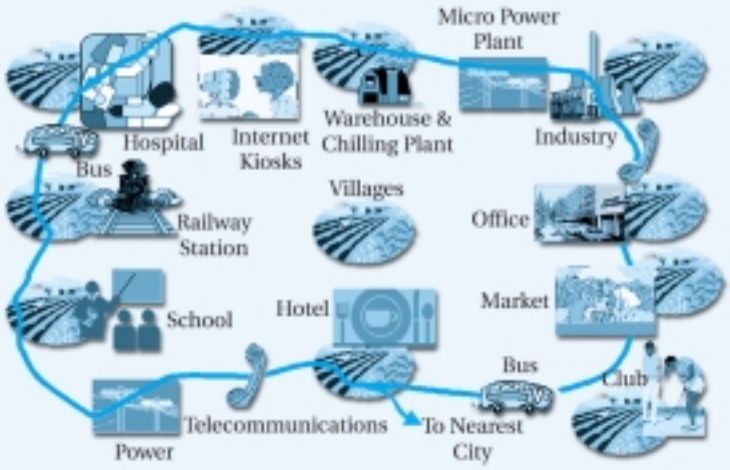
It is the expectation that this combination of employment and ecology will make rural areas as attractive as cities are, if not more attractive. Then, rural development may be expected to prevent, if not actually reverse, rural-urban migration.

3.7.2 Experience in India has demonstrated that the true handicap suffered by rural areas is poor

connectivity and little else[1]. In addition several studies have brought out that rural poverty can be reduced by providing good rural connectivity. This lacuna may be rectified by linking together a loop of villages by a ring road and high quality transport [fig. 3.6]. That transport connectivity creates in those linked villages a large enough market to support a variety of services, which the villages will not be able to do individually. Thereby, the ring road and the transport service together convert those villages immediately into a virtual town with a market of tens of thousands of people. Such a well-connected rural space (combined with state of the art telecommunication connectivity) will have a high probability of attaining rapid growth by setting up a virtuous circle – more connected people attracting more investment, and more investment attracting even more people and so on[2]. Basically, this model involves:

(a) selecting a ring of villages[3] [fig. 3.7]
(b) connecting the villages on the ring by establishing a high quality transport and telecommunication system
(c) encouraging reputed specialists to locate schools, hospitals and other social services around the ring and
(d) marketing this well serviced space to attract industry and commerce.

Fig 3.6 A Typical Rural Model



3.7.3 It is suggested that the scheme be implemented as follows:

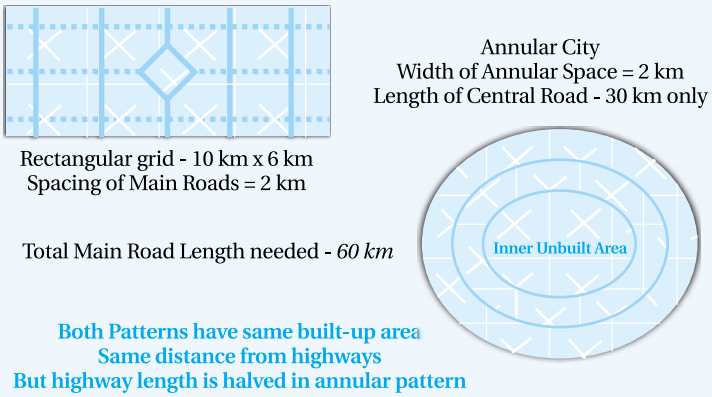
(a) Take on permanent lease an annular strip of space about 30 kilometres in circumference and about 500 metres wide on an average.

1 The percentage of villages with primary schools is 49.3 in Kerala and over 92 per cent in Bihar and Madhya Pradesh. Yet, Kerala has over 85 per cent literacy while the situation is dismal in the latter states (*India Human Development Report, 1999)*. The explanation for this anomaly becomes apparent when we note that over 85 per cent of Kerala villages are connected by a pucca road where as the figure is barely 20 per cent in Bihar and Madhya Pradesh. Evidently, access to good schools (even if they are some distance away) is more important than proximity to any odd kind of school. That is, *it is not important for a village to have every service inside, not even a primary school is critical, but the village must be well connected to good quality services, the higher the quality and the wider the road, the more attractive its economy.*

2 It is interesting to observe that the fastest growing areas in the United States is the Silicon Valley or Route 128 (round Boston). Both are outside (and not inside) cities. So, is the prestigious Washington Beltway.

3 Both Route 128 and the Beltway are rings. It can be shown that a ring halves the length of all infrastructure and hence costs too.

Fig 3.7 Optimum City Shape



In order to minimise the cost of acquisition (and the disturbance to agricultural production), it is best to choose, as far as possible, a route that follows the least fertile and the least valuable tracts of land.

(b) The land is taken on lease and not by outright acquisition. The rent may be set at twice the current price of the crop the farmers grow. Displaced farmers may also be offered, say 10-20 square metres of commercial space per hectare of land surrendered.

This arrangement helps both farmers and developers. Farmers are guaranteed crop-price-indexed income some three times what they earn at the present time plus whatever they can make from the commercial space. The latter gives them also a job to do. That is better than the difficult to manage lump-sum compensation and more practical than guaranteeing a government job. The developers benefit because they do not have to produce large amounts of capital up-front. They pay as they earn. A land-use plan is now prepared. The space leased from the farmers is roughly divided as: half for residences, a quarter for public purposes, a sixth for social services and the remainder for commercial uses.

(c) Residents pay a land rent of about Rs. one to two per square foot per year (preferably multiplied by the Floor Space Index of the building).

This charge is simple to collect and is nominal compared to the rents that people are forced to pay currently even in the slums of our big cities. Yet, this small charge will, in ample measure, cover the cost of public amenities like roads, and gardens. It will also be enough to pay farmers for the land they contribute.

(d) A ring road with a dedicated bus lane is constructed along the middle of the annular strip.

For the government, the cost of this road is the major cost of the project. About a third of this expenditure (typically, Rs. 10-12 crores) may be provided by the central government as a grant. Loans may be taken to meet the balance of expenditure and the interest costs charged to the residents and obtained from the levy mentioned above. In initial years, till the time residential space gets filled, the state government may bridge the gap (estimated to be around Rs. 1-2 crores) between the interest costs and the levy collected.

(e) Irrespective of traffic demand, frequent bus services are run around

this circular road and high quality Internet services too are provided.

The road and the bus service together constitute the seed of the project. Internet service empowers modern commerce and industry to operate from this strip. As the road will always be a permanent asset, the bus service alone is the truly experimental (and speculative) part of the entire scheme. In the final analysis, it is the quality and frequency of the bus service that will be the real attraction for investors. So, it would be wise to make no compromise on quality in either case. This speculative investment may be insured by the state government and the cost is unlikely to exceed Rs. 1-2 crores.

(f) The three kinds of employers, namely, businesses, social service providers (normally NGOs) and government agencies lease enough space to build residences for their employees.

This is essential for maximising ecological quality. Combining business space and residential space into an integrated package enables most employees to reside within walking distance of work. That will, ideally, eliminate daily commuting to work and thereby remove the greatest financial, environmental and social cost of urbanisation.

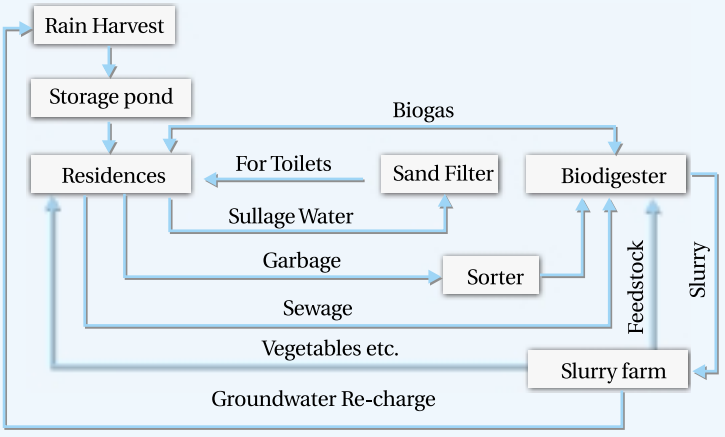
(g) Social services like schools and hospitals not only get land virtually free, they are also endowed with the space allocated for commercial purposes. Thus, rents from commercial space become a guaranteed income to schools, hospitals and the like.

Market rents paid by commerce and industry should be normally adequate for these institutions to service all their capital costs. Thus consumers will be spared of that burden. Business persons too will find it useful to have a stake in these institutions. Consumers will pay in full the recurring costs – thus ensuring that social services need no subsidy from the government and hence, run no risk of shortage of funds.

(h) Both water harvesting and waste disposal are left to be micro-managed by individual employers or housing groups.

As no point on the annular strip is more than a few hundred yards away from open fields, water harvesting and waste disposal are both easy and inexpensive to manage. The technology too is readily available [fig.3.8]. Even cooking energy can be locally generated. In general, the operation of these services is optimum for about 20-50

Fig. 3.8 Water Harvesting & Waste Disposal



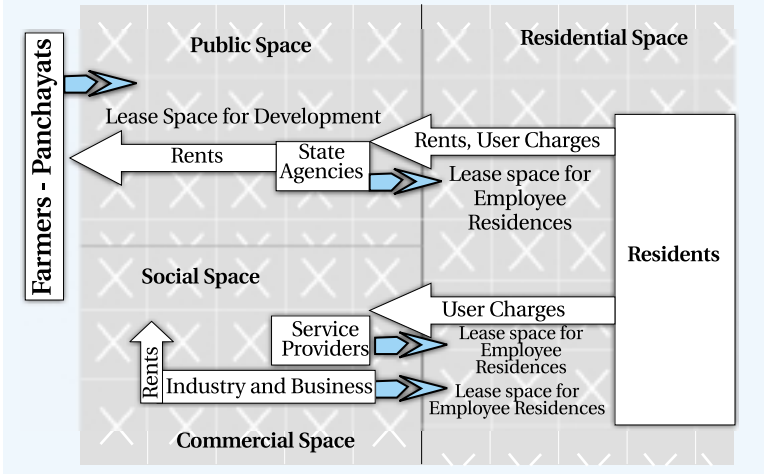
dwellings. With a smaller number, professional management becomes impractical; with larger sizes, transportation costs escalate rapidly. Hence, it is best to divide residential space into parcels of one to two acres for group housing and let the groups (or the employers who employ these groups) manage these services.

(i) Panchayats are entrusted with all residual tasks including maintaining public spaces, and will also act as the monitoring authority.

Basically, in this model, most municipal services are managed, as far as possible, by private enterprise. That will improve efficiency and quality provided there is (a) enough competition and (b) total transparency. Panchayats could be the regulatory authority that will monitor these two conditions. An overview of the model is shown in fig. 3.9.

3.7.4 The success of the model depends ultimately on the quantity and quality of businesses that are attracted. It is the wealth generated by them and the employment created by them (directly and indirectly) that will sustain the scheme. Hence, employers are the crucial stakeholders.

Fig 3.9



3.7.5 This is a composite project requiring the support of a number of government agencies both at the centre and at the state level. So, no single government department will be able to "own" a project of this nature. Hence, it is best to operate the project in a mission mode on a no loss-no profit basis. For that reason, a compact autonomous board composed of representatives of state, central governments, Panchayats, and employers will manage this project best.

3.7.6 The model is a highly decentralised one. Of the seven services listed above, water, waste disposal and shelter will be managed by resident groups or by their employers. Health and education is best left to reputed NGOs. Commercial firms will handle and supply energy and telecommunications. It is best to treat the ring road as a national highway (at least as a state highway).

3.7.7 The way this model is designed, once the project takes off, it should be self-supporting. However, it would be useful if the central and state governments kick-start the project by inducting some employment of their

own. Typically, in urban areas, government agencies employ about five per cent of the population. It will give a great fillip to the project if the government promotes a similar level of employment in this project area also.

3.7.8 Maintaining high quality environment is a major objective of this project. For that reason, congestion should be avoided at all times. That will happen only if the supply of services is always kept in excess of demand. Unfortunately, we react only after congestion sets in and not before. A simple rule will prevent that error. Let all services have enough scope to expand and cater to a population of several hundred thousands and further, sufficient surplus capacity to serve an extra 30,000 people at any given time.

3.7.9 These ideas have been presented to village leaders in several places in Tamil Nadu and in Uttar Pradesh. In each case, the response was most gratifying. Farmers loved the idea of the circular road. They were also delighted with the idea of an annual lease fee indexed to crop price. They all assured that they will gladly co-operate in implementing any scheme of this nature.

3.7.10 In brief, the proposal is:

a) An autonomous development board be set up to implement the scheme.
b) The central government to grant one-third of the estimated cost of constructing the ring road (about Rs. 5 crores).
c) The government also to arrange for a loan for the remaining amount.
d) The central (or state) government to act as a guarantor for the rents to be paid to the displaced farmers.
e) In initial years, till the project becomes self-supporting, the state government may provide a bridge loan to meet the gap between income and expense, estimated to be around Rs. 1-2 crores.
f) A provision is made for introducing conventional services like police stations, post offices, banks and the like to generate employment in the public sector on a scale normally available in cities.
g) The project to be so designed that all services have enough leeway to expand to serve up to a million people.

3.7.11 The cost directly to be incurred by the government on the project is of the order Rs.7 crores and is expected to pull in at least fifty thousand people within three to five years, attracting private investments worth several hundred crores of rupees in the bargain. That corresponds to seed money of Rs. 1500 per person (about Rs. 4500 per job created). The scheme may be considered as acceptable enough to be replicated if at least half the expected number is attracted and sufficient space to house them is offered by the villagers. Otherwise, the project may be written off as impractical.

Conceptually, this scheme is similar to PC networks, which have superseded the traditional central computers. Like PC networks, rural development of villages too promises to supersede large cities by offering, in a decentralised manner, better quality of service than cities provide, and at a much lower cost too.

3.7.12 Such type of rural development programme has to be introduced in multiple rural areas with following possibilities:

a) A certain portion of the fund allotted by Planning Commission to the Department of Rural Development at the Centre, should be made available for this programme.

b) Every year, about Rs.500 crores from the constituency development fund allotted to MPs could be earmarked for this programme.

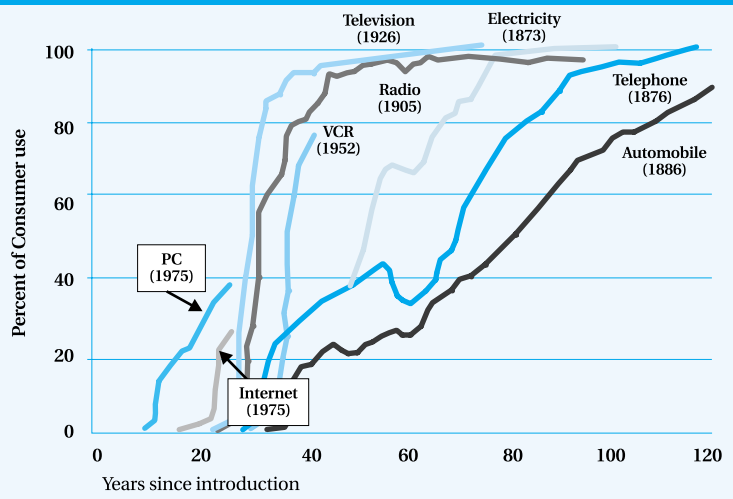
CHAPTER 4

Convergence of Technologies and Governance

4.1 Convergence of Technologies

There was a time when different communication & radar technologies used different parts of the electromagnetic spectrum. Thus telephone signals travelled by buried copper wires, AM radio used carrier frequencies between 550 Khz and 1600 Khz, FM radio used 88 Mhz to 110 Mhz, and TV channels used still higher frequencies. Even in telephony, at one time, voice signals were carried on low quality copper in an analog mode, while digitised data were carried on higher quality optical fibres in a digital mode, complete with error-correcting coding to ensure perfect error-free transmission. Nowadays even voice signals are digitised and carried on the same lines as data. Similarly, there was a time when one used a telephone instrument to initiate telephone calls, a desktop or laptop computer to send and receive e-mail or to browse the web, television to watch TV programs, and so on. But with the advent of buried optical fibre, cellular telephony [fig.4.1], the phenomenal

Fig. 4.2 Impact of Consumer Related Products
(in developed nations)



growth of Internet [fig.4.2], Wireless Application Protocol (WAP) enabled telephones, Internet over cable TV, Voice (and now Video) over Internet etc., these distinctions have essentially disappeared in the global market in which India has to compete. Also several technologies and convergence products are expected to dominate in the coming years [fig.4.3 & fig.4.4]. Further, all these different types of technologies use overlapping parts of the electromagnetic spectrum. At the same time, the various types of terminal instruments have coalesced into just two or three intelligent digital personal assistants [fig.4.5]. This phenomenon has been referred to as the convergence of technologies. The convergence phenomenon can be expected to lead to more efficient use of the electromagnetic spectrum. One can already see this happening in the case of cellular telephony where the same spectrum is assigned to different operators in different regions, thus permitting more users to be packed into a given range of frequencies.

Fig. 4.3 Technologies that would stay

- Fibre-Optic cable for city to city connectivity
- Wireless Application Protocols *(WAP)* for city-to-home connectivity *(Last Mile)*
- Blue Tooth for use within home

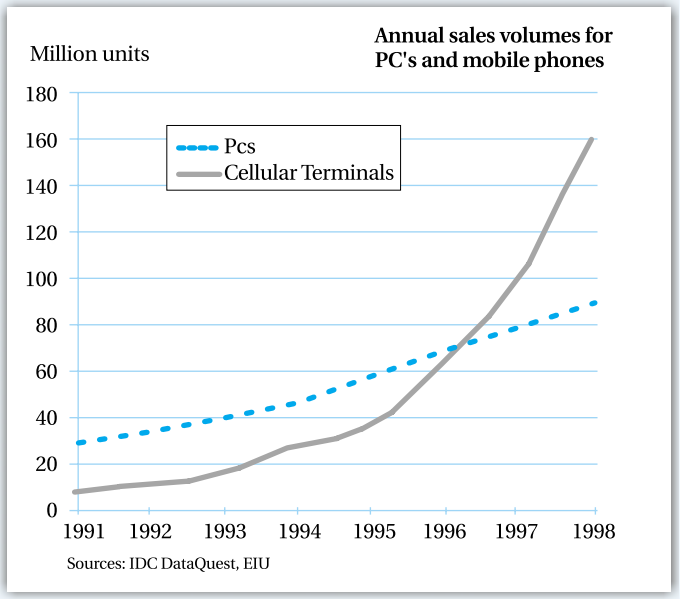
These technologies could be exploited for Indian needs and our manpower address huge software & technology needs.

Already in the U.S.A. it is no longer considered essential for a person to travel to the office and work. An employer is perfectly contented to have an employee work out of home, because the employee can access whatever data and/or facilities he/she needs through the public telephone network. It is interesting to note that, in spite of these advances in technology, majority of the people in the U.S.A. still prefer to go to work, often driving long distances and spending enormous amounts of time to get there, not to mention wasting huge quantities of fossil fuels. This is apparently because there is a clear social dimension to the workplace, quite apart from the professional dimension. One can only speculate how the next generation would react, and whether they would treat "going to work" with the same degree of sanctity as the present generation.

Thus the convergence of technologies has profound significance for the way in which one will live and work [fig.4.6]. One needs to recognise this fact and react.

Fig. 4.4 The Smart Devices Market Is Exploding

- *"Smart Devices"* will lead the market within 5 years
  - Include Mobile Phones, Smart Phones, 2-way pagers, and Communicators
- Could reach 2 million devices within two years



Implications for India ??
- Leapfrog PC revolution into Smart Devices
- Enable Commerce & Entertainment.
- Lower Cost of ownership than PC
- China, Japan are examples, more Mobiles than PC, Fastest growing mobile & gadget market in the world

4.2 Convergence of Governance

In order to cope with and harness the full potential unleashed by the convergence of technologies, it is essential that there be also convergence of governance [fig.4.7]. In India, at present there are several ministries and government departments whose jurisdictions overlap the various components of the digital revolution. For instance, there is the Ministry of Information and Broadcasting; Ministry of Communications, which contains within it the Departments of Telecommunications, Telecommunication Policy and Posts; the Ministry of Information Technology; and if one includes matters of security, the Ministry of Home Affairs, the Cabinet Secretariat and the Ministry of Defence. Each of these ministries and departments has its own exclusive domain. The multiplicity of government departments has led to delays in decision making. For instance, everywhere in the world, Voice over IP (VoIP)

Fig. 4.5 Digital Convergence-Smart Devices

- More and more devices become cheap one-chip components
- Different devices are joined to form new multi-purpose devices
- Devices and applications converge to form digital personal tools

- Behind digital convergence is the drive towards Natural Interfaces

Fig. 4.6 Convergence of Communication Technologies

- Key feature of communication technology: *convergence!*
- As bandwidths used by broadcast and telephone converge, the technologies also converge
- Voice, Video and Data circuits are now the same!
- Recognize this fact and react

has become the norm, which offers international telephony at the same rates as a local call. But in India using IP circuits to carry voice traffic is prohibited. VSNL carries both voice traffic and internet traffic, using its own international circuits to carry its voice traffic, thus saving considerable amount of money for itself which contradicts the very premise of denying VoIPs to others. All over the world, governments of both developed and developing nations are increasingly beginning to recognise the power of technological convergence, and gearing their governance mechanisms to cope with this convergence. This requires fine-tuning governance by rationalising their administrative structure of ministries and/or departments. It would require governmental decisions to cut through all these multiple jurisdictions and put in place a rational structure.

Fig. 4.7 Convergence of Communication Technologies: Challenges

- While *technologies* have converged, the *ministries* have not converged
- Appropriate structural changes need to be made in the administrative set-up to facilitate, and in fact to promote, convergence
- Unenforceable rules (e.g. no Voice over IP) should be done away with

4.3 Paradigm Shift in Governance

The advances of information technology will not only force a review of the legal and practical meaning of the notion of individual privacy, but also that of the privacy of nations. Furthermore, the existence of inexpensive, multiple and worldwide network for communicating information is likely to shift power from government to individuals. While information technology will vastly increase the power of a government to monitor its people, the government's control over the information distribution will be diminished. Information will still be power – but it will be a shared power. The increased worldwide distribution of information will also lead to increased awareness in India of how the people with superior life styles live. The availability of information network will diminish the reliance on elected representatives and technical experts to make decisions on behalf of the public at large. The forum of public opinion rather than ministerial negotiation will begin to have a great influence on the final decisions; the recent scenes in the Seattle round are a testimony to this. This will also mean that we will have to provide greater attention to the quality, clarity and reliability of information available to the Indian electorate.

4.4 Recommendations

The following actions are recommended as a means of facilitating the convergence of technologies.

- Voice over Internet Protocol (IP) must be allowed (The Government has announced a policy change to this effect; however, the change has not yet been implemented).
- The monopoly of government-run agencies in IT-related areas needs revision. While private ISP's have been permitted to set up their own gateways, access to submarine cable, and private long distance telephony are policy changes that have been announced but need to be implemented.
- Monitoring and watchdog agencies such as TRAI should be replaced by a more comprehensive body whose jurisdiction includes all parts of the electromagnetic spectrum. Towards this end, the Communication Convergence Bill, piloted by the government needs to be introduced on priority.
- The growth of the EM spectrum, their use as well as bandwidth, especially web-enabled services, must be nurtured by a set of imaginative and pro-active policies and practices. In particular, all charges to be paid by private operators for the provisions of services to customers that are now exclusively offered by DoT, need to be on a revenue-sharing basis and not on a license fee basis.
- A monitoring system to measure the quantity, quality and impact of different kinds of information on the economy and society is needed like the information with regard to literacy available today.
- Harnessing the full potential unleashed as a result of the convergence of technologies will demand very fast decision-making process for growth of export of IT and knowledge products. This dynamic global situation has to result in the convergence of functions and administration of Ministries of Communications, Information Technology and Information & Broadcasting in our country.

CHAPTER 5

Information Driveway–Forcing Functions

5.1 Introduction

The world is undergoing a transition from a paper economy to a digital economy. In this economy, information and knowledge form the key assets that need to be secured. Information security, which was once the concern of the national security agencies, has started to touch every component of the society including the corporates and the common man. This in effect has resulted in an increased interest in research and development in information security world over.

The advances in Information Technology and the advent of internet and e-commerce have resulted in the knowledge products forming a substantial portion of the economic growth of many countries. Countries that master the techniques of creating, managing and protecting their knowledge and information products would emerge as the superpowers in the ensuing knowledge era. In this chapter, we discuss the efforts that are needed to provide a strong and secure foundation to the digital economy. The emergence of India as a cost-effective destination for software development for worldwide needs is very well known. The well articulated policies of the Government to leverage on this foundation and to make the Information Technology capabilities of India as a vehicle to propel itself as a strong Knowledge Super Power in the coming years are also very well publicised. In order to

achieve the projected goals, the need of the hour is a highly proactive role that would take into account the changing scenarios in the information driveways and the non-linear interactions between the forcing functions. In this chapter, we address these issues in more detail.

Developing nations like India will find increasing opportunities in the emerging digital economy to reutilize their vast intellectual resources and to become economic and knowledge superpowers. The developed nations often hold information security technologies closely and exercise control on their availability to other nations. Thus, there is an impending need for a nation such as India that is destined to play a key role in digital economy to create a framework for understanding all aspects of information security. India, on its part has made significant strides in this regard. The role of information security in a knowledge society is also brought out.

5.2 Indian Software Industry

India has the second largest pool of English speaking scientific manpower in the world today. Of this, more than 300,000 were software professionals in 1998-99. This pool of young software professionals is expanding continuously through well-orchestrated manpower training programmes of high quality education system in India. A major proportion of the software professionals is employed in the industrial sector.

The Indian software industry has been showing an impressive growth rate of more than 50 per cent consistently since 1991. From a mere US $ 150 million in 1991, the software industry has grown to US $ 6.2 billion. It has also become a globally competitive industry with an outreach to nearly 100 countries.

Realizing the vast opportunities in software, the Indian Government established an IT Task Force that spelt out the national vision in IT and the approach to achieve the vision. The IT Task Force made 108 recommendations that included changes in the rules and regulations to remove the impediments to the growth of the software industry, infrastructure and quality manpower development, assimilation of IT in governance and more importantly the data security and cyber laws. The IT Task Force set a target of US $ 50 billion annual software services exports by 2008. An independent report states that this target by the year 2008 is eminently attainable. Thus, India's mission is clearly focused on becoming a key player in the Knowledge era.

5.3 Emergence of E-commerce in India

The electronic commerce made a modest beginning with a market of around US $ 30 million in 1998-99. It nearly doubled in the following year. It is anticipated that the market potential for e-commerce revenue in India would be around US $ 250 million by the end of year 2001. It is apparent that e-commerce would play a major role in enhancing the software development market both in the domestic as well as

international fronts. In fact, it is strongly believed that initially business-to-business secure commerce transactions would be the ones that will emerge, leaving business-to- customer behind.

There are three major ingredients that need to be in place for the e-commerce-based society. They are: -

- Creation of security awareness and confidence to do secure transactions over the net
- Development of provably secure algorithms for a variety of applications for secure electronic transaction between individuals, corporate and government. These algorithms have to be based on the value and life cycle of the information and the threat perception, and
- Laws that are sensitive to the changing scenario, and that offer protection to the individuals, corporate and the government.

The Indian Government's initiative through the IT Act-2000, addresses many of these issues. Further, the IT Act brings out a framework that encourages commercial use of the internet while protecting the national information infrastructure from being attacked or misused either from inside or outside the country.

There is also a move to bring out a very comprehensive Intellectual Property Right bill that will protect the intellectual property generated in the country and also ensure that no undue exploitation of India by advanced countries takes place. This Bill will also provide the platform to redefine the IPR related laws in tune with the changes in technology, ownership and valuation of intellectual property.

5.4 Digital Divide

The existing disparities between the developed and developing nations, which today are measured in terms of comparative economies, living standards etc are moving into dimensions such as knowledge. The issue of knowledge divide and digital divide is being debated due to several emerging disparities. This is due to widening gaps in education, work-force, technology, access to capital and so forth. Worldwide there are concerted efforts to narrow this gap and and ultimately close them completely, through creating solutions that enable everyone to participate in the digital world. There are several indications and possibilities to show that India will not suffer such a digital divide coupled with appropriate actions:-

(a) Technology is fast changing. The costs of transferring information are plummeting.

(b) India is a late entrant and therefore, our investments have not been locked in old infrastructure and old technologies. We can take advantage of the frontline technologies, cost effective infrastructure and leap frog.

(c) The new digital medium enables opportunities to reach those that are distant or economically poor and need education while permitting sharing of infrastructure.

(d) Piloting of the proposed Bills in the Information Communication Technologies sector, support to the information technology entrepreneurs by the government at the right time and the commitment of several states to the promotion of IT give new dimension to reduce digital disparity.

5.5 Forcing Functions:- Changing technologies and their convergence

There are three basic constituents that shape the knowledge economy. These are computers, connectivity and content. Together, these generate knowledge that has to be made secure with a framework of laws, which will both foster and protect. India by virtue of its having a large pool of scientific talent and being one of the oldest civilisations, is excellently poised to generate original contents.

5.6 Computers and smart access devices

Many factors have contributed to the easy availability of computers in India and the skills necessary to optimally utilize them. First is the growth of the software industry that has enhanced the PC penetration in the country. Second is the Moore's law, due to which the costs of computers have been falling at approximately 40 per cent a year.

The economic access will also increase as the technologies as well as devices will become simpler and cheaper. One promising development from India that has the potential to increase PC penetration is the 'Simputer'. Developed by scientists from Indian Institute of Science, this computer could be used by even illiterates. Technologies such as these, which are relevant to the developing world, will make the final difference in bridging the digital and knowledge divides.

The microprocessor that forms the heart of the PC is becoming smaller, faster and cheaper. This has resulted in a paradigm shift in which the present day microprocessors lay more emphasis on functionality rather than performance – performance being taken for granted. The net effect is the birth of more and more cheap one-chip systems. The discontinuous growth in VLSI integration levels has made it possible for different access, computing and communication devices to join and form new multi-purpose devices or smart devices. The way the devices and applications converge to form digital personal tools is also the drive towards natural interfaces – the urge of the mankind to interact with the "computer" in ways similar to his interaction with fellow human beings. In simple words, smart digital tools of tomorrow will provide language independent interface to the knowledge world.

This convergence of many devices and applications would soon change the PC that we know today and would also change the information access patterns, thus placing very stringent conditions on the network.

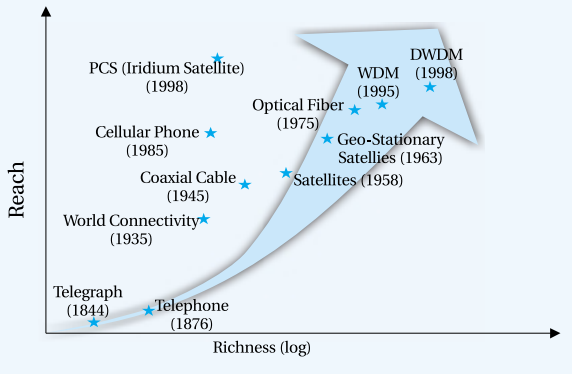
The PC sales across the world are tending to saturate. The smart devices revolution

is already on. World over and in particular in countries like China and Japan, there are already more mobile phones than PCs. In India, the annual sale of PCs crossed the 3 million mark recently. The rate of increase of PC sales may come down in India in a few years. The PC may be dominantly used for software development than for information access and processing. The PC with large Plasma Display Systems would be used in shopping malls and houses for display and infotainments. The information access may often be done through tethered and untethered mobile gadgets that will have adequate processing power to present information through a natural information interface- voice and video. The moderate computing power of the mobile access and communication devices would shift the computing loads to the network and it will see the re-emergence of "data centres" of the past through Application Service Providers (ASP).

5.7 Communications

The communication technology has been growing at a pace faster than that seen in the performance of microprocessors. The communication bandwidth has, in fact, been doubling every year. Starting from telegraphy to modern day fibre optic based Dense Wavelength Division Multiplexing (DWDM), the communication technology has been exponentially increasing in both reach and richness [fig. 5.1]. Seen together, the advances in computers and communications have ensured the death of time and distance, making information available at any time and at any place.

Fig. 5.1 The Reach and Richness of Communications Technologies

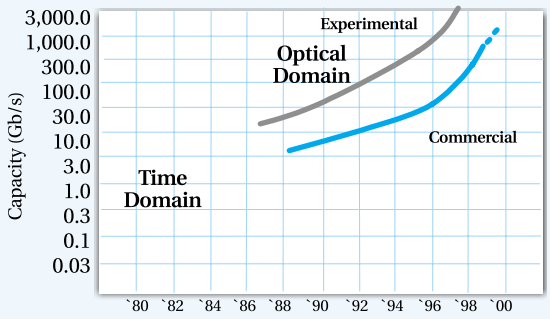


The PC and tethered & untethered telephone systems would increase across the country even without a coordinated action plan, because of their low cost of ownership- often within the reach of the common man. But, connectivity across the country, without which the full potential of a knowledge society can not be realised, requires well-planned infrastructure development.

Since the information network infrastructure is expensive and consumes large amount of time to deploy, world over, the research and development efforts have been directed towards improving the bandwidth over existing media that were laid for voice telephony and television. These include the telephone cables, fibre optic cables, TV cables, VSATs and wireless.

Fig 5.2 gives the fibre capacity as a function of time. Both laboratory experiments and operational fibres display potential for enhancements upto several thousands of Giga Bits of information per second. Compare this with the present utilisation

Fig. 5.2 Fibre Capacity as a Function of Time



Both laboratory results from Lucent Technologies and commercial realization are shown

in India of these fibres at around 622 Mbps- a gross under utilisation that makes the fibre look like a mere replacement for copper – that too, an expensive replacement. Similarly the coaxial TV used for carrying cable TV signals can also be expanded to several giga bits per second and made two way in an inexpensive way leading to an enhanced internet penetration. This will make the 35 million cable TV users active on the internet through cable modems. Similarly, use of ADSL technology would expand our telephones to access the internet at speeds exceeding 2 Mbps as compared to the present speeds of around 28.8 kbps. The wireless access technology has also been showing enhancements and has been proving to be a far cheaper alternative for last mile connectivity. The Wireless in the Local Loop (WiLL) can give speeds upto 128 kbps based on indigenous technology and with their inherent multiplexing, would offer a very low cost telephone and internet access. With the advent of Wireless Access Protocol (WAP) and the emerging Wireless 3G, it would be a matter of time when one would be able to have video viewing facilities on the mobile phones. The "Blue tooth" and other WAP Sync technologies threaten to put all appliances within a house, web enabled. Thus, the future shows that the technologies as illustrated in fig.4.3 will improve the bandwidth continuously.

India is a vast country and this makes the design of the national network more difficult. Luckily, India has invested heavily and has established fibre cables of more than 250,000 Kms, an order of magnitude longer TV and telephone cables. A careful planning can exploit the available infrastructure and make the nation very well connected, at 25 to 40 Gbps, and that too without having to spend large amount of money. This is indeed the need of the hour.

It is believed that such connectivity will provide easy, guaranteed and secure access to the network and this would accelerate the development of applications for distance learning including the 3L's of learning – the Library, Laboratory and the Lectures all in the digital form, entertainment, e-commerce, health care and agriculture- all the necessary ingredients of the knowledge society.

5.8 Contents

While it is well known that the computer and communication powers grow exponentially, it is less known that the storage capacity increases exponentially at rates even faster than all of these. In fact, storage capacity doubles every nine months and the cost of storage plummets much faster than the drop in the cost of computing and bandwidth.

When the world transited from an agrarian to an industrial era, developed civilisations like India did not recognise the transition and lost most of its civilisation's knowledge. A timely effort to convert its palm leaf and word of mouth based knowledge into paper form would have preserved its wealth of knowledge. Western civilisations at that time were nascent and did not have much to lose. Similar situation exists today. It is imperative that a national effort is needed to capture all our knowledge – both formal such as Ayurveda and informal such as Indian herbals be made digital with an appropriate value addition and protected dissemination. This can constitute a much-needed wealth for the knowledge society. The recent decision of the government to initiate programme on Traditional Knowledge Digital Library [TKDL] is a welcome step.

5.9 Information Security-Indian Scenario

Through different tools in Information Technology, information gets stored in a digital form as bits and bytes and gets multiplied when these bits traverse the network. In essence connected information creates information explosion that has the potential to create a knowledge explosion and also prosperity if that knowledge can be converted into wealth through innovative and skilled actions. When the society is information rich, it needs to device mechanisms to protect it, in much the same way the nation's borders are protected against aggressors. Information security has thus become an important part of a knowledge society.

Information security scenario in India is just emerging. Until the IT Bill was passed, a physical signature was mandatory for any transaction of funds. The cyber infractions in India and cyber related crimes have been a few and far apart, mainly limited to hacking of a few commercially insignificant web sites.

Few organisations, particularly in the defence, have experience in the development of many cryptographic techniques, protocols and other products that secure information of varying economic value and lifetime. They also have a structured and well-tested public and private key infrastructure. Many other organisations have been using imported security software and hardware solutions to protect their databases and communication systems. In fact, the import of encryption products from the developed nations into India is substantial like the import of high-end computer systems. The financial sector has been preparing itself to launch Internet banking in a big way. A few banks have already started the Internet banking services on a trial basis.

However, research and development in information security has to cope with the national needs and its products would find a market place once the country's e-commerce and other Internet related services pick up.

The basic building blocks of information security include:

1. An excellent monitoring tool for the network traffic, web and database access

2. Intrusion detection systems
3. Firewalls and router solutions
4. Encryption algorithms of provable security
5. Virtual Private Networks (VPN)
6. Public key infrastructure
7. Remote access security

On the basis of the experience in running very large expansive networks such as ERNET, NICNET, etc., in the country for over a decade, several educational institutions have developed excellent monitoring tools for the network traffic. Initially, these tools were developed in order to ensure optimal utilisation of the scarcely available network bandwidth and to evolve localised usage and changing policies. Now they have matured into excellent monitoring tools that give usage features. The inherent strengths of the academic institutions in Artificial Intelligence and Image Processing combined with the experience of monitoring traffic have resulted in the development of mature host and network based Intrusion Detection Systems. Currently, efforts are directed towards improving them for the detection of a wider class of intrusions.

Active Network has been a very strong area of research amongst the academic community in India. Active networks exploit the ability of the network and router to carry and execute portable codes besides data. Active networks have been developed for ensuring differentiated class and quality of service in heterogeneous networks of varying bandwidth nodes. The same concepts have come in handy in the development of intelligent routers that are sensitive to the type of data they carry, thus providing for a framework for enhanced network security.

Indigenous firewall solutions that have been extensively validated are available and are in use in many institutions. These range from simple packet filtering products to multi-layer protection systems. These support several distributed proxy based services.

Remote access security devices that work at low last-mile speeds including smart cards and biometric authentication are under development in various industries and academic institutions.

India has a tradition of high level research in number theory and theoretical computer science. This has placed its academic institutions and research laboratories in a unique position to act as a continuous source of improved encryption algorithms. The major focus has been on evolving computationally efficient algorithms that can be realised optimally in hardware and software, so that a repertoire of e-commerce and secure communication applications could be launched. Currently, there has been some success also in indigenous algorithms with a provable security. The combination of internationally accepted symmetric and asymmetric cryptographic algorithms for the Global Information Infrastructure and those of indigenous origin for the National Information Infrastructure is the trend in India, and this would contribute well to the foundation of a secure Indian digital economy.

5.9.1 The future trends in Information Security

The emerging IP standards such as MPLS and IPv6 will provide enhanced security for the network and so would the easy availability of 128-bit symmetric encryptions. These would attract different types of intrusions and security breaches. Development of Intrusion Detection Systems and firewalls in the new IP world will be a great challenge.

The present trend in the microprocessor design is to design processors that have enhanced functionalities while performance is taken for granted. Most of the modern processors offer multimedia extensions to their instruction sets, making the world of computing look three dimensional- computing, graphics and communication. This is currently changing the traditional drag and drop windows interface to the users to one of voice activated. In a country like India wherein the literacy levels are low, local language voice interface to the web will enable a far larger IT dissemination than the current windows interface. This would also exploit the larger telephone penetration in the rural areas and their low cost. In brief a voice interface to the web is likely to be the future trend in many developing countries heralding a v-commerce era. Voice has the advantage of providing greater authentication capabilities. The future research in India should focus on the use of voice as a digital signature to perform transactions on the web and voice enable the web. This is also needed to ensure that the more than 95 per cent of India's population, which does not understand English also becomes part of the digital revolution.

Unwiring the Internet is an emerging trend that threatens to change the way we access the web in the future. It is estimated that more than 10 per cent of the e-commerce will be through mobile handsets by the year 2003, both in India and abroad. Indian industry is well aware of the potentials of mobile-commerce [m-commerce] and has developed strong expertise through WAP initiatives. The security protocols and encryption algorithms in a broadcast world would prove to be an excellent challenge.

5.10 Conclusions

India is preparing itself to enter the knowledge era and to seek a leadership position. The national policies for IT have stimulated a growth in trained IT manpower. It is time that we established at least one Cyber University offering to start with at least up to Bachelors level in Science.

The e-commerce and the Internet related applications are increasing in tune with the national vision. With these, the knowledge products developed in India would increase and this should propel stronger research and development efforts in information security as also the changes in the laws that deal with our financial transactions and the Electronic Governance.

The Indian Judicial system is one of the largest in the world. In a knowledge society, a judicial system with IT induction will

enable provide quick response towards protecting knowledge.

The hardware industry requires a major fillip and this will come in handy when the world becomes a world of embedded systems and the software demands saturate.

All of these would call for a relook at the roles and charters of many ministries and reorganising them in a way that is responsive to the realities of convergence in technologies and applications.

CHAPTER 6

National and International Initiatives

6.1. Across the world it is a common sight to see citizens queuing up to pay their taxes, electricity/water bills, vehicle registration done and so forth. Often people have to go from one government department to another, filling up innumerable number of forms on the way, in order to transact a business with the government. One of the greatest problems for any one who deals with government agencies, whether as a citizen or as a business, is its sheer complexity. Moreover, government departments expect the users to communicate with each of these departments in turn rather than being prepared to communicate with each other. The IT revolution sweeping across the globe has the capacity to reduce the transaction costs and enhance the national efficiency by changing the way in which most public services are delivered by the government as also the fundamental relationship between the government and the citizen. Along with e-commerce and e-business, the next internet revolution taking place is e-governance.

6.2 Government cannot choose its customers; the services they provide must be for every citizen, and much of what they do must encompass the poor, the less privileged, women and the elderly, with special emphasis on rural areas. How can the government reach the last man or woman in a remote village?

6.3 There seems to be increasing awareness in all governments to bring in functional changes that can lead to a one-stop shop for all citizens' needs [fig. 6.1]. This has resulted in the launch of many internet portals of the state and central governments. Portals of this nature are being attempted in a small way in states like Andhra Pradesh, Karnataka, Tamil Nadu, Madhya Pradesh and many more. A detailed study of these initiatives suggest that while few state governments have embarked upon implementing new and innovative use of Information Technology for e-governance, education and commerce, other states in the country are beginning to realise the potential of transforming to knowledge-based society. Some of the examples of implementation, including web-based manufacturing, and experience at national and international level are explained in this chapter for the purpose of presenting the advantages of introducing IT and knowledge products [fig.6.2].

Fig. 6.1 Some Indian Experiences

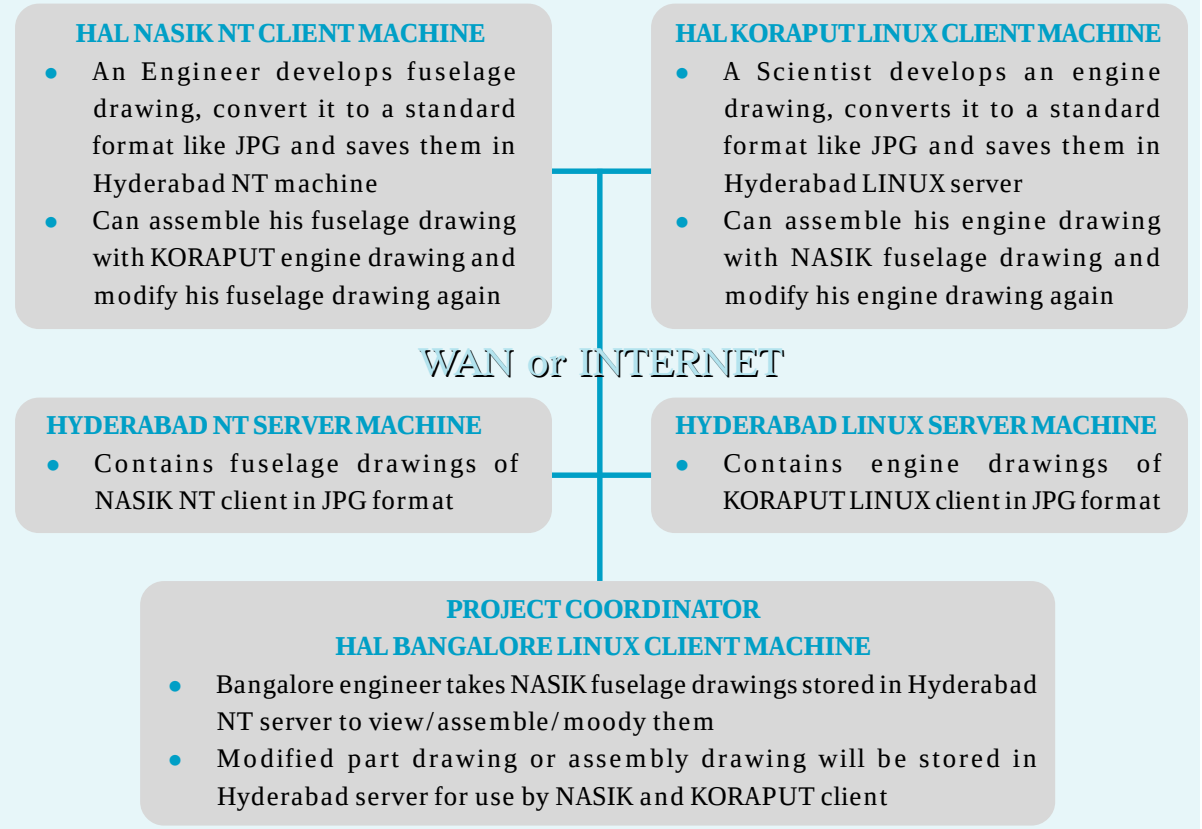
- Many district mandis in A.P. electronically networked to provide market-related info through state planning & development Monitoring system
- 21 centres in 5 blocks (covering 30 villages) in Dhar dist., (MP) connected through intranet for providing land records, food stock, market info, educational and library services
- Zee interactive learning system using TV/PC in Kiosks (Zed points)
- Participation in flower auction in Netherlands by florists in Tumkur dist., Karnataka
- Activities in many taluk offices in Thanjavur dist., T.N., computerised on pilot basis to provide services such as land records, community certificate, old age pensions and many more
- Reasonably effective functioning of Railways and Airlines reservation system

6.4 National Initiatives

6.4.1 State planning and development monitoring system – Andhra Pradesh

The state of Andhra Pradesh has been digitised to a certain level, which includes 23 districts, 1125 mandals, 295 assembly constituencies and 28245 revenue villages. These are being connected through a state Wide Area Network called APSWAN. With the establishment of such a network, the state administration is geared up to tackle several issues and help extend the reach of people and government alike. Further, over 70 market yards across the state are computerised and networked to the Agricultural Market Yard department at the state government headquarters. This provides total on-line connectivity to monitor arrivals of the commodities, the prevailing prices etc. at head quarters as well as at the market yards. This enables the farmer to determine the prices at which to sell his produce or direct his produce to another market to fetch a better price. The farmer also gets information about various services available at the market yard such as tariffs for storage facility, weighing and hamali charges etc. The process thus eliminates the commission agents and exploitation of the farmer. The information available in the network enables the

Fig. 6.2 A Conceptual Application of Web Based Manufacturing



government not only to monitor the functioning of the markets, but also helps in formulating appropriate strategic plans for the state. Since the system generates all the necessary reports online, it enables the government agencies to improve efficiency of operations and extend better services to the farmers. Therefore AP government is rightly giving priority to connectivity. The Karnataka government has also undertaken a similar project.

6.4.2 Gyandoot Madhya Pradesh Dotcom Intranet Project Experiment

The feasibility of universal access to information has been demonstrated by the Gyandoot Dotcom project in Madhya Pradesh. This experiment is carried out successfully in Dhar district. A total of 21 centres in five blocks in Dhar district have been wired with locally made servers and multimedia kits for each centre in a cost effective way. The centres are located in the panchayat ghar and electricity costs are borne by the panchayats. The person who manages the centre pays the cost of telephone links with the state wide Intranet and villagers are required to pay a nominal charge for obtaining government related services such as access to documents like land records, regular market updates and other useful information. This substantially reduces the role of middlemen. Each centre

caters to 15 gram panchayats situated in 30 villages having a potential clientele of around half a million inhabitants in the Dhar district.

The success of this unique experiment has shown that mass empowerment can only come through such innovative experiments. The potential of such a project has been recognized internationally for introducing a new paradigm in the use of IT by involving common people. This recognition has sent an important message to the world community about the potential of use of IT in bringing about social transformation.

6.4.3 Karnataka Initiatives

Reliance, in collaboration with the government of the state of Karnataka, has decided to establish 7500 Mahiti centres (information Kiosks) of which 745 centres would be used for maintaining a data base on land records and other documents, which could be accessed for a nominal fee. It is estimated that around six million farmers will get benefited.

Another experiment worth mentioning is the initiative in floriculture industry at Tumkur. The industry regularly participates in the international bid for exporting Tulip flowers to the Amsterdam and other European markets on a regular basis making full use of IT. The flowers are despatched to the respective destinations at the right time.

6.4.4 Tamil Nadu Experiences

A comprehensive database of land records in various parts of the state has been created. A set of application software for use at taluk and district levels has been developed, tested, finalised and has been installed in 50 taluk offices. Further, two pilot projects are running in four taluks of the state for digitisation of the cadastral maps as the first step towards creating data base of digitised land maps. The state has also implemented application software for monitoring development projects at the block level and most of the district headquarters have been connected to the state headquarters through video conferencing facility. The thrust of these projects is to make the citizen interface with the government both pleasant and purposeful.

6.4.5 UP Experiment

Kashika telecom has established in eastern UP low-cost e-mail dhabas financed through bank loans. Computer education programs are also available through these Kiosks. These Kiosks also help local farmers regarding information about paddy prices and land records to a limited extent.

6.4.6 Private Sector initiatives

Zee Interactive Learning Systems project provides interactive learning through blending satellite, video, the internet, multimedia and cable network. The project will have several ZED points (Kiosks) and it involves launching of an exclusive project for educating rural children. The teaching will be interactive through the combined use of TV and PC. The aim is to construct “knowledge building communities” at an

affordable cost even to rural population, where students and faculty around the globe can collaborate.

Intel Corporation has taken the initiative to set up teacher training laboratories to train 100,000 schoolteachers in India. The company also plans to participate on a joint project with the department of Education to develop an effective program for computer aided learning in schools. It also envisages operating "cyberschool on wheels" project especially targeted towards educating rural masses.

6.4.7 Real-time Hydrometeorological Data Acquisition System

Apart from these examples of IT application in Education, there are many examples of the use of IT in various other areas. For instance, the Narmada Control Authority (NCA) has undertaken a massive computerised, networked river water management and flood forecasting programme across the Narmada Basin. This programme envisages installation of 26 real-time data acquisition systems along the river at vital places to monitor the water levels in the river, the rain fall and various other weather related data for forecasting of flood and disaster management. Since these sites are located at remote places, a satellite communication network is provided and all the sites are networked to the Master Control Centre at the state Hqrs at Indore. The Master station runs the model of the river basin to predict water flows and water levels at different points of the river in order to generate flood and lean flow forecasting along with other water management functions. In phase II of the programme the number of monitoring centres are to be increased to 90.

6.5 International Initiatives

In early nineties, the ICT revolution accelerated the pace of transformation of societies into knowledge societies with heavy emphasis on delivery of services in health, education etc. in the developed world. For example, in the area of Telemedicine, Australian State Governments used telemedicine to provide health care to remote areas of Australia and even to other areas of Southeast Asia. The goal is to provide apart from acute care, a lifelong prevention programmes to help its citizens avoid lifestyle related illnesses, such as heart disease etc., that have become common in the west. Malaysia plans to use the PC based TV technology as the basis of a Telehealth programme throughout the country.

The state of Columbia in the United States of America is currently using internet-based video to provide medical training to physicians, becoming the first hospital to do a heart operation live over the internet. The doctors demonstrated surgical techniques over the video, and an accompanying slide presentation provided the necessary technical details. The video could be replayed at anytime so that surgeons at all of Columbia's clinics and hospital can gain an exposure to advanced techniques that would otherwise not be available to them. Important medical conferences are also simultaneously

telecast and through the use of internet based technologies, better participation of delegates is now possible without being actually present at the conferences.

Several other initiatives to reduce the government-citizen transaction costs are also being taken. For example, since 1996, a pioneering project called "Service Arizona in USA" has allowed the locals to carry out a growing range of transactions on the web, from ordering personalised number plates to replacing lost ID cards. Instead of having to stand in a queue at the motor vehicle department, they can go online and renew their registration, in a transaction that takes an average of two minutes. What is more, this has not cost taxpayers even a cent to set it up and it is free to users. The website was built, maintained and hosted by IBM, which is being paid 2 percent of the value of each of such transaction.

Australian state of Victoria operates a MAXI online system, which is organized around life events that change a person's legal status or impose a reporting requirement: marriage, becoming of legal age, moving etc. If one changes residence, for instance, he or she fills out the change of residence information once from a PC or from a public kiosk.

The web application automatically updates the records of the concerned individual in the respective state agencies, which need to know the change. Citizens have to know only what they need to do, not the locations and procedures of different agencies. MAXI is handling a large volume of transactions a month and the number is steadily rising.

As the internet provides the best way to interact with Government, all citizens need access, even if they do not possess individual PCs. Electronic kiosks that function like bank ATMs will ensure that every citizen can participate equally in the new way of working with the Government. Placed in public utility places like post offices, libraries, and schools, these kiosks can help governments improve services while trimming the cost of delivery.

Irish Government by using extensively the existing postal infrastructure has done the best by setting up multifunctional kiosks in post offices. Online systems accessible by kiosks or PCs, are most useful for citizens and cost effective for Government, when they are designed as multipurpose. The kiosk setup at post offices in Ireland generally processes all utility payments, issue passports, issue license for motor vehicles, and even disburse entitlement payments.

In this regard the Australian example of replacing its system of index cards on bulletin boards with kiosks that display job postings is worth mentioning. In addition to providing more complete and updated information, kiosks enable the Government to provide unemployment services quickly in an area of sudden loss of jobs.

In the field of education, technology can also reduce administrative overhead in schools and make it easier to compare educational results through an effective use of information technology. The State of Victoria, Australia has deployed an infrastructure that will eventually connect

one lakh PCs, providing a five to one ratio of students to PCs across the state. Victoria is embarking upon training every principal and teacher from all 1750 schools on the integration of technology into school work. Victoria state is also using PCs to handle business processes, for example, using e-mail to disseminate school documents and memos, financial statements, and images to its many remote schools. Administrators will use software to track trends in student absentees or staff absentees etc.

Towards providing multiple opportunities for global access to contemporary knowledge for life long learning, Massachusetts Institute of Technology [MIT] of USA has recently taken the initiative to open up all of its 2,000 courses and post materials like lecture notes, courses outlines, reading lists and assignments for each course for free on the internet.

Parthenay, a small town of 12000 people in France, is one of the four communities in three countries that have gone online as part of the European IMAGINE project, supported by the European Union and a partnership of cities and industries. Citizens are using the web in their day-to-day lives for such things as ordering bulk groceries to exchanging ideas. Cattle breeders have chat sessions to discuss issues of common concerns. The goal of the IMAGINE project is to pass on an integrated solution to another thirty European communities and deployment.

One of the world's ten poorest and most densely populated countries, Bangladesh has one of the least developed telecommunications systems, with a penetration rate of less than four lines per 1000 people. To extend telecommunications to rural villages, Grameen Telecom provides cellular pay phone services at an affordable price. This is made possible by reselling airtime from Grameen Phone, a cellular operator with a national licence that is building and operating a rural phone network. In the Grameen villages, the Grameen Bank supports business opportunities for entrepreneurial women who can become the village pay phone operators. Grameen telecom's programmes target women entrepreneurs, who are literate, and who have a small business or shop close to the village centre, to operate the pay phone services. Grameen Telecom was established for the sole purpose of developing the village pay phone programme and encouraging entrepreneurship and development in rural areas. The village pay phone programme is having a positive impact in the villages since it provides connectivity to people around and across the rural parts of the country.

The experiences and initiatives listed here are only a sample to show the potential of use of information and communication technology, government and society's will to use these technologies for bringing about a transformation towards a knowledge society.

CHAPTER 7

Vision–Inputs & Goals

7.1 We have so far considered the profile of knowledge society, multiple components and system integration. The three main pillars of a knowledge super power comprise: the societal transformation, knowledge protection and wealth generation. Responding to the clarion call given to the nation by the Prime Minister, India must become a knowledge superpower by the year 2010.

7.2. It emerged from the deliberations of the task force that the core strengths of the nation have to be coupled to the desired goals. The core strengths of the nation are as follows:

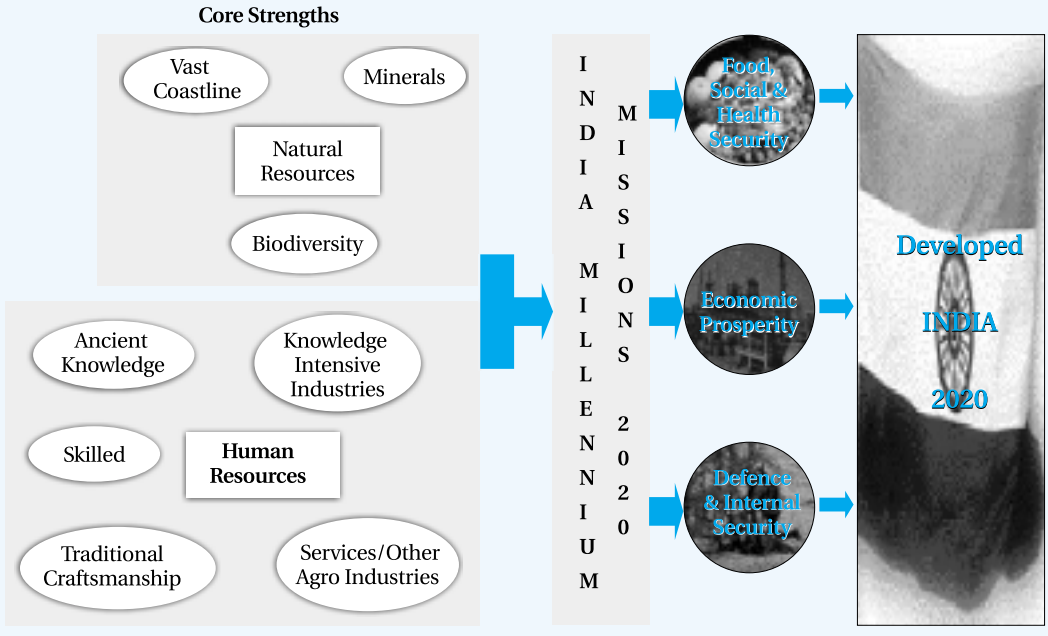
- Aerospace technology
- Agri-food technology
- Chemical process engineering
- Civil engineering
- Textile engineering
- Engineering services
- Project Management
- Systems Integration
- Software
- Design of systems
- Labour-intensive manufacturing
- Indigenous medicine
- Entertainment

7.3. Besides these, the nation's strengths predominantly resides in its natural and human resources. In natural resources, India

is endowed with a vast coast-line with marine resources and also oil wealth. In minerals, apart from conventional material resources, it is well-known that India has the largest deposits of titanium, beryllium and tungsten. India ranks among the top few nations having a rich bio-diversity. Particularly, in the herbal area there are potential applications for developing multiple products for nutrition, prevention and cure of diseases. Of the global herbal product market of US$ 61 billion, China has a share of around US $ 3 billion, whereas India's share is not even US $ 100 million. Hence, there is tremendous opportunity for growth in this area. India has similar potential for promoting floriculture and acquaculture in a big way. Knowledge-based value addition for these natural resources would mean exporting value-added products rather than merely the raw materials. Use of IT for commercialisation and marketing can increase our outreach and speed enormously. Ancient knowledge is a unique resource of India for it has the treasure of a minimum of 5000 years of civilisation. It is essential to leverage this wealth for national well being as well as to seek global presence for the nation.

7.4 Human resources, particularly with large young population, is unique core strength of the nation. This resource can be transformed through various educational and training programmes. Skilled, unskilled and creative manpower can be transformed into wealth generators particularly in the service sectors, agro industries etc.

Fig. 7.1 Vision, Missions & Goals



Knowledge-intensive industries can be generated out of our existing industries by injecting demand for high-level software/hardware, which would bring tremendous value addition. It is said, "the precious asset for a company or a country is the skill, ingenuity and imagination of its people. With globalisation, this will become more important because everybody will have access to world class technology and the key distinguishing feature will be the ability of people in different countries to use their imagination to make the best use of the technology".

7.5. Using India's core strengths and by knowledge-based value addition, the nation can realise the economic, internal and external (defence) securities. This, in turn will accelerate our march towards creating a developed India of our dreams [fig. 7.1]. Indeed development and innovative use of multiple technologies with transparent management structure and coupled with IT, will catapult India into a knowledge super power.

CHAPTER 8

Knowledge Society: Approach and Action Plan

8.1 Introduction

The ultimate aim of any society is to add value to make human life more comfortable. In the long run each society develops an environment, culture, customs and practices based on its native strengths like natural resources and skills, ingenuity, imagination and civilisational strengths of its people. This development process leads to a Social Transformation. During the first transformation, nations moved from agriculture and labour-intensive economy to an automated and industrial economy. India with its huge population and vast and fertile land resources was not allowed this evolutionary path mainly due to its colonization by Europe. Later the United States and Japan had the freedom to make this change and they made full use of the opportunity for the benefit of their people. Today, they have become highly developed nations or Industrial societies.

The enormous industrial development of the last 200 years has now led to a second transformation from a highly industrial society to a knowledge society. It appears that while we did not get the opportunity to participate in the transformation as an industrial society, our chances to undergo the second transformation to a knowledge society are extremely bright due to its several endowments, and especially because we were already a leading knowledge society in the millennia gone by. By using the native strengths of the people and enunciating

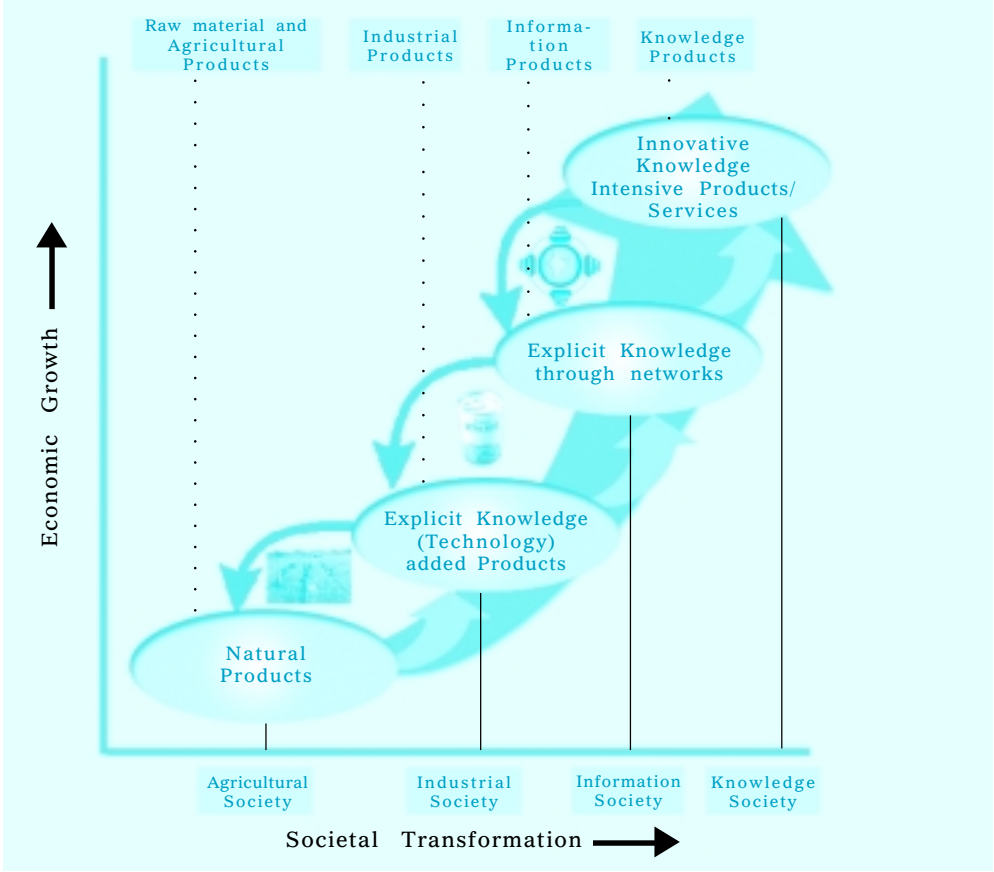
appropriate national plans, this transformation can be further accelerated and used to solve the basic problems of the nation and develop it as a sustainable knowledge society. However it is possible to identify a few of the trends a knowledge society may have [fig.8.1].

Fig. 8.2 indicates the value of products coming out of different societies. The agriculture society concentrated on producing natural products such as grains, fruits, timber, ores and minerals etc. The industrial society added value to these products and increased productivity by incorporating explicit knowledge to this. The Information Society added further value through electronic networking, which enabled dissemination of information and access to information products rapidly. The knowledge society will be a society producing products and services that are rich in both explicit and tacit knowledge thus creating more valuable products. Some centre of excellence are already emerging in pockets, but hopefully this will expand to cover the entire country in due course of time. The real capital of this knowledge society will be provided by its knowledge workers, who will have the capacity to create explicit and tacit knowledge rich products. The society will be highly networked to create knowledge intensive environment along with enabling process to efficiently create, share, exploit and protect knowledge.

Fig.8.1 Characteristics of Knowledge Economy

	Industrial Economy	Knowledge Economy
• Objective of Society	Basic needs for all through Development	Empowerment
• Education	Text Book, Teaching & Formal	Creative, Interactive, Self-learning and Informal with focus on values, merit and quality
• Workers	Skilled, Semi Skilled	Flexibly skilled, knowledgeable, self-empowered
• Type of work	Structured & hardware driven	Less structured & Software driven
• Management Style	Directing	Delegative
• Quality of Personnel	Performance based	Knowledge based
• Impact on Environment & Ecology	Heavy	Strikingly less
• Economy	Industrial	Knowledge driven

Fig.8.2 Economic Growth in Different Societies



8.2 Employment Generation

Unemployment is an economic phenomenon that depends upon the stage of development of a particular national economy. India has a mixed economy with agriculture as the dominant sector. In this type of mixed economy, while the agriculture economy follows the classical Say's law of demand and supply; the industrial economy is governed by Keynesian theory of consumption. The demand and supply of industrial goods can be artificially regulated, as the products are non-perishable. Likewise, perishable items through value addition and technology intervention can become economic entities. Another problem with industrial economy is that it cannot provide employment to all, as very high productivity can be achieved by using high technologies and knowledge base. For a country like India with over 1 billion population, it is impossible to achieve employment for all by industrial growth alone. However, boosting the service industry can generate employment for many more Indians than was thought hitherto possible.

In August, 2000, Planning Commission has assessed the contribution from different sectors to GDP and workforce upto the year 2012. This assessment is based on

calculations of GDP at factor cost in three broad sectors of the economy :

i) Primary Sector (Agriculture, Animal husbandry, Fisheries, Forestry including medicinal and aromatic plants)
ii) Secondary Sector (Mining & quarrying, Manufacturing, Electricity, gas, water supply & construction)
iii) Tertiary Sector (Trade, hotels & restaurants, transport & storage, information & communication, financing, insurance, real estate business, community, social & personal services)

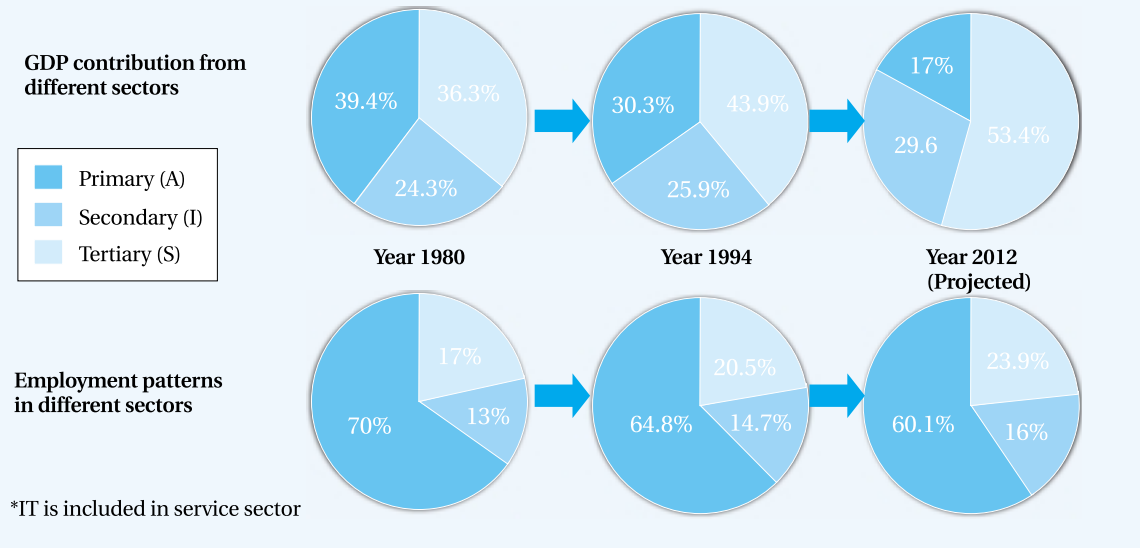
As per this assessment, it turns out that in 1993-94, the primary sector mostly driven by Agriculture has contributed 30.3 per cent to GDP while Secondary sector (driven by Industry) has contributed 25.9 per cent and the Tertiary Sector (mostly services and construction) has contributed 43.9 per cent to GDP. The figures for these sectors in 1999-2000 were 25.5 per cent, 27.4 per cent and 47.1 per cent respectively. The projected figures for the sectors in 2011-2012 are 17 per cent, 29.6 per cent and 53.4 per cent respectively.

It can thus be observed that the contribution of the primary sector is on the decline and that of the tertiary sector is on the upswing with the secondary sector growing somewhat slower. The trend over the years is pictorially depicted in fig.8.3.

The pattern of employment in the corresponding three sectors is as follows:

Year	Primary	Secondary	Tertiary
1980	70.0%	13.0%	17.0%
1993-94	64.8%	14.7%	20.5%
2011-2012	60.1%	16.0%	23.9%

Fig.8.3 Overall goals for Employment Generation



It can be seen from the above that the proportion of agricultural workforce is heading downwards whereas that of services is on the increase of which IT is a growing component. The trend over the years is also graphically represented in fig. 8.3. This trend in the last two decades can be attributed to gradual shift of traditional agricultural labour in the primary sector to other areas of economy in secondary and tertiary sectors. It can also be seen that in respect of rate of growth of GDP, the service and manufacturing sectors have started contributing more than agriculture sector inspite of a large number of people being deployed in agricultural labour. The employment increase in secondary sector (Industrial) over the next 10 years is estimated due to suggested growth in high-tech agriculture equipments & tool industry, infrastructure industry and the growth in agro products industry. The high technology deployment and increased education & awareness is expected to result in higher levels of mechanisation, automation and productivity in agriculture sector which will result in surplus personpower. The agriculture and agro-based industries would be able to absorb this surplus personpower to a great extent and the remaining workforce needs to be trained for skills to cater to the increasing demands of the Tertiary sector (Service and IT industry mostly).

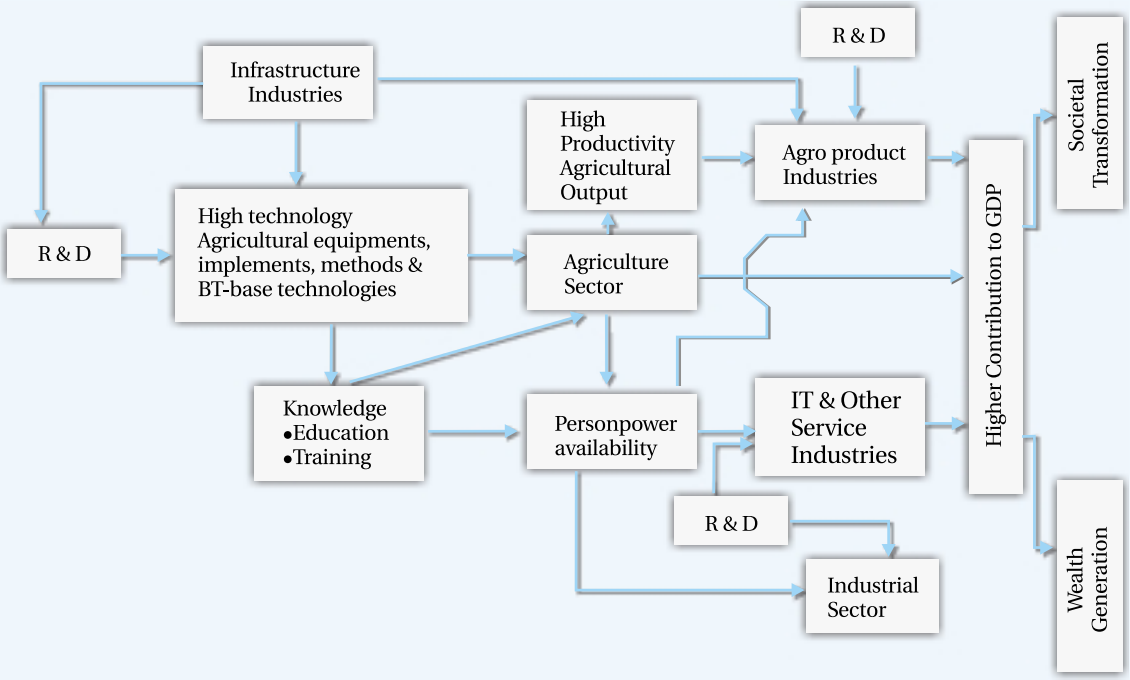
The economic and societal transformation of India can be facilitated only when all parts of our population become active and productive members of the Indian knowledge society. New systems of education, training, learning, relearning and even unlearning in every single endeavour ranging from agriculture to industry are crucial and IT can play an important role towards this end. It has been demonstrated that IT has the power to reach the unreached. At one end, by using IT, we can reach those in distant rural or hilly areas. At the other end, the recent initiatives by a private sector training institution have shown that through internet, functional computer literacy could be acquired by even slum dwelling young children, who were illiterate or semi-literate. In other words, it will be possible to use new tools and technologies to spread formal & functional literacy and achieve skill upgradation as well as new skills development.

A strong and enterprising service industry can get the high tech industry support from anywhere in the world. To achieve higher extent of employment generation and higher per capita productivity, a model is proposed in fig. 8.4. The model suggests designing, developing and deploying the high technology tools and methods in agriculture sector. By focusing on all walks of life, be it a farmer or a rural woman or a customer, we can indeed make all of them knowledge workers. A farmer can be a knowledge worker, if he understands the soil in which he sows, the why and the how of the pesticide application that he makes and he develops the capacity to use information on short and medium range weather forecasting to decide planting of seeds. Our empowering him to use information and knowledge will make him a knowledge worker. These advantages unleashed by technology will enable

gradual reduction in the number of farmers through the years, while maintaining the agricultural production at the required level. Similarly, a poor woman in a rural setting, who acquires veterinary knowledge will be able to take care of the stock of her animals and improve the standard of living of her family. In the same way, when a customer is empowered with the knowledge of the product that he buys, he automatically puts demand on improving the standards of production as well as the delivery of the goods to him. He can potentially bring in new revolution, just as 'white revolution' was triggered by the empowerment of a customer to judge the quality of the milk. In short, empowering every single Indian with knowledge in his or her respective sphere of action or influence will help in improving the 'national efficiency' in every single walk of life, ranging from agriculture to industry to knowledge based service industries. A new paradigm in the Indian social and economic transformation is thus entirely possible at a pace that has never been witnessed before in India.

The direct out come of this model will be two folds - an increase in productivity and release of surplus personpower from traditional agriculture sector. The benefits of higher productivity can be converted into wealth with establishment of Agro based industries. The surplus manpower can be upgraded with proper education and training and be re-deployed in agro-based industries, service sector and IT industry.

Fig.8.4 Strategy for Employment Generation



The above employment generation model can be tried first in some states which are agriculture intensive but at the same time are characterised by chronic unemployment such as U.P., M.P., Orissa or Haryana.

The three focus areas of the model are:

i) Research and development in agriculture technology and agro based industrial product that leads to higher productivity in agriculture sector and growth.

ii) Building infrastructure for agriculture, R&D, industry for high technology agriculture & agro-industry equipments, fertilizer, pesticides, seeds and export of agro based products.

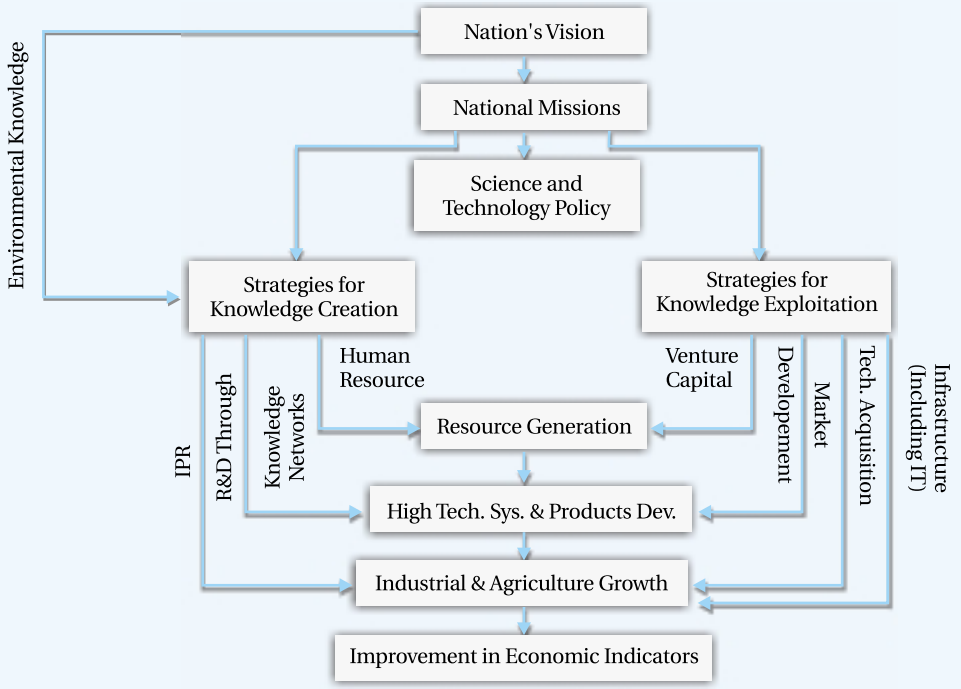
iii) Native strength and employment generation possibilities as criteria for identification of service industry in order to give boost to them.

In addition the IT industry can absorb a large amount of surplus personpower. The employment generation goals that can be targeted through these approaches in the next 10 years are indicated in fig. 8.3.

8.3 Wealth Generation Strategy

The need of wealth generation cannot be neglected while developing a knowledge society. Since knowledge of all types will be the engine of growth in a knowledge society, there is a need to manage this knowledge at the national level. A nation

Fig. 8.5 Framework for Nationwide Knowledge Management



wide knowledge management framework is suggested in fig. 8.5. Like knowledge management in organizations, Nation wide knowledge management involves a set of infrastructure, processes, policies and practices which will lead to an environment where knowledge creation is encouraged, nurtured, rewarded and finally exploited for achieving the nation's economic and societal objectives.

Nation's S&T, fiscal, trade and industrial policies need to be evolved based on nation's strength, weakness, environmental threats and opportunities. The implementation of knowledge creation and knowledge exploitation strategies finally lead to wealth generation and improvements in national economic indicators. The seven strategies identified, three for knowledge creation, and four for knowledge exploitation are:

i) Building up infrastructure for intellectual property rights (IPR)
ii) R&D through R&D networks
iii) Human Resource Planning and Development
iv) Promoting Venture Capital
v) National and International Market Development
vi) Selected technology acquisitions
vii) Infrastructure Development

All the above strategies require changes in laws and regulations to facilitate the Indian knowledge economy.

It may be noted that the transformation to a knowledge society needs leaders to lead the transformation, while the nationwide knowledge management needs planners and implementers for its successes. Some of the key knowledge creation areas are biotechnology, pharma (including drug design), meteorology, consultancy, space technology, ocean engineering and infotainment. The key knowledge exploitation areas are IT, telecommunication and traditional knowledge products. This model for wealth generation should be tried in relatively advanced, better planned and managed IT intensive States, like AP, Tamil Nadu, Karnataka, Madhya Pradesh and Maharashtra. These states could be chosen to be the success pilots as the probability of success in these states is high.

The success of these strategies would largely hinge on the creation of a technology financing mechanism on lines similar or better than Technology Development Board (TDB) to give a boost to knowledge industry.

8.3.1 The knowledge economy can make considerable impact on job creation by providing avenues for the agricultural sector to realise its full potential and hence address the problem of underemployment and disguised unemployment. In the coming years, the key role in this regard would be played by biotechnology, with IT providing the tools for managing the operations of the sector. A four-tier approach is proposed for this purpose.

i) Biotechnology (BT) can help remove four problem areas that have

prevented the agricultural sector realise its true potential. These are: (a) Preventing post-harvest losses, (b) Dechemicalisation of agriculture [for example, developing crops with nitrogen fixation capability] and conservation of water and energy, (c) Preventing pest and disease infestation, and (d) Increasing yields and productivity using emerging technologies [such as developing crops with biotic and abiotic stress] towards a second "Green Revolution". Post harvest losses can be prevented by increasing the shelf life of farm products, improving the storage & transportation facilities and increasing the scope of agri-processing and agro-industries in the country. The knowledge economy can play a significant role in supporting these activities as modern facilities are required which meet the high food quality and food safety standards that are being demanded by the discerning consumers of today. In this context, it is important that potential of BT-based products and services become increasingly used in agriculture, health and environmental industries and indeed in all sectors of economy as illustrated in the case of agriculture. It is therefore essential that an organic structure for both BT promotion and application is put in place. In all these activities mentioned, IT has a prominent role in managing all the sectors detailed earlier in the urban and semi-urban areas.

(ii) There is need to promote knowledge based service industries in which India has competitive strengths. This involves creating new service industries and not relying on the models provided by the industrialised countries. Towards this end, both the formal and informal sectors and, in particular, the traditional knowledge base would have to be harnessed. For this purpose, studies need to be conducted to identify the activities that have the greatest potential to be the core of these new India-specific knowledge based service industries.

(iii) We have strong foundations and potent knowledge in our Vedic scripts, scriptures covering space sciences, material sciences, aeronautical sciences, flora, fauna and traditional Indian knowledge in yoga, spiritualism and philosophy. We should consciously package and market our knowledge in these fields. Not only do these have a value but there is an associated commercial value too.

(iv) India should create a Traditional Knowledge Digital Library (TKDL) which would serve a bigger purpose in providing and enhancing her innovation capacity. Further, this could integrate widely scattered and distributed references on the Indian traditional knowledge systems in a retrievable form. It could act as a bridge between the traditional and modern knowledge systems. The initiation of TKDL has been approved in the Union budget for the year 2001-2002.

(v) There is also an urgent need to

improve capacity building in the economy. This needs to be done in three mutually supportive areas. The first is in the area of human resource development. This would require the government to play a major role in the education sector. The prime objective should be to make quality education affordable to all. Developing R&D capabilities and capacities is the second area that needs attention. Hitherto our R&D activities have been largely carried out in government supported facilities. As for the industry, only the public sector has been making some investments in R&D and technology generation efforts, both in house and in collaboration with government labs, IITs and University departments. Private sector has lagged behind. The final link in the chain of capacity building is new application of technologies flowing from R&D-based innovations. This is the key to ensuring that the knowledge economy has a vital role to play in economic and social transformation of our country.

8.4 Measuring and monitoring Indian competitiveness

One of the important needs for the country is to understand where we stand in the competitive world. The indices of world competitiveness are based on the global competitiveness report prepared by the World Economic Forum. The competitiveness as defined by this forum, is "*the ability of a national economy to achieve sustained high rates of economic growth*". By this definition, the ranking of different countries as of April 2001 turns out to be: USA [1], Singapore [2], Hong Kong [6], Australia [11], Germany [12], Taiwan [18], UK [19], France [25], China [33] and India [41]. The world competitiveness is therefore decided by a triangular combination consisting of progressiveness of industry, technology push and status of governmental deregulation, all working in unison. Again, in terms of overall GDP size, India is at position 12 in the world, and in terms of per capita GDP India's position is 57 in the world. This situation is unacceptable to a country that has a desire to get transformed to a developed country in a matter of two decades. Strategies and tools needed to bring about this transformation of India and thereby ushering in a knowledge society would have to be deployed.

8.5 Knowledge Development Index

If knowledge society is a society with a capacity to create, absorb, disseminate, protect and use knowledge to create economic wealth and societal good, then it is pertinent to seek information on how not only India as a whole is doing vis-à-vis the rest of the world, but also as to weather we have major state wise disparities in India. If one compares the picture at the time of independence and now, it will be seen that not only have these disparities widened but also that they are likely to have major consequences unless we quantitatively measure them, continuously monitor them and mitigate them through policy initiatives, investments and actions.

A knowledge development index pertinent to the Indian situation could be developed by looking at each of the attributes of creation, absorption, dissemination, protection and use of knowledge. The indicators on **creation** of knowledge could involve the number and quality of research papers as judged by internationally accepted indicators, number of patents filed and used, new technologies created etc. The **absorption** could involve the fraction of students in primary, secondary and tertiary educational systems, number of S&T personnel per capita, etc. The **dissemination** could be linked to the density of news papers, television sets, telephones, PCs, internet hosts, access to scientific journals, etc. The **protection** could include indicators linked to the number of patents in India and abroad, indicators on enforcement of IPR disputes in terms of their numbers and speed of disposal, awareness and widespread use of information security products, extent of multiple use of indigenous technologies in civil and military applications, etc. The **use** of knowledge to create wealth could be judged on the basis of the content of new knowledge in the new products, production based on indigenous technology as a percentage of the total, knowledge intensity into exported products, technology exports, new jobs created because of new indigenous technologies, productivity increase due to absorption of new knowledge, etc. The **use** of knowledge in societal transformation could be judged by an increase in the efficiency of the delivery of services to the citizens.

8.6 Building innovation systems

It is through the process of innovation that knowledge is converted into wealth and social good. Further, innovation is an important factor for the competitiveness of both service and manufacturing sectors. Innovation tends to emanate less from R&D and more from other sources, including organizational change. Hence there is an urgent need to establish an efficient innovation system in the country. Such a system would involve creation of clusters, which are networks of inter-dependent firms, knowledge producing institutions [universities, colleges/institutes, research institutes, technology providing firms], bridging institutions [e.g. think tanks, providers of technical or consultancy services] and customers linked in a value-addition creating production chain. The concept of clusters goes beyond that of a firm network, as it captures all forms of knowledge sharing and exchange. Thus an innovative system with its clusters would tap into the growing stock of global knowledge, assimilate and adapt it to local needs and finally create new knowledge and technology [Fig. 8.6]. For such an innovative system to succeed in a knowledge society, the following are necessary:

- Improving inter-ministerial coordination and ensure consistency and credibility in policy formulation
- Introducing new mechanisms to support innovation and technology diffusion, including greater use of public/private partnership.

8.7 Movement for knowledge society

Most of the social transformation takes place through public participation. Starting a government-supported but people-driven movement ***Marching towards knowledge society*** can facilitate this. The leadership and active involvement of government, semi-government and non-government organizations is the key to the success of such social movements.

The focus of such movement will be on creating the following:

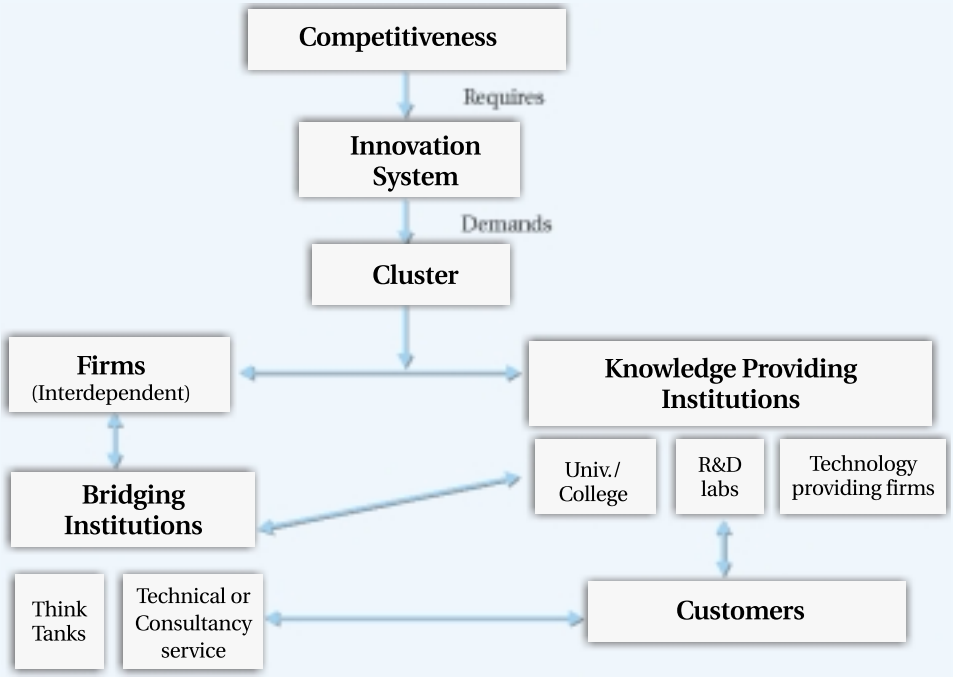
i) Awareness about the critical importance of universal primary education. Constitutional provision on compulsory primary education to all, upto the age of 14, must be strongly enforced on sustainable basis.

ii) Awareness of and demand for preventive health techniques, such as yoga, meditation, exercise, diet and living habits etc. disseminated using all mass media concurrently, on a nationwide basis.

iii) Morale building and spread of pride in our ancient knowledge, our intellectual capacity, cultural heritage and educational inheritance, must also become a national campaign.

iv) A sense of community solidarity and of social and environmental responsibility needs to be inculcated as a huge "value engineering exercise".

Fig.8.6 Necessary Ingredients for a Knowledge Society



8.8 Managing Change

While wealth generation through management is more of a project management activity, where planning, implementation, skills and processes are well defined, managing the social revolution is a strategic change and requires high degree of leadership.

The six main activities of this change process are:

1. Implementation of employment generation model
2. Implementation of knowledge management model for wealth generation and economic development.
3. Nation wide knowledge movement.
4. Reengineering the education system.
5. Establishment of IT infrastructure and its effective utilization in changing the education system and taking education to all.
6. Forecasting possible negative impacts and provide action needed during the transition phase to knowledge society.

8.9 Implementation

The task of spearheading this change to transform the country as knowledge superpower in about a decade has to be carried out through establishing a mechanism. As this change needs to take place across the states, cadre, societies involving the entire nation, it is suggested that a Cabinet Committee for Knowledge Society (CCKS) be constituted for this purpose. This committee, being the apex implementing body, would evolve policies, guidelines and the needed management structure to harness India's potential for transformation to a knowledge superpower. The committee may factor in the following while evolving implementation strategy:

i) The employment generation model may be first tried with agricultural States with higher unemployment problem.

ii) The Nationwide knowledge management for wealth generation can also be experimented first in those states where R&D and infrastructure exists [fig.8.7].

iii) Nationwide knowledge movement needs the participation by all and hence needs political approval and support from all parties. The role of voluntary organizations, media, infotainment industry and local folk entertainment industry will be very important. Process for communicating change, political processes and symbolic processes need to be developed and implemented. Education and awareness needs to be emphasized.

iv) The emphasis of knowledge society will be more on knowledge than formal education. The growth in literate, educated and knowledgeable manpower will result in different social dynamics. This dynamics needs to be studied on continuous basis to provide midcourse correction to the programme.

v) A knowledge society will need massive empowerment at all levels.

Fig. 8.7 Approaches to Knowledge Society Development

Model I

Approach
- Identify few states having successful experience in IT Sector
- Provide them with Infrastructure needed like Power, Communication, Connectivity and Manpower Training

Result
- Targetted Business achievable in the targetted time frame

Model II

Approach
- Task multiple states and spread the limited resources

Result
- More time to achieve the same targetted figures for wealth generation

Choose The Right Model

The empowerment of states, districts, villages, gram panchayats, educational institutes etc. needs to be studied and be given priority based on core team's recommendations.

vi) The existing performance index of GDP, Import-Export ratio etc. may perhaps not be adequate to judge the Nation's prosperity, in a knowledge society. New performance indices need to be evolved for evaluating the strength and sustainability of the knowledge society.

vii) An environmental monitoring mechanism and bringing on board environmental risk factor as an integral part of technology development projects must be ensured.

CHAPTER 9

Recommendations

The task force on the Knowledge Society had an opportunity to hear the presentations of nearly 200 experts in various fields of technology, education and social sectors as well as from government agencies during the course of meetings and workshops held for the purpose. Another important input to the task force, apart from these discussions, was from the number of reports received from the experts for consideration. The draft report containing the recommendations based on consolidation of these inputs was reviewed by a Steering Committee and the final draft report was circulated to the entire task force members for their views and comments. Based on these and detailed discussions by the Steering Committee, the task force has converged on the following set of recommendations:

I. Components of Knowledge Society

Knowledge Society is one that uses knowledge, through all its constituents and endeavours, to empower and enrich its people to drive the process of societal transformation and to enlighten its people to take an integrated view of life. It is a society that is committed to innovation and learning and has the capacity to create, absorb, disseminate and use knowledge to generate economic wealth and societal good for all its people. It is thus recognized that for a Knowledge Society three important components are mutually interacting from national point of view - societal transformation, wealth generation and knowledge protection.

A. Societal Transformation

For societal transformation the areas of focus are the following:

a) Education
c) Health Care
d) Agriculture
e) Governance

These will eventually lead to : employment generation, higher industrial growth, higher national efficiency & productivity, empowerment of women, transparent society and rural prosperity.

B. Wealth Generation

In respect of wealth generation the important areas are:

- IT & Communication (ICT)
- Bio Technology
- Space technology
- Materials technology
- Oceanography

The Service-driven areas include:

- Weather modification
- Disaster Mitigation
- Tele-medicine
- Tele-education
- Native knowledge products
- Infotainment
- Conventional & non conventional energy
- Environment & ecology

In order to benefit from the potential of these areas, attention should also be given to the informal sector of the economy. This would not only accelerate the growth of GDP but would also help improve the quality of employment and increase incomes of workers in the informal sector.

C. Knowledge/ Resource Protection

Growth of knowledge society progressively requires development of capabilities for protecting the knowledge/resource and therefore involves areas such as :

1. Strengthening of Intellectual Property Rights
2. Protection of biological and microbial resources
3. Protection of native knowledge and culture
4. Protection of network and information generators from all kinds of electronic attacks

II. Education

There is a need to step up our capabilities and capacities in various selected fields as indicated in Section-A. This is likely to lead to a trained manpower demand for more than 3 million knowledge workers by 2010. According to a NASSCOM study, there would be a requirement of 2.2 million trained manpower in IT alone (hardcore IT and IT-enabled services together) by the year 2008. It is recommended that:

a) Quality universal elementary education by 2010 has to be realised. The mission-mode programme of “Sarva Shiksha Abhiyan” launched by the central

government for universalizing elementary education must be fully supported to meet this objective.

b) The reach and quality of education at all levels needs to be enhanced and made responsive to meet the requirement for transformation to knowledge super power.

c) For quality education, quality teachers and faculty is a must. The teaching job may be made more attractive to encourage inflow of good faculty.

d) Higher education, general and technical, must have links with all industrial and societal endeavours. Towards this end, a large number of centres of excellence to turn out quality manpower in areas relevant to industry and society need to be established with triangular partnership of academia, industry and government.

e) IIT, IIM and IIIT type of institutions need to be multiplied, as there is a rapidly growing demand for manpower in several sectors of knowledge economy.

f) All private initiatives from individuals as well as corporates, including from Non-Resident Indians/People of Indian Origin, should be enlisted to increase access & availability of education and for improvement of quality of educational efforts.

g) There is a need for upgrading RECs to bring them on par with IITs.

h) Postgraduate institutions must also have a small and compact under graduate programmes in order to provide a dynamic teaching and research environment. The availability of high quality faculty in post-graduate institutions would also enrich the quality of under-graduate teaching and building proper academic attitudes among the under-graduates.

i) Education through technology-based learning making full use of developments in Information and Communication Technologies such as Video-conferencing, web-based education, etc. will accelerate the pace of learning. Distance education through invoking IT should eventually lead to the establishment of cyber universities imparting anytime, anywhere and anyone education.

j) There is a need to encourage demand-driven non-formal institutions like NIIT in different areas and provide linkages between their programmes and those of formal educational system through credit transfers, vertical mobility and other mechanisms.

k) The system of deemed university should be further liberalized so that it is possible to develop innovative and flexible educational programmes of studies on a self-financing basis.

l) The establishment of an Education Development Finance Corporation through private sector initiative, has to become a reality eventually. In this context the launching of a new comprehensive Educational Loan Scheme by the Indian Banks Association, as announced in the union budget for 2001-2002, is a welcome feature.

m) Free women's education for all upto college level, to be provided.

n) The service rules in academy, R&D and industry/agriculture/civil service should be flexible enough to make free flow of knowledge workers across all these sectors and also promote entrepreneurship.

o) Universities, including those supported by UGC, should be permitted to set their own fees keeping in view quality of education imparted.

p) An empowered coordinating mechanism between MHRD, AICTE and UGC has to be set up to speed up decision-making processes.

q) Both Doordarshan and Akashvani should telecast/broadcast knowledge channels, such as Gyan Darshan and Gyan Vani. These channels should endeavour to penetrate deeply into the hinterland.

r) Educational institutions must be encouraged to set up formal networks with other institutions for resource sharing and for synergistic development of the entire educational system.

III. Infrastructure

A. Electric Power

1. The all round progress of the nation is strongly coupled to the electric power generation capacity and its availability. This must be given overriding priority in the national planning to sustain the GDP growth rate envisaged.

2. The task of rural electrification across the nation is essential for a nation to progress in tele-medicine and tele-education. Alternative sources of energy based on emerging technologies such as fuel cells and also harnessing the solar power, biomass-based power etc., must be explored.

B. Connectivity

B1. Conventional Connectivity

Conventional connectivity comprising roads, railways, ports, inland water ways and airways has to be given thrust in an integrated way in the national planning and adequate investments have to be made on them. This is also important for attracting and sustaining knowledge based industries.

B2. Electronic Connectivity

1. As the optical fiber based links are being established both by the government at centre and state as well as private sector, it is essential to have an integrated plan of action. Between states, centre and private enterprises an integrated policy guidelines is called for. The last mile connectivity should take into account both industries and home by using technologies such as:

- Asymmetric Digital Subscriber Loop (ADSL)
- Wireless in Local Loop (WiLL)
- Wireless Application Protocol (WAP)
- Blue Tooth Technologies (for office and home connectivity)

2. The fiber optic cables, last mile connectivity technologies and the transponders available in the satellites, need to be integrated for increasing the band width in the country.

3. In view of large penetration of Cable TV, especially in the villages, it is recommended that Internet access is made available through cable TV. This will enable opening of new frontiers in education, infotainment and business.
4. The existing large number of post offices, public telephones and STD booths could be creatively used as key infrastructure component of the knowledge society.
5. Voice over Internet Protocol (VoIP) must be permitted.
6. Along with convergence of technologies, convergence of governance is also essential in order to cut down the process time for making decisions and reducing transaction costs for the citizen. In this direction the introduction of Communication Convergence Bill needs to be accelerated.

IV. Strategies

A. Employment Generation

1. Implement a strategy, which suggests designing, developing and deploying the high technology tools and methods in agriculture sector. The direct outcome of this model will be:

- an increase in productivity and release of surplus person power from agriculture sector.
- the surplus person power can be upgraded with proper education, training/skilling and be re-deployed in agro product, service (including IT) and other industries.
- the benefits of higher productivity can be converted into wealth with the establishment of agro-based industries.

2. The "Rurbanisation" model suggested could be tried out in multiple states.
3. A four-tier approach is suggested for increasing employment potential in the knowledge economy:

- Creating structures for both biotechnology promotion and application
- Promotion of knowledge-based service industries in which India has competitive strengths
- Packaging and marketing our ancient scriptures and traditional knowledge, especially in medicine
- Improving capacity building in three mutually supportive areas; human resources development, R&D capabilities and application of technologies flowing from innovations.

4. The employment generation goals that can be targeted to be achieved through this approach in the next one decade could be such that employment patterns in different broad sectors of economy are:

- Primary (driven by Agriculture): 60%
- Secondary (driven by general industries): 16%
- Tertiary (driven by Service industries): 24%

5. The employment generation model

may be particularly useful in states having higher unemployment problems.

B. Wealth Generation

1. Implement a nationwide knowledge management framework for creating an environment where knowledge creation is encouraged, nurtured, rewarded and finally deployed for achieving nation's economic and societal objectives. The seven strategies identified for knowledge creation & utilisation are:

(a) Creating capabilities and mechanism for effective functioning of Intellectual Property Rights
(b) R&D through networked environment
(c) Human resource planning & development
(d) Evolving an institutional (financial and technical) arrangement for facilitating innovation.
(e) National & International market development
(f) Acquisition of selected technologies
(g) Infrastructure development

These have to be supported by changes to be brought in laws and regulations to maximize the potential of a knowledge economy as well as by creation of a new technology financing mechanism to give boost to knowledge industry.

2. Promote local language voice-interface (than windows interface) to the web to enable greater dissemination of IT exploiting the larger telephone penetration in rural areas where literacy levels are low. This, while heralding native-requirement driven v-commerce in the country, would enable majority of India's population to become part of the digital revolution and reduce the digital divide.
3. The high-quality R&D work being carried out in our government-funded R&D establishments must be translated into commercially successful products. Towards this a mechanism that will mandate conversion of such research into national wealth as well as migration of technologies for societal benefits, should be evolved.
4. A number of technology parks and incubation centres with all basic infrastructure, including venture capital companies and legal advice, accessible to an entrepreneur at nominal cost, must be set up.
5. The existing R&D and IT infrastructure must be utilized for accelerating nationwide knowledge management for wealth generation.
6. Innovation is necessary for conversion of knowledge into wealth as well as for competitiveness of both service and manufacturing sectors. To bring in competitiveness in the national economy, an efficient innovation system needs to be established. Such a system would involve creation of clusters, which are networks of

- Interdependent firms
- Knowledge-producing institutions

- Bridging institutions
- Customers

linked in a value-added creating production chain.

7. A Knowledge Development Index needs to be worked out for the country. This must be used to monitor the interstate and intrastate change in knowledge development and also help in planning, resource allocation, growth, etc.

C. Knowledge/Resource Protection

1. Design and implement an Intellectual Property Rights (IPR) system that will protect our vast natural resources, indigenous innovation, concepts and traditional knowledge.
2. Initiate action in order to bring awareness on IPR among all sections of population, including raising specialist human resource.
3. R&D efforts in information protection would be propelled by the growth of knowledge products developed to keep pace with the increasing e-commerce applications. Therefore major private sector initiative in information security must be launched in a mission mode.
4. Develop provably secure algorithmic software for a variety of applications for secure electronic transactions based on threat perception. The tradition of high-level research in number theory and theoretical computer science could be a continuous source of improved encryption algorithms.
5. Create security awareness and confidence to do secure transactions over the net.

D. Societal Transformation

1. A people's movement ***Marching towards Knowledge Society*** should be started to facilitate such transformation. This movement would focus on:

- Time-bound programme for universal elementary education by the year 2010.
- Ensuring awareness of and access to health care.
- Spreading awareness of pride in our nation's past heritage and skill sets.
- Mounting a massive campaign on education in human values, inculcating community solidarity, social harmony and environmental responsibility.

2. National knowledge movement needs the participation by all sections and strata of population.

E. Implementation Structure

The task of implementing the national transformation to a knowledge society and thereafter to a superpower in about a decade, has to be carried out through establishing a proper mechanism. Towards this end a Cabinet Committee for Knowledge Society (CCKS) is suggested. This committee, being the apex body, would evolve policies, guidelines, the needed management structure and consider the following during implementation:

1. The employment generation model may be first experimented with agricultural States with higher unemployment problem.
2. An environmental monitoring mechanism and bringing on board environmental risk factor as an integral part of technology development projects must be ensured.
3. The Nationwide knowledge management for wealth generation can also be experimented first in those states where R&D and infrastructure exists.
4. Nationwide knowledge movement needs the participation by all and hence needs political approval and support from all parties. The role of voluntary organizations, media, infotainment industry and local folk entertainment industry will be very important. Process, both political and symbolic, for communicating change need to be developed and implemented. Education and awareness of knowledge society needs to be emphasized.
5. The emphasis in a knowledge society, will be more on knowledge than formal education. The growth in literate, educated and knowledgeable manpower will result in different social dynamics. This dynamics needs to be studied on continuous basis to provide midcourse correction to the programme.
6. A knowledge society will need massive empowerment at all levels. The empowerment of States, Districts, Villages, Gram Panchayats, Educational Institutes etc. needs to be studied and be given priority based on this task force's recommendations.
7. The existing performance index of GDP, Import-Export ratio etc. may perhaps not be adequate to judge the nation's prosperity, in a knowledge society. New performance indices need to be evolved for evaluating the strength and sustainability of the knowledge society.

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Government of India
Planning Commission
(Education Division)

Yojana Bhavan,
Sansad Marg,
New Delhi – 110 001.
Dated 15th February, 2000

ORDER

Subject: **Constitution of a Task Force for India's Development as Knowledge Society**

1. In order to implement the Prime Minister's five-Point Agenda for making India a Knowledge Superpower, the Planning Commission has decided to constitute a Task Force for India's Development as Knowledge Society.

2. The terms of reference of this Task Force shall be as follows:

(i) To assess the current status of Knowledge Industry.

(ii) To suggest strategies and plan of Action for a new Education System for the Twenty-First Century leading towards making India a Super-Knowledge Nation by:

(a) Leveraging of existing competencies in IT, telecom, bio-technology, drug design, financial services and enterprise wide management.
(b) Global networking.
(c) Education for developing a learning society.
(d) Vibrant government-industry-academia interaction in policy-making and implementation.
(e) Economic and business strategic alliances built on capabilities and opportunities.
(f) Setting up the Education Development Finance Corporation for needy, deserving students.

3. The composition of the Task Force shall be as follows:

1. Shri K.C. Pant — Chairman
Deputy Chairman,
Planning Commission

2. Dr. K. Venkatasubramanian, — Member (Convenor)
Member, Planning Commission.

3.	Dr. A.P.J. Abdul Kalam Principal Scientific Adviser to The Government of India 319, Vigyan Bhawan, New Delhi – 110 001.	Member
4.	Prof. R.A. Mashelkar Director General, Council for Scientific & Industrial Research, Anusandhan Bhawan, Rafi Marg, New Delhi – 110 001.	Member
5.	Shri Ashok Parthasarathy 26, Lodhi Estate, New Delhi- 110 003.	Member
6.	Shri N.R. Narayanamurthy Chief Executive Officer, 44, Electronic City, Infosys, Hosur Road, 3rd Cross Road, Bangalore-560049.	Member
7.	Dr. Hari Gautam Chairman, University Grants Commission (UGC), Bahadur Shah Zafar Marg, New Delhi – 110 002.	Member
8.	Shri K.K. Baksi Principal Adviser (Education), Planning Commission.	Member
9.	Prof. J.S. Rajput, Director, NCERT, Sri, Aurobindo Marg, New Delhi – 110 016.	Member
10.	Dr. N. Vijayaditya Dy. Director General (Acting DG), National Informatics Centre (NIC), CGO Complex, Lodhi Road, New Delhi – 110 003.	Member
11.	Dr. V.P. Garg Joint Adviser (Education) Planning Commission.	Member-Secretary

4. The Chairman may if deemed necessary co-opt additional members or invite Expert(s) as special invitee(s) if such need arises.

5. The Task Force shall submit its report to the Planning Commission within six months of its constitution.

6. The expenditure on TA/DA of official Members in connection with the meetings/field visits will be borne by the parent Departments/organizations to which the Members belong. Non-official Members will be entitled to TA/DA as admissible to Group 'A' officers of the Government of India and this expenditure will be borne by the Planning Commission.

15/1/2001

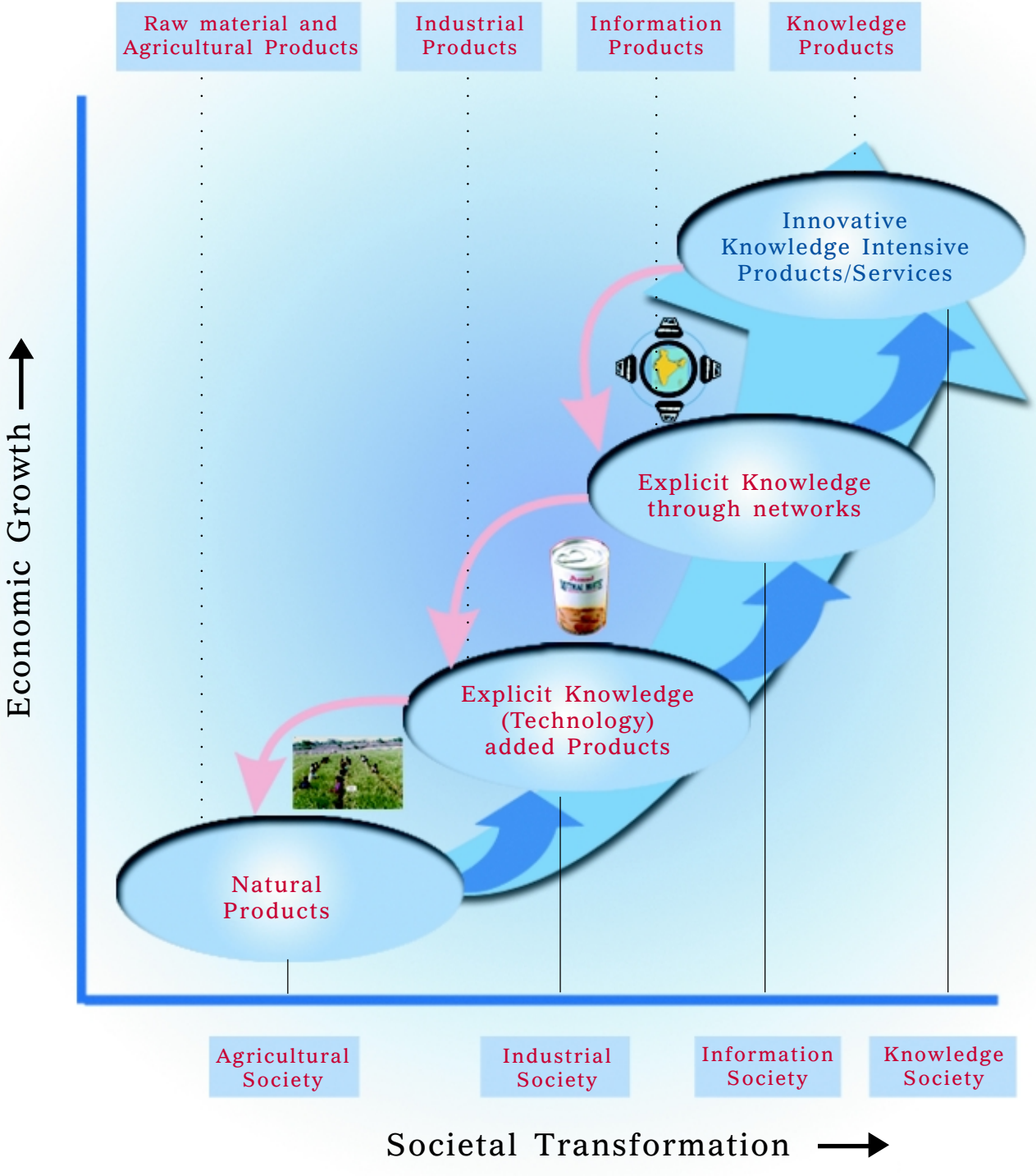
Arvind Kumar
Director(Administration)
Planning Commission

To,

The Chairman and Members of the Task Force

Copy to:

1. PS to Deputy Chairman,
2. PS to Minister of State
3. Principal Secretary to Prime Minister
4. Secretary, Planning Commission
5. All Members of the Planning Commission
6. All Heads of the Planning Commission
7. Admn.-I, Section/Accounts-I
8. Information Officer
9. Plan Co-ordination Division.


Raw material and Agricultural Products
Industrial Products
Information Products
Knowledge Products
Innovative Knowledge Intensive Products/Services
Explicit Knowledge through networks
Explicit Knowledge (Technology) added Products
Natural Products
Economic Growth
Agricultural Society
Industrial Society
Information Society
Knowledge Society
Societal Transformation