

Presentation by Anil kakodkar in the Plenary Session on “R&D for value addition”

Thank you Dr Vijay Raghavan. Let me first express my gratitude to the organizers for this opportunity to be here. What I intend doing is to quickly share some thoughts on where we go from here in terms of mobilizing research and development capabilities for value addition as the title of this session indicates and what is it that we need to do to make India a technologically advanced country. You will agree with me that this is at the core of sustained or sustainable economic progress of the country.

Clearly we have a strong foundation in S&T and the theme which I want to place before you is how we can leverage that foundation and move further in terms of economic growth of the country. Growth in economy, and we know India is moving forward in terms of economy, is driven by many factors. Different people look at it differently. Business people will talk in terms of raw materials, technology and finance or investment to take a project or a programme forward. That is one way of looking at the growth of economy. To my mind, in more fundamental terms, the economy is driven by resources and the ability to leverage them. India has been at one stage very rich in raw materials. Both dug out of the ground as well as produced on the ground through agriculture. And we used to earn a lot of wealth, by way of exporting these raw materials. Even now it occupies a significant component of the contribution to the economy. The second resource is our large youth population. People do work both within the country and outside and that contributes to economy. Higher the capability of people, higher is the rate of contribution. We know, we have this advantage of demographic dividend and so we have a great opportunity in terms of demography driven economic progress. This to my mind is the main driver of our economy today. The third resource, which is the most important in the current era, is about knowledge. We know, we are in the knowledge era. Knowledge is now the most important driver for economic progress in many countries particularly the advanced ones. Given our demographic dividend, we can hugely benefit from embracing the knowledge era through knowledge empowerment of our human resource. This would mean enhancing our capabilities in R&D and its translation into new product and processes that benefit our economy. Rural areas where two third of our population lives, need special attention in this regard. I think at the current stage of development of our country, we should look at all the three modes of growth in economy and S&T of course has a contribution to make in each one of them.

Now for real growth in economy, we need to explore every opportunity for value addition. Clearly there are a large number of areas where one could talk about the value addition. To be able decide on areas where we should focus our attention; I think the best way is to look at the major items of export and import. And so if you see the list

of items on the top of the table both in terms of India's export to other countries as well as in terms of what we import, you will find that many of them belong to the same category. For example take the case of iron and steel, we import something to the extent of 11 billion dollars equivalent and we export something like 9 billion dollars. We are rich in iron ore. Our iron ore is one of the best in quality. We also have a rich legacy in steel making. So I would have imagined that our exports would be much larger than imports. Or for that matter imports should be minimal. Competitive value addition capability in such areas would clearly make a big difference to our economy. This is where we need to focus our S&T contribution on. There are of course areas where we have done well. Take for example the pharmaceutical or clothing sector, the country has done very well. But there are a larger number of areas where we need to enhance our export compared to imports and those are the areas according to me where we should primarily focus our R&D efforts on.

There are a few other items where I would like to draw your attention in this context. I am associated with TIFAC which is one of the organizers of this meeting. TIFAC is currently engaged with the problem of Guargum. India produces about 80% of Guar beans, a fairly draught tolerant crop. Guargum and its derivatives have several applications in sectors like industry, food, pharmaceuticals and cosmetics. The demand for Guargum shot up consequent to rapid growth of shell oil and shell gas production primarily by USA through adoption of horizontal drilling and fracking technologies. As a result USA has become the largest hydrocarbon producer in the world. Guargam and its derivatives play an important role in this process as a lubricant and so the demand for guar beans, primarily an Indian farm produce, went up and our farmers started exporting a lot of this material abroad. A patent search related to value added products from guar beans revealed that despite India being around 80% producer of this crop, we hardly possess any significant IP in this area. So much so that some of our raw materials now go to third countries for value addition before reaching their destination primarily in USA. It is clear that we need a better connect between our industry, agriculture and S & T so that as a country we en cash such opportunities. Today we in fact may be running the risk of having lost the opportunity which other countries may well be exploiting at our cost. We must correct this situation and maximize value addition within the country. Done successfully through appropriate S&T inputs, we can bring better benefits to our farmers, activate a whole set of industrial activity and make a much larger contribution to our economy.

Ilmenite is another example where there is a big opportunity waiting to be realized. We all know that titanium is a very important metal which has many uses in strategic as well as non-strategic domains besides its oxide being the base for paint industry. Alloys made from this metal can be stronger than steel with weight slightly

higher than aluminum. Further the material is highly corrosion resistant. Ilmenite from which titanium is produced is available in plenty in our country. We are exporting large quantities of ilmenite without much value addition. Thus although this wonder material is rapidly gaining in importance and we have large resources to produce this material we are simply exporting them without any significant value addition. The value addition has been eluding us. We have a small plant in Kerala essentially to meet strategic requirements. But for this endeavor to be commercially successful in the global market place you need to set up large capacity plants and for some reason that has not happened. Why? Because titanium production is energy intensive and energy costs in our country are high. Also the environmental burden arising as a result of this processing, particularly because such plants have to be located closer to the coast, is a major challenge. Not that the technology that addresses these challenges has not been developed. There are labs in the country which have developed this technology, not only to process ilmenite but also red mud which is a waste arising out of aluminum processing and there are huge red mud dumps in India and abroad, it's a global environmental problem. This process has been developed in a company in a private sector. I can also name the company. It is Garda Scientific Research Foundation. They already have set up a pilot plant to test the process. The energy consumption is much lower and the process is environmentally friendly. That makes the process very competitive to the extent that it has the potential to impact the global market. As a nation we should jump at this development, reinforce the efforts and encash the opportunity. For this, we need a particular ecosystem where different players can come together irrespective of whether they belong to public or private sector. The ideas are not a monopoly of a particular sector. They can come from anywhere and I think as a nation, we should have the capability and ability to get all of it together and realize the opportunity.

Rare earths are again a classic case. More that 90% of rare earth resources are in China. In India we have significant rare earth resources primarily because rare earths are associated along with thorium. We have been processing rare earths as mixed chlorides. You might have heard the story that China initially captured the rare earth raw material market by dumping, in the mean time they learnt and perfected the technology for value addition. And then they started dumping the processed rare earth products and tightened the export of raw materials. They literally if brought the world on its knees. All big countries had to reorient their strategies with respect to rare earths. Some of them are still recovering from the shock.

It is clear from these and several other examples that we need to leverage our S&T capabilities not only to link research to technology products but also to focus these efforts in areas of large market opportunities both within the country and globally.

This would need demand driven competitive research and a conducive policy environment to facilitate market entry. We need to cover a lot of ground in both these areas.

The next point that I wish to make relates to the issue of creating a right ecosystem that promotes new entrepreneurship or new start ups to bring out new products on the basis of knowledge created in our higher education systems. This is how globally competitive technology products can be created. That is the route to superior market advantage for a country over others. Both, higher education institutions as well as the ecosystem in which they operate are important for this purpose. To understand this matter better, let us look at the data on R&D investments made by various countries. Indian R&D spending is actually larger than R&D spending of countries like Israel, Canada, UK, Sweden and some others. These are the countries which supply technology products to India. Further in terms of average spending per full time equivalent worker in science and technology area, we in India are in fact comparable with the best in the world. The question then is, why we are so much behind these countries in terms of value generation through new technology products. As matter of fact, at one stage our IITs were ranked fourth in the world, ahead of Harvard, in terms of number of venture capital backed new founders. They attracted funding of around 3 billion dollars. That was in US. It is important that we create opportunities in India so that the much larger number of IITans and alumni of other high performing institutions in the country can also similarly perform. IITs and similar other institutions have started doing quality research and new product development. We can make a big contribution in terms of knowledge products to cater to the market needs here and abroad provided we create the requisite eco-system. With growth in high quality institutions focussed to translation research and a right innovation ecosystem there is no doubt that India would soon be a technology power house for the world. Now that's the main message that I want to leave with all of you. Happily, this transition has started happening.

Apart from a supportive policy environment, I think it is very important that we have coexistence of quality education, skill education, high quality research, greater support to translation of research into products, an environment that nurtures entrepreneurship and a very strong industry / society engagement. All these elements must be present on our university campuses and in our higher education institutions. Thus on one side we support individual research for discovery of new knowledge and at the same time we have a strong group research activity and the supportive ecosystem where we can move towards commercial products. Research parks, industry incubators, venture studios etc. should become integral parts of our university

ambiance. All technologically advanced countries already have such a framework. For example China has some 300 research parks. We should not be lagging behind.

So we need to build an eco system where we have colocated or proximately located institutes with complimentary capabilities being able to network together to produce specified deliverables. For this purpose we need to have mobility of faculty, researchers and industry people and also society professionals to move across the domains. For some one working in a university, having carried out some development and now wanting to demonstrate that in an industry or a commercial place, he or she should be able to spend a couple of years there without being uprooted from the university and come back. I know it happens in some places, I think we must make that happen as an universal feature.

Further the research in our institutions must be taken to a high level. We must shed compartmental view of fundamental research and applied research. Fundamental research which is the key to creation of new knowledge also leads to cutting edge technologies and at times new disruptive technologies provided we have the ecosystem to promote such a translation. One element for such a thing to happen is to have PhD level research in engineering and technology particularly at the interface of basic research and technology. Applied research of course is the work horse for growth and evolution in technology. Thus we should look at them all together and they must co exist. Clearly we need people with right mind set to sustain an ambiance that would promote and sustain such broad spectrum R&D. Such attitudes need to be inculcated as a part of human resource development. Nurturing the spirit of innovation among students should start right from the school level.

Nurturing excellence in areas as diverse as teaching, fundamental research, technology development and entrepreneurship under a common roof is a challenge in itself. The institutional value system that would go to asses the performance of different types of individuals should lead to a universally accepted yard stick for measuring excellence. This should accommodate the fact that we need to give importance to all the domains that together lead to realisation of institutional goals. Simply stated this yard stick should be based on the contribution to institutional objectives, impact on peers, down stream partners and other stake holders.

I now wish to turn to another aspect of R&D for value addition. Two thirds of our population lives in villages. Today per capita income in rural areas is around half of per capita income in the urban areas. Most of this is based on agriculture and allied activities. Agriculture which was the main contributor to our economy at some stage is relatively a very small contributor today even though two third of our population is dependent on it. On the other hand there are significant opportunities for value addition

to agricultural produce. Further in the emerging knowledge economy, which favors decentralization and democratization, the spectrum of economic activity in villages can become very broad. Thus given proper knowledge, training and opportunities with access to cutting edge technologies, it should be possible to significantly enhance value addition in villages with attendant growth in rural economy. Considering that the larger part of our population lives in villages, such a paradigm would contribute to national economy in a big way with much reduced urban – rural gap.

What we need is essentially to ensure that all these people have access to empowering education. Education which will enable them to understand the principles of science and technology, and also empower them and make them capable to implement those principles so that they can engage themselves in the value addition activities at a much higher level. For this purpose we need to create knowledge centres in rural domain with vibrant research and human resource development programs of relevance to the neighbourhood and link them to socio-economic development activities in the region. A pilot experiment to try out such an approach is currently in progress at Gopalpur near Pandharpur in Maharashtra.

Simply stated I think it is important that we should embed high quality education and research in rural domain. I would go the extent of saying that if you have to set up an university or a research institution, locate it in rural area. The conventional wisdom for sighting such an institution will say that we should locate it in a city, we should locate it in a place where there is good connectivity, we should locate it in a place where there are opportunities for spouses and facilities for education of children. These are very important issues and so I would say that if it costs you say 500 crores to set up a university infrastructure in a city or in an urban area, spend another 300-400 crores but create that infrastructure in a rural area and address all these requirements like connectivity, good infrastructure, jobs for spouses, good education for children and so on, but focus the work, the research and development of that university to the needs of the surroundings. Building on what Dr. Kalam used to call PUARA 'Providing Urban Amenities in Rural Areas', we are talking about a CILLAGE that is 'best of city in a village' adding the knowledge and technology based development dimension in the rural context.

A CILLAGE, apart from supporting academic and research activities focussed on rural development would also support capacity building and technology adoption by people in the area. Demonstration of technologies which can make difference to the livelihood of people in the neighbourhood would be integral to activities in a CILLAGE. CILLAGE would also support problem solving, technology up gradation as well as defining research areas of interest to the region. I am actually

convinced that you can do state of art globally competitive research addressing problems of rural areas. A CILLAGE would also have a number of outreach extension centres to engage with a broader domain. These outreach centres, CILLAGE and other modes of engagement with neighbourhood development together constitute a good innovation ecosystem in the context of rural development.

In addition to its active involvement in higher education and research, a CILLAGE can also make a significant difference to school education in the neighbourhood. In the Pandharpur experiment, a NKN node at the CILLAGE with long range broad band wireless connectivity to schools within 20-25 km radius enables the schools, students and teachers to benefit from ICT enabled education. Thus if you have an environment where you have a top class university carrying out relevant technology development, a lot of live technology demonstrations for people in the neighbourhood duly supported by broad band linkages between universities and people, you have an engagement of technology based development activities with school and college education in the area and a comprehensive innovation ecosystem in the context of rural domain, I see no reason why within 10 15 years; you can not see a major transformation where rather than people in villages wanting to move to cities, people in cities may want to go to villages because there are larger economic opportunities in villages than in cities. I think we should pay serious attention to such a possibility.

That would be a major dividend out of S & T for India.

Thank you.