New Global Agenda: Digitatlisation, Decarbonisation & Democratisation

by

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Let me begin by congratulating the graduates of the day and also their parents, because the parents have given them the best gift any parent can give, education. Education is the future after all. I want to congratulate AIT, for its silver jubilee, its 25 years of glorious journey. And now we look forward to 25 years of journey into the new India where you will complete the golden jubilee. I also hope that this Institute, which has scaled great heights of achievements, as was amply evident from our directors speech, will scale much greater heights, because human achievement has no limits and thus limitless journey is one that we shall be aspiring for.

I always believe in this: **education** imparts new knowledge, **research** creates new knowledge while **innovation** converts knowledge into wealth and social good. I do hope that this link of education, research and innovation will be strongly established in the coming 25 years and with such integration, AIT will truly become a world class institution.

There's only one more message I have to give you my young friends. I gave the 100th convocation address of Banaras Hindu University a month ago and the title of my talk was, **Dikshant** (convocation) is not **Shikshant** (end of education), the knowledge and skills that you have acquired and demonstrated are important but it is not the end of your education but the beginning. Therefore, you will always be a student even if you are graduating today. Knowledge is expanding at such a rate that in a couple of years your stock of knowledge will be obsolete, if you do not update yourself. So until and unless you continue to refresh and relearn, you will not be able to survive and succeed in this competitive world. So I hope this journey of learning, this Saraswati puja will continue forever.

The theme of my talk today are the 3-D's that will drive the global agenda. The first D is Digitalization, the second D is Decarbonisation and the third D is Democratization, meaning Democratization of access.

I was very happy to read an important line from the letter of invitation from the Director of AIT, which stated that the theme that AIT has chosen for this 25th year is “Sustainability through Technology”.

If you look at these three D's, the second D and the third D pertain to sustainability and the first D will drive both second and third D. Decarbonisation is a must if we are to avoid climate change. Democratization of access, means dismantling inequality so that we are able to establish social harmony, which is so important for sustainability of the society. Thus we are focusing on the sustainability of the planet as well as that of the society, without destroying either, and both of these can be very greatly influenced by technology. This is the topic of my talk: How we can use technology to make this happen.

Let's begin with digitalization, if you look around you will find that everything is happening exponentially in technology. We observe that the performance in technology is increasing tenfold but the price is rapidly dropping again tenfold. What are those new technologies? The internet of things, big data, artificial intelligence, machine learning, advanced robots, virtual reality, augmented reality, mixed reality, 3D printing, 3D visualization, mobile internet, cloud and block chain etc. are these technologies. Just to illustrate how exponential this growth is, here is one example. Take a look at the programs in sensor technology sensors during the years 2007- 2014. In just 7 years, the number of sensors has gone up by a factor of a thousand, the cost has gone down by a factor of thousand, the power required per sensor has gone down by a factor of thousand, the physical size of each sensor has gone down by factor of thousand, and the number of transistors per sensor have gone up by thousand. During just seven years, everything is changed by thousands. This is what I mean by exponential.

And this is great news for a country like India, because costs are going down exponentially. Because we are now having access to this new technology instead of waiting for another 10 years. Using this digital technology, we can create a radical transformation.

Digitalization is going to affect everything. We will have science 2.0 in which, we will contribute and take contributions from online journals, manuals, research papers, data discovery, information and knowledge being shared, an explosion of online tools, all research and knowledge will be accumulated together and change the way we view science.

Allow me to give one example which I am quite proud of. I was the Director General of the Council of Scientific Industrial Research. We were 40 Laboratories and 20,000 people. One of the programs CSIR launched was called “Open Source Drug Discovery”. Drugs were earlier being discovered by multinational labs, by scientists working in isolation. In this

program we created a web based open portal, which helped in co-creation. Can you believe that 130 countries with 7900 members were involved in co-creation with 40% of them being young students. Can you imagine so many students participating in drug discovery, which is an advanced research endears? This is thanks to the power of digitatlization.

Let's come to education. Education 1.0 was the Guru Shishya system. There was a Guru and Shishya and knowledge was not available for everyone, it was available only for the select. Then came education 2.0, what you and I have gone through, a broadcast system of education, assembly line model. But education 3.0 is going to be very different, because in this system, information memorization and brute-force recall will be a thing of the past. The brain will no longer be used for storage but it shall be used purely as a processor. All knowledge will be indexed, and will be available on internet. The smartphone that I am carrying has the power to capture all the knowledge that resides in Pune in various labs, within my pocket.

Before coming here, I was having a talk in the director's office. I said it would be a challenge for the faculty to keep ahead of the students, because the students are going to be more informed then the faculty, thanks to Google as their Gurus. I told him about my embarrassing experience, where I give a talk on a subject that I thought I knew everything about, and young students from 12th standard, asked me questions, 50% of which I could not answer. So I think this new reality implies that we are looking at new, hungry, inspirational, knowledgeable, young students and the faculty will have a hard time handling this. They, in turn, will have to change themselves to be equipped, and relevant in the new system of education. Because chalk and talk with their back to the students will not work, because the moment they turn their back, they will discuss that many of their students have vanished! We need new methods. Interactive learning, e-Learning, case studies, are just some of the new things we have to do.

Having talked about science 2.0 and education 3.0, let me move onto industry 4.0. Industry 1.0 was mechanization of production using steam. Industry 2.0 was mass production using electricity; industry 3.0 utilized simple digitalization. But industry 4.0 will use complex digitalization, with cyber physical systems, and there are going to be new parameters. Data is going to be the new oil, information is going to be the new currency, and artificial intelligence is going to be the new electricity. Look at AI, just as Industrial Revolution freed humanity from physical drudgery, AI will free humanity from mental drudgery. I'll give you an

example how AI will work. There is a very difficult Chinese game, called Go. An AI machine called AlphaGo was created by Google that could beat the 18-time world champion in March 2016. It achieved this ten years before its stipulated time. What is even more interesting is the move 37 in game 2 that the alphaGo made. Experts say that there was only one in ten thousand chance that a human could make It. That means machine learning has gone to an extent, where the machine is able to provide an answer, that human cannot.

Just like you look at the car that is following you in the rear view mirror, and then discover that it is closer to you than you think, similarly, the future is much closer to us than we think. Let me illustrate. A report by the world economic forum said, that by 2025, an artificial intelligence machine will be seated at the board of directors. This report came out in 2015. However, in reality in the year 2015 itself a company appointed an AI machine on its' board as one of the directors. Now news has also come out that this machine has been given voting rights when investment decisions are taken. This means that in the job situation has shifted drastically.

The Secretary of US Development of Labour is reported to have said that 60% of the students in senior classes will do jobs that don't exist today. So right now the challenge that education institutes are facing is how to train students for jobs that do not yet exist. There are five C's that are now going to be important in terms of skills in future. The first C is **Complexity**, our ability to deal with the second is **Critical Thinking**, third is **Creativity**, fourth is **Compassion**, and the fifth is **Co-Creation**. Allow me to explain.

First, Complexity. Dealing with **complexity** is going to be very important. The world is VUCA, which mean volatile, uncertain, complex, and ambiguous, whole range of things happen which impact every situation. So our thinking cannot be linear, it has to be nonlinear. **Creativity**. It is obvious, it has to stay with you forever. Third is **critical thinking**. The fourth is **compassion**. Emotional intelligence is going to be very critical. There is a prize called the Queen Elizabeth prize of Engineering, which is like a Nobel Prize in engineering. I was in London few weeks ago to attend jury's meeting. I was interviewed on what would be the future engineer; I said an engineer without empathy is no engineer. Engineers of tomorrow have to use both sides of brain, left and right. Engineers of tomorrow have to be solution engineers, who solve the problem of society. Finally, **co-creation**. There is learning by doing, but more important will be learning by co-creatiion. And not just a men and a man, but man and machine. These are the five C's we have to develop.

Having dealt with first D, with digitalisation, I come to the second D decarbonization. I remember I was the president of Indian National Science Academy. Lord Martin Reese was the president of Royal Society. He gave, what was called, Blackett Memorial Lecture. You know what was the subject of his talk? “21st century, the last century”. And why did he say it? He talked about the looming disasters because of the ravaging of biodiversity, ozone layer depletion, climate change and so on and so forth. And we are at a tipping point. Because if you just see what is happening in a world with thousands of coal fired power plants, nearly 2 billion cars and trucks and billions of tons of coal, oil and natural gas mined and combusted, it is no surprise that some 40 billion metric tons of CO_2 are discharged into the atmosphere annually. The oceans and the plants of the world absorb some. Yet concentration of CO_2 in the atmosphere inexorably rises every year. Climbing past 400 ppm as compared to 280 ppm before the industrial revolution. Now I will tell you the significance of this 400 ppm. You know where is the tipping point, when the world will be in a real crisis? When we have 2-degree centigrade rise of average world temperatures, above the current level. And when will this happen? When we have 450 ppm of CO_2. And we have already reached 400 ppm. So the window is really very small.

We desperately require technological breakthroughs. And to have any hope to slow down this change and to reverse it, it will require energy efficient and some game changing technological breakthroughs. And of course you can see that we are making progress. If you look at technological advances making clean energy sources such as solar, wind, etc. they are becoming more efficient and cheaper, leading to steady growth in deployment. But increase in use of renewable energy, is still being outrun by even faster increase of fossil fuel consumption. Economies of developing nations like China and India will depend on growing use of energy. Developed nations such as America are major energy consumers. And you’ve seen the stand that President Trump has taken. It is worrisome that he doesn’t believe in climate change. And it is a challenge. I think, therefore, that entire humanity as such is going to face this challenge.

Lets not talk about the world. What is India doing? I am really happy to see the progress we are making. During the last four years, for example, our renewable energy production has doubled to about 70 GW. Our solar capacity has gone up by 8 times, from 2.3 GW to 22 GW. Our wind energy has gone up by 1.6 times. So that is wonderful. This is also backed up by technology and new policies. For example, the case of LED. I still remember the

speech that our dynamic minister Piyush Goyal, gave on 15 Nov 2015 during the Earthcare Awards function. I was there as the chairman of the Earthcare Awards Committee. He said that the Government wants to bring down the LED prices from Rs. 450 to Rs 45. I'm very happy it has been brought down to Rs 35 and not 45! As many as 32 Crore LEDs have been supplied by the Government. LEDS have been given in Public private partnerships. Electricity bill has come down. In terms of making carbon footprint smaller we have achieved great results due to introduction of LEDs.

But our pursuit has to be relentless. It will be always technology plus public policy that will go together. Look at fuel cells for example. Under the program that I launched as DG of CSIR, namely New millennium Indian technology leadership initiative. Today we have fuel cells that are better than the best in the world in terms of performance and also lower costs. That is better as well as cheaper. But having developed these indigeneously that we require a policy to adopt it. For example take telecom towers. They're all run on diesel generating sets not fully but wherever required? And they burn around 2 billion dollars worth diesel emitting particulates. Fuel cells will emit water, not solid particles. Can we create a policy to replace all the diesel generating sets with fuel cells? Yes, we can. So this technology that India has developed, if it is backed up by policies we can actually achieve something that is game changing.

Now let me come to the last D. I talked about digitalization, I talked about decarbonisation. Now let's talk about **democratization of access**. Why is it important? Our income ineuqlities are growing. So we must bring access equality despite income inequality.

When do you see that? India has now 1.2 billion mobile phones. So just as somebody who is driving in a Rolls Royce has a mobile, somebody who is sweeping a street has a broom in one hand and a mobile in the other! That is what I mean by democratization of access.

And that is happening in big way. Look at Jio for example. You know we used to take pride in missed call. We thought that was the great Indian innovation. But what is a missed call? You're not paying for it. The telecom company is paying for it. And we took pride in that. We don't have to do that anymore. We have zero priced voice call from Jio right? So India has moved from jugaad of missed calls to a disruptive systematic innovation of zero priced calls. Data it is available for Rs 3 per GB. The cheapest in the whole world.

The title of my new book is “Leapfrogging to Pole Vaulting”. And I’ve gifted a copy for the AIT library, so whenever you get time please have a look at it. So what was the idea there? I had a discussion with Mr Mukesh Ambani. I’m the Chairman of Reliance Innovation Council for the last 11 years. There are members of the Council, who are Nobel laureates. Reliance has this motto of growth is life. And once Mukesh said `Doc, we must leapfrog’. I said do you know why the frog leaps? He leaps because he is afraid of the predator. And he jumps a few feet. We don’t want to jump a few feet because we are afraid of our competitors. We should pole-vault. The size of the poles determines the size of one’s aspiration and how far you can go. And Mukesh, being an extraordinary visionary leader, fully agreed. In fact a programme called `beyonders’, who are leaders, who are capable of thinking beyond the realms of current possibilities was created, leaders, who are capable of pole vaulting to great heights and great distances. And you will find a chapter on building such pole vaulting leaders in the book.

And Jio has helped India pole vault from 155th position in mobile data transition to the 1st position! And more pole vaulting is on cards.

Let’s turn to third D, namely Democratisation of access.

I’ll give a couple of examples. In my mother’s name, I have created what is called as `Anjani Mashelkar Inclusive Innovation Award’. Inclusive innovation means innovation that works for all. Doesn’t exclude anyone. This is the 8th year of this award. One award went to Mihir Shah. Just a young man in his early thirties. He was concerned about breast cancer, because there was a death in his family. He created a cancer detection test that is noninvasive, it is called ibreast. It can detect the presence of cancer by just moving a handheld machine around the breast. The cost of this scan is not 100 dollar it is 1 dollar! They have partnership with GE Life Sciences. They are going to 25 countries and screening 50 million women. An idea born here demonstrating how high technology, which can be made to work for the poor leading to democratization of access.

Then another award winner, Rahul Rastogi. His father had a challenge and what was that? Cardiac issues. So he had to be taken to the hospital, in the middle of the night. Then you lie down, there is a nurse who it takes your readouts. You spend half an hour. Rahul said why? And he created a portable ECG. Half the size of a Smartphone. You put your two thumbs on the despite for 15 seconds. Put the device above the heart thrice for a 15 second

duration. Repeat the same set of movement below the heart. And if you've downloaded an app called Sanket, You will have your ECG on your smart thing within 3 minutes. So there you are. ECG not in 30 minutes but in 3 minutes. ECG not for Rs. 200 but Rs. 5! And for buying Sanket, you can go an Amazon, type Sanket and you can actually buy it. Making high technology work for the rich is very easy. Making low technology work for the poor, very easy. Making high technology work for the poor is what leads to democratization of access with high quality.

The examples that I gave you are just illustrative. There are a variety of examples on how technology can be made to work to create democratization.

So may young friends I've talked about the 3 Ds. First is digitalization second is decarbonization and the third is democratization of access. All of these will create a better world.

You would say, Dr. Mashelkar, you're now 76. You must have learnt something in life. Tell us about 5 lessons that have helped you.

So I will tell you 5 Mashelkar mantras which have worked for me. I hope they will work for you.

The first, your aspirations are your possibilities. Keep them high. If you aim at Everest you'll actually reach Kanchanganga. But if you aim at Kanchanganga, you will not even reach Hanuman Tekdi. So keep aspirations high.

The Second is, and particularly to the young generation I have to mention this, like instant coffee there is no instant success. There is no substitute to hard work. In my life I've worked 24x7 day after day, week after week, month after month, year after year.

I landed from Goa to Mumbai at midnight yesterday, drove from Mumbai to Pune, reached Pune at 3 o'clock and here I am giving the Convocation address. So hard work has no substitute that's the second point.

The third point is that perserverance pays. It is always too early to quit. Quitters are no winners and winners are no quitters.

The fourth lesson is the following. You keep on knocking on the doors of opportunity. They don't open. Forget about that. Create your own doors. If you can't find a way, create your own way.

And the last point. The fifth. The most important. There is no limit to human endurance. There is no limit to human achievement excepting the limit you put on yourself.

Day before yesterday, I was with Manohar Parrikar, the Chief Minister of Goa, actually having enormous challenge being in a very advanced stage of cancer. I saw him and we talked and he was still talking about the distant future. He's on a drip but with that he presented the budget in the assembly! Incredible. We should be proud that this is a story of great determination, great courage, there is no limit that he has put on his mind.

Young Arunima Sinha was thrown out of a train, she lost her leg in 2011 and you must have seen the news that in 2019 she climbed Mount Everest. She didn't give up. So there is no limit to what you can achieve in your life. And the journey on the ladder of excellence is limitless. The only limit will be what you put on your own mind.

So my dear friends, all my best wishes to each and every one of you for the great journey on that limitless ladder of excellence and achievement, and achievement not just for you, not just for the family, but for the society as a whole and for our beloved nation.

Thank you very much.