ADVOCACY FOR TECHNOLOGY BASED PLANNING FOR DEMOCRATIZING THE PROCESS OF GROWTH

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Abstract: *Advancing technology has been perceived as a permissive source of economic growth which would benefit those economies which have social, economic and political assets to take advantage of this source. Nation States, accordingly, have to ensure investments for creating diverse economic assets capable of extracting the advantages from the emerging technologies and such investments have to be renewed and reoriented over the technology cycle in the competitive global market. Ideally in a technology dependent economy the process of investment in strategic assets should be automotive among governments and firms to ensure the integration of the latest conducing technologies. A distortion creeps in when economy is planned basing on financial and profit parameters and such an indulgence results in nation falling behind in competitive economy. Even a country like US felt its competitive edge being challenged by countries like Japan, China and India who took to technology based planning in strategic sectors and it proposed a correction in its strategy to maintain its edge. India has pursued technology based planning in certain strategic sectors with spectacular results. In other sectors, India has largely gone ahead with finance based planning. In the age of rapidly advancing technologies impacting the growth, it is proposed in this paper that India should resort to technology based planning particularly when technology has ready game plan to result in include growth in decentralized set ups and democratizes the process.*

In his lecture to the memory of Alfred Nobel, on December 11, 1971, Simon Kuznets[1] dealt with technology led modern economic growth to point out six characteristics associated with the phenomenon as follows:

1. Higher per capita growth
2. Higher rate of productivity

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1 Modern Economic Growth: Findings and Reflections lecture to the memory of Alfred Nobel, December 11, 1975 by Simon Kujnets; nobel prize.org/nobel-prizes/economic science/lectures/1971/kujnets-lecture.html.

3. Structural shifts in economy on large scale
4. Structural changes in society and its ideology
5. Intensifications of communications among nations
6. Spread of technology led economic growth was limited to a few developed countries.

According to Kuznets, above characteristics are interrelated and the interactions among them point towards:

a) Advancing technology changes the scale of production plants and the character of enterprise units.
b) Growth of urbanization with disruption in past statuses in occupations and social hierarchy giving way to new set of interrelationships.
c) New skills are valued and previous by acquired skills are set to decline in value.
d) Way of life gets measurably changed with certain advantages and certain disadvantages.

Resultant to these shifts, there would be some groups who would stand disadvantaged while others would stand disproportionately advantaged. So the stable pattern of society would tend to shift towards disequilibrium. The state would be required to play a crucial role in managing growth induced conflicts. Thus in rapid economic growth induced by advancing technology, the state has a crucial role to play for stimulating growth and structural change by legal and institutional innovations to encourage new potentialities on the one hand and on the other continuously managing the resultant conflicts by not letting the conflict potentials cross the threshold.

The economic revolution to be brought about through advancing technologies and innovations has to be controlled and guided by the sagacious state.

When technologies and innovations are being taken up for economic outcomes, their overall impact gets known only much later. There may be surprises ahead, which may be positive or negative. Negative surprises which were not anticipated or were thought to

outweigh the advantages, would need to be deftly regulated by the state and if necessary by a set of innovations which minimize the negative effect.

Spread of modern economic growth would thus be dependent upon a stable, but flexible, political and social framework, capable of accommodating rapid structural changes and resolving the conflicts that it generates, while encouraging the growth promoting groups in the society. Kuznets in his lecture observed that such a framework is not easily or rapidly attained and identified Japan as the only nation outside those rooted in European civilization that had joined the group of developed countries until then. Kuznets did not fail to observe in his lecture that a larger segment of the globe and its populations were not participant in the technology induced economic growth for various reasons rooted in history and consequently in its institutions. He was clear in his observations that because of diversity associated with this category of nation states, strategies for creating the trigger for technology induced economic growth would be nation specific and a fit for all strategy would not work. Nevertheless, he foresaw, that these less developed countries would be struggling to take advantage of modern technology in order to assume an adequate role in the interconnected world. National accounting framework would be required to encompass the hidden but important costs, for example, in education as capital investment, in the shift to urban life, or in the population and other negative results of mass production and would be set off against the positives such as greater care and longevity, greater mobility, more leisure, less income inequality etc. To integrate technological consideration into national development planning process better technology measurement methodologies would be required to be designed. Developing countries, depending upon their specific requirements would be required to make the integration process organic and effective “make–some and buy–some technologies” based on the concept of an approach to their

specific development planning and using three technology domains (importing technology, traditional technology, and exporting technology)[2].

About five decades down the line since Kuznets observed that advancing technology is permissive source of economic growth, many among the less developing countries have made astounding strides in their economic growth riding on the wings of technology and local innovations so much so that they are now among the comity of top rung world economies. These countries and their governments have managed the material and social assets remarkably well to achieve the unprecedented rates of growth and have become subject of studies by scholars e.g. Ruchir Sharma[3]. 10 high performing Asian economies: China, Hong Kong, Indonesia, South Korea, Malaysia, Singapore, Taiwan, Thailand, India and Japan have shown remarkable growth/trends in caloric consumption enrolment/ratios/industrial production in quinquenna; 1950-2005[4]; belying the fears of US economists of 1945 who categorized Asian region unpromising candidate for high economic growth. In 1950 even the most prosperous of these countries had a per capita income less than 25 per cent of that of the U.S. between 1960s and the end of 20th century. However, many of the countries of south and south-east Asia experienced vigorous economic growth, some with growth rates far exceeding the previous rates of industrialized countries. It had been estimated that growth rates would probably continue at high levels in South East Asia for at least another generation. Such a forecast in 2005 was based on four factors: the trend towards rising labour force participation rates, the shift from low to high productivity sectors, continued increase in educational level of the labour force, and other improvements in the quality of output, that were not being accurately measured in national income accounts[4]. Kuznets in his lecture referred to above chose not to mention the remarkable achievements of the countries of the region in economic growth, which were not entirely commodity based, so soon

[2] Technological Forecasting and Social Change, August 1987, vol.31 (i): 5-18, Special Issue Technological Capabilities Assessment in Developing Countries, sciencedirect.com/science/article/pil/

[3] Breakout Nations: In pursuit of the Next Economic Miracles by Ruchir Sharma, April 2012

[4] High Performing Asian Economies, Robert W. Fogel, NBER, working paper no. 10752, nber.org/papers/w10782

after they came out of the domination of colonial powers. Undeterred by the misgivings of the economists of advanced economies, the governments of the newly emerging nations in the region demonstrated that they had the capacity of taking advantage of technology induced economic growth undeterred by the challenges of institutional, ideological and social adjustments that would be required in the process. A special mention is to be made of India and its leadership that the trauma of partition of the country and the havoc created by the communal strife in its wake, the commitment to trigger the development process was not allowed to rest. Science and technology was integral to the planning process for development which was taking shape soon after the Indian people were enabled to assume sovereign powers free to determine their own destiny. Remarkably, the system of governance adopted was parliamentary democracy based on universal suffrage- each one having one vote irrespective of his caste and status. Governance was to be through newly carved institutions which guaranteed individual constitutional rights of equality and fraternity with freedom of speech and ensuring separation of powers among the legislature, executive and judiciary. A thought has to be reserved for the dexterity of the people and its leadership of the time that the experiment of governance through a democratic constitution in the most diverse country in the world was unprecedented with many harbouring that the nation would not be able to bear the weight of such an experiment in governance. Belying all apprehensions, a stable environment was brought about conducive to orderly and steady growth for a nation which had its sole asset in unwavering commitment to grow applying the latest in science and technology. By the time Kuznets delivered his lecture referred to above, achievement of India in green revolution at least should have been within his knowledge and he would have enriched his lecture by citing the example of India that governments in emerging countries had demonstrated their capabilities in making use of advancing technology with all its attended positivities and negativities, in furthering economic growth and in the process ensuring food security for a large mass of population residing on the planet earth.

Revival of science as a discipline in India took place in the late nineteenth century as an instrument for seeking recognition by the Upper Caste middle classes in the eyes of the West that the Indians could also equal to the sciences of the present day. Learned men of these classes would not like to identify themselves as ones who took to science as an instrument of production of wealth despite the then lieutenant-governor, Richard Temple advising that science also may be made to add immeasurably to the national wealth and so to afford lucrative employment to numberless persons according to their qualifications and acquirements and went on to identify a large number of occupations for which training could be imparted, including those of land and geological surveyors, civil engineers; trained mechanics, foresters, engravers, wood and stone carvers. Lieutenant Governor's vision was that science would become instrumental in the introduction of new industries in Bengal and also every one of the old established arts and manufacturers of the country would be rendered more useful and remunerative than at present. The above prescription dated 1875 would be in the nature of industrialization of rural India through the application of Science & Technology. But to the upper Indian middle class, it was anathema to be identified and associated with manufacture which was to be the profession of the people at the lower rung of the hierarchy of the caste structure. Temple's suggestions towards making science as an instrument of generating wealth was not acceptable to the emerging scientific community in India belonging to upper castes. Thus the Indian science in the early years of its revival in the nineteenth century overlooked the scenario that during the ongoing industrial revolution during that period entire society across Europe was being artisanised and science through its application was increasingly becoming as an instrument of wealth earning[5]. Thus the emergence of an independent industrial culture through the application of science had to wait until much later when the realities of global competitive economy were to be faced by the Indian Nation. Directional change, however, was provided prior to that by Jawaharlal Nehru who in his presidential address

[5] Science and domination: India before and after independence, Prof. Rajesh Kochar, iisc.ernet.in/currsci/feli.25/articles33.htm.

to the congress in 1936 observed that the standard of Indian people would rise through rapid industrialization. In the following year i.e. in 1937, on the occasion of the silver jubilee of the Indian science congress, he reaffirmed that the future belongs to science and to those who make friends with science and seek its help in the advancement of humanity. Thus science and technology was poised as a tool for production of wealth also in Independent India in addition to its continuing the pursuit of intellectual fulfillment.

Soon after independence many geo-political events happened that required science in India to enter the domain of foreign policy and emphasis of government got focused on the nuclear, missile and space programmes to provide a feel of strengthening India's efforts towards emergence as a sub-super power. Production of wealth aspects of science consequently had to wait when India came to face the reality of competitive world economy. Science & technology has to necessarily create a technology–driven artisan class- a phenomenon which could have begun in 1875. Meanwhile the Industrial scenario globally has been impacted by the fast changing technologies on the back of information and communication based infrastructure bringing about unanticipated structural changes in global manufacturing processes and trade patterns requiring data based technologies to manage the new complex commercial activities. Internet and renewable energies are creating a new infrastructure for a third industrial revolution that would change the way power would be distributed via an energy internet just like information is generated and shared online[6]. Discussion Note 2014/3, makes mention of 3D printing technology which is set to redefine the manufacturing processes and further it lists out several technologies on the horizon which have the potential of bringing about disruptive changes in the industrial sector[7]. Competitive edge of a country in coming years would thus be determined by its ability to exploit the emerging technologies by creating enabling economic assets ahead of its competitors. Therefore,

[6] The Third Industrial Revolution by Jeremy Rifkin, worldfinancialreview.com

[7] DN 2014/3, 'Case for Revisiting National Manufacturing Policy to provide for Technology Watch and Integration and Coexistence of Manufacturing and Service Sector' by M.M.K. Sardana, ISID Website

there is a pertinent case that nations who wish to compete globally and have the aspiration to be leaders among the pack, should be resorting to technology based planning rather than continue to rely on fiscal based planning.

Reagan administration (1981-1987) in the U.S. sensed that countries like China and India stood to pose threat to America's competitiveness because of their ability to use technology-based planning. That administration initiated a programme within its intelligence framework to address challenge to America's competiveness under Michael Sekora. A key finding of the project was that at the end of World War II decision makers throughout the U.S. began shifting away from technology-based planning and began adopting economic based planning.

In a technology based planning, the decision making would be towards acquisition of technology to produce the best products or provide the best service. Technology would be manipulated, both offensively and defensively, to acquire and maintain the competitive edge. In contrast, in economic based planning, manipulation of the funds is the foundation of decision making and the measure of success is the efficiency of the economic manipulation.

The findings of the project were that while the U.S. corporates were in the process of sophisticated economic shell games to maximize profits, the countries like China and India were concentrating on technology acquisition and its manipulation to build on their competitive edge in their domestic as well as foreign markets. It was recognized that the U.S. could not maintain the level of technology based planning as it had done during the World War II and it would be needed to reinstate a level of technology-based planning that far surpassed that which was executed by Japan China, India and others. It was driven home that mankind was poised to make the next big evolutionary leap forward in tech-based planning the automated innovation revolution. With the automated innovation, acquiring and utilization of technology research and development, technology alliances, etc; is standardized and automated; the result

would be that the acquisition and utilization of technology would be executed with unimaginable speed, efficiency and agility and that would further result into a rapid stream of unimagined products and services based upon technology break through ensuring edge to America's competiveness and economic health for several generations[8] .

Socrates generation I was selectively used as the foundation for the U.S. government's highest priority programmes such as Strategic Defence Initiative, the Stealth Project, Super Computers, Tele presence and Integrated Circuits. These initiatives achieved impressive results to demonstrate the supremacy of American competitive edge[9]. The project developed a computer based "Tech Space Map", a tool providing a precise and detailed representation of current and emerging technologies. This was used to develop technology strategies for high priority government programmes in the 1980' and it led to investments that resulted in digital revolution of the 1990s[10]. Reagan, an opponent of expanding bureaucracy, proposed creating a new organization for the project with the responsibility of supporting U.S. government agencies and commercial sector in their endeavor to work together in a self-determined, highly symbiotic fashion so that technology and full range of other resources throughout the U.S. would be utilized in a highly coherent but flexible and independent fashion all towards increasing further the competitive edge of the U.S. and all its private and public organizations. However, the executive order proposed could not be finalized before he demitted his office. His successor, President Bush, abolished the project Socrates altogether for reasons which have not surfaced in available literature. There are speculations that the project was relabeled as Industrial Policy (IP). However, IP did not achieve or establish the desired level of co-ordination as was envisaged by the Project Socrates[11]. In the real world the

[8] The Daily Caber, http://daily caber.com, An Unfinished Legacy: President Reagan and Socrates Project

[9] Excerpts from Ervin Ackman's book, "President Reagan's Programmes to secure U.S. leadership indefinitely: Project Socrates" academia-edu M874296

[10] Ronal Reagan had it Right; Bring back project Socrates, by Mike Sekora, Manufacturing and Technology News, June 30, 2010

[11] Op. cit 9

installed wisdom and installed capital would not give up easily when threatened by new idea seeking to lessen their influence. Therefore, the role of the economic institutions and the corporates who were to lose their influence in case the recommendation of Socrates Project were allowed to be incorporated in the policy frame work for growth; cannot be ruled out. Thus the economic based planning was to guide the 'Industrial Policy' and adequate flow of investments to strengthen the economic assets to facilitate the deployment of emerging technology did not come by coherently.

Concern about persistent weak performance of the U.S. economy following 2008-09 recessions have been expressed largely in terms of debate over the right combinations of monetary and fiscal policies rather than going in to the aspects if underinvestment in productivity enhancing assets, especially technology.

Undoubtedly, the long term growth paradigm would be drawn by a set of fiscal policies, but these policies must be investment oriented and transcend many business cycles. In contrast to stabilization policies, the emphasis must be on investment in a range of productivity enhancing technologies, as opposed to the traditional and current reliance on an investment component that focuses largely on conventional economic infrastructure such as transportation networks. While such investment projects are having a positive impact and are essential for an economy with a deteriorated traditional infrastructure, the scope and magnitude is inadequate for a long term growth strategy. The strategy of investment in productivity enhancing technologies must be based on growth model that reflects the increasingly complex and technology intensive nature of global competition. The development and utilization of technologies on a scale large enough to attain significant global market share for domestic industries require investments in a number of other categories of assets such as human capital; channel for diffusion of technology and business knowledge to firms; incentives for capital formation; intellectual property protection; and modern industry structure incorporating co-located and integrated supply chains. The policy message is that only the most efficient existing or newly created economic assets will be viable in future. To

survive, companies, industries and entire economics will have to become more productive by assimilating existing technologies and developing new ones[12].

India took to technology based planning in strategic sectors associated with Nuclear energy, Space, Ocean Science, Biotechnology, Missile development.

The gains in these sectors have been spectacular. Investments made during the implementation of Green Revolution Technologies would also qualify to be included in technology based planning. In the digital world of today being impacted by advancing technologies, India would be required to extend the concept of technology based planning if it wants quantum leap to match its global competitors and regain its rightful status of economic and strategic power. As brought out in DN 2014/3, India has been caught napping in assessing the impact of oncoming technologies like 3D printing and thereby has delayed investing in creating appropriate economic assets specific to the technology. There are other advancing technologies as listed out in DN 2014/3, which have proven potential of economic exploitation and strategic value addition. Technology based planning would obligate that there is a mechanism of assessing such technologies and means of adapting such technologies within the country with indigenous innovation and initiative for their diffusion to the firm levels and schemes for creation of skilled manpower as appropriate reinforced with entrepreneur development programmes. Technology based development would be requiring that there is automativeness in the entire system of government, private sector and the educational system to strategise in tandem so that paradigm shifts that are required with the onset of new technologies happen engulfing all through the production chains with readjusted inputs for optimum outputs expeditiously. As the world's economic development becomes more and more dependent on advancing technology; the technology cycle for a set of technologies would be shrinking and thus all the participants in economic growth would need to be on alert without the luxury of a respite. Indian planning exercise has to be beyond the

[12] Beyond the Business Cycle: The Need for a Technology–Based Growth Strategy, Gregory. Tessey, Economic Analysis Office, National Institute of Standards and Technology; February 2012

pale of fiscal and financial parameters and move towards continuous capacity building exercise of acquiring technologies and creating appropriate economic assets including manpower. National Accounting Standards would be under constant review to make the entire exercise accountable and also debatable from cost benefit point of view.

As the technology based planning advances many concepts rooted in economic theory of growth as summarized by Kuznets in preceding paragraphs may require to be reviewed extensively particularly which call for economy of scale and building of conventional infrastructure. Technology may dictate investment in developing e ways rather than high ways; jobs may be available near home and thus movement in search of jobs may change in pattern. Huge reduction in marginal costs in music industry, publishing industry and entertainment industry has been a reality through networks enabling millions to share these products without paying the producers and artists. Similar networks are now beginning to reshape energy, manufacturing and education. Cost of capturing solar energy and wind energy is fairly low once the capital costs are brought down with the help of technology. The phenomenon of lowering marginal costs is penetrating in the manufacturing sector with the spread of 3D-technology. In education sector, millions of students are benefiting from open on line courses; the content of which is distributed at near zero marginal cost. The economic potential of internet of things is already within the grasp of these who have skills of mining the 'big data' thrown up by the "Internet of Things" which lowers the marginal cost of producing and sharing a wide range of products and services to near zero; just as they now do with the information goods.[13]

The concept of lateral power around distributed renewable energies that are found everywhere and are, for the most part free-sun, wind, hydro, geothermal, heat, biomass and ocean waves and tides. It is technically feasible to collect dispersed energies from millions of local sites and bundle and share with others over a continental green

[13] Information Explosion, Challenges and opportunities, ISID DN 2012/09, isid.org.in

electricity internet to achieve optimum energy levels to maintain a high performing sustainable economy.

Internet of things has democratized information while internet of energy would democratize energy. The startup cost of business would get minimized with the additional advantage of starting manufacturing locally suiting the local taste and needs without depending on far away situated firms and factories and their distribution network.

China, United Kingdom, Netherlands, Italy, U.S. France, Kazakhstan etc. have already taken preparatory steps and committed funds for bringing about the Third Industrial Revolution (TIR) rooted in integrating "Internet of things" and "Non-Conventional Energy Network". The strategy of TIR has also been embraced by UNIDO and has been commended for implementation[14].

India has also started working on a plan to ensure half of all homes in major cities receive some power from solar or wind energy by 2019 emulating Germany where half of the homes have roof top solar power systems. Gujarat implemented Jyoti Gram Yojna that provides 24x7 Power to each household. The scheme depends on solar, wind, biomass and waste energy[15]. If implemented, India would be joining group of nations joining the third industrial revolution. Germany is already ahead to test the introduction of energy internet that will allow tens of thousands of German businesses and millions of home owners to collect renewable energies on site, store them in the form of hydrogen, and share green electricity across economy, in a smart energy internet. Entire communities are transforming their commercial and residential buildings into green micro-power plants. More than 1 million buildings in Germany have been converted into partial green micro-power plants. Sophisticated IT software, hardware, appliances and

[14] The Third Industrial Revolution: How lateral power transforming energy, the economy and the world; Wikipedia

[15] Green energy to power over 50 % homes in big cities, Chetan Chauhan, Hindustan Times, New Delhi, June 09, 2014

vehicles are being developed that will merge distributed internet communication with distributed energy, to create smart buildings, infrastructure, and green mobility for the cities of the future.[16] Planning of TIR would thus necessarily require a wholesale reconfiguration of economic infrastructure in tune with the requirement of the emerging technology in order to take the economic growth to next level. Such an effort would require technology based planning and investment initiatives would be towards creating appropriate assets enabling the reconfiguration of the economic structure. Such investments would be towards renewable energy technology on an unprecedented scale; convert millions of buildings into green micro power plants; embed hydrogen and other storage technology throughout the national infrastructure; laydown a green energy internet and transform automobile from the internal combustion engine to electric plug-in and fuel cell cars. The new high tech workforce of TIR would need to be skilled in renewable energy technologies; green construction, IT and embedded computing, nanotechnology, sustainable chemistry, fuel-cell development, digital power and grid management, hybrid electric and hydrogen-powered transport and hundreds of other technical fields.

Entrepreneurs and managers would need to be educated to take advantage of cutting edge business models, including distributed and collaborative research and development strategies; open source and networked commerce, performance contracting, shared savings agreements, and sustainable low carbon logistics and supply chain management.

The rapid decline in transaction costs through the outset of the TIR would be leading to democratization of information, energy, manufacturing, marketing and logistics, and the

[16] The Third Industrial Revolution: How the Internet, Green electricity, and 3-D printing are ushering in sustainable Era of Distributed Capitation

ushering in of a new era of distributed capitalism that would change the very way we think of commercial life[17].

India has distinct advantage of massive young manpower capable of being reoriented to take up the challenge of being economic assets to take advantage of the advancing technologies as the leadership in government, business and civil society join together to take up technology based planning overcoming the installed wisdom and installed capital. Technologies on the horizon ensure inclusive growth in decentralized setups democratizing the development process.

[17] Ibid