

NITI Aayog Lecture Series

Technology for Transformation

Bill Gates

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Well, thank you so much for that kind introduction. Prime Minister Modi, members of the Union Council of Ministers, senior government officials – it's a privilege to be here with you today. I was excited when I received the Prime Minister's invitation to deliver the second talk of the NITI "Transforming India" Lecture Series.

As the Prime Minister remarked when inaugurating these talks, a long administrative tradition has served India well in many ways. He also noted that we live in an age where change is constant. Drawing on the best of India's democratic tradition, while embracing these changes, is a powerful opportunity for India. Hopefully the observations I share today can illuminate some of these big shifts and the implications for India, both challenges and opportunities. I don't have a perfect crystal ball, so consider my thoughts for what they are. The observations of an entrepreneur engineer, business leader and now a philanthropist.

Prime Minister Modi asked me to speak candidly about the challenges India faces and how technology can enable and accelerate India's transformation. Although I have visited India many times over the last two decades, there is no doubt, I am very much a novice when it comes to understanding India. India is an exciting and complex place, perhaps even for the people who live here. So my comments are not dictating but rather advice – advice from a friend who wants the best for India.

My very first trip here was for Microsoft. I was amazed at the great engineers I met, and at that time it started a wonderful success where India became a huge contributor in the IT sector. Today, of course, Microsoft has over 6500 employees here and our third CEO Satya Nadella was born in India. I continue to visit India even as I was making the transition from my full time work to be with the Gates Foundation. In fact, it gave me an opportunity to visit more and to get to more cities – not just Bangalore and Hyderabad but many other cities as well. And I saw many great opportunities. I saw a commitment that this government has to tackling inequity.

One of the first things that our foundation did in India was a partnership called Avahan, with the government, on HIV prevention. And that was a very complex program because it involved reaching out to people like sex workers and creating communities and encouraging them to practice safe behaviour. There was a lot we learnt in that program and, in fact, it was very successful and over time it was handed over to the government. That successful collaboration led to many others in different states like Bihar and Uttar Pradesh and many working at the federal level. Most of the work has been focused on maternal and child health, nutrition, sanitation, financial inclusion and agriculture, all areas where we see big successes emerging from India.

Perhaps the program I feel the most proud of – and India should as well – is the elimination of polio from India. Many people thought this would be the most difficult country in the world to get rid of polio, given the size and the number of kids who move around. But in fact India did a great job and it hasn't seen polio in quite some time. And that energised the world's polio eradication program. In fact, we are hopeful that the very last cases of polio will be some time next year. And then, after a three-year period for certification, it can finally be declared as the second disease to be completely eradicated joining smallpox.

India is a huge priority for our foundation. In fact, we do more grants here than anywhere, except in the United States itself. Since 2010, we've granted over a billion dollars here in India. And that's a number in the years ahead where we expect to see continued growth.

Let me now focus on the global trends and what I see in the world. I am very optimistic about India's future. But every country in the world, including India, is subject to these trends. These are powerful shifts.

The first is that the global economy is in flux. The assumption that global trade would continue to grow as a percentage of the world economy no longer appears to be true. In fact, global trade is recently declining somewhat – and so to sustain a country level growth of 7-8%, India will have to both increase its share of global exports and take steps to expand its vast internal market, whether it's inefficiencies, land issues, labour issues, tariff and taxes, there is a lot that can be done. It's fantastic that you took the step to change the GST, but that is just the beginning.

Another trend is what's going on in energy. We all realise today that both on a local and global basis, hydro carbon energy can create problems. Now we need to innovate – either innovate to make improvements in hydro-carbon energy both in terms of reducing the local and global pollution and bring in other forms of energy. This is a super important area for innovation.

Then we have the trend of climate change. Of course that is connected to the world's energy system and it will have big implications for food security. Given that India has 55 to 60% of its crop area rain-fed, the climate change leading into higher rain forbear ability is a huge challenge. It really underscores the need to innovate to help more resilient crops and greater productivity as well as rationalising more water use.

Next we have the change in burden of disease. India, like many developing nations, faces a twin set of epidemics. First, we still have communicable diseases. But already the rise of diabetes and neurological diseases are creating a burden for your health system. We also have possible surprises in the health area. Either a naturally caused or an intentionally caused epidemic or the problem of anti-microbial resistance. In fact, the foundation has been doing disease surveillance recently and seen that the anti-microbial resistance problem is particularly troubling and only substantial innovation can avoid that problem.

Another trend which I view very positively is an increase in philanthropy. Now philanthropy will never be at the scale of government. And it is no substitute for government. But in many ways philanthropy and its diversity and its creativity can fund pilot programs in innovation that will create models for the government. I have been meeting with philanthropists all over the world and I am encouraged by the trends. More and more people who are very successful are giving their money away and even people with modest wealth are engaging in philanthropy. On Friday I will attend an annual meeting at the India Philanthropy Initiative where a number of families talk about how they do better at philanthropy, how to encourage each other not only to work together but to do even more. India has a great tradition for philanthropy through families like the Tatas, the Birlas, the Bajajs'. They have been doing great work for a long time. And more recently people like the Premjis, the Nilekanis, the Piramals, and Kiran Mazumdar Shaw are also doing very creative work. And so philanthropy plays a very exciting role funding both new research and pilots in a way that's complementary to the government.

The last trend is what's going on in the digital arena. Here we have companies like Google and Microsoft and many academic universities rapidly changing artificial intelligence. Computers today can see and understand language as well as human beings. That is a milestone that we only reached in the last few years. And so as devices, you have seen that artificial intelligence get created it will really change the market. Many of the manufacturing jobs that required fairly low skills will be eliminated by the automation that uses those technologies. And so although they still are great lessons to learn from the

industrial models that were used in east and south east Asia, this model will have to be updated. It will have to be a higher value added set of approaches pulling in the best of India's very strong IT sector.

It will be necessary to embrace artificial intelligence and cloud services even though there will be some disruptions to the job market. The need for retraining and adaption as this innovation accelerates will be greater than ever. I think it's important to embrace innovation. It is a little daunting to people that the world is changing at a pace unmatched in human history. In many ways India will have to shape the innovations in the world and come up with its own innovation because it has very unique circumstances. And I want to talk to you about ways that I think India can accelerate the amount of innovation taking place in the country. Countries that have strong innovation ecosystems will be best equipped to address not only their own domestic challenges but to build the products of the future.

Science has given us a lot more tools, and not just in the digital realm. We have things like gene editing that allows – whether it's in human health, animal health or plant health, to do really amazing things. We have much better medicines coming out of the deep understanding we have in biology. I am very hopeful and I certainly expect our foundation to invest a lot in breakthrough vaccines coming out in the next 5 to 10 years. We are hopeful to have a vaccine for Malaria, for Tuberculosis, for HIV. And these are huge innovations that will change the healthcare market dramatically.

Even in an area like sanitation, we are seeing that new technology can change things for the better. And we can use the digital innovation to change delivery. Often when we think about innovation it's just the magic new tool, the seed or the vaccine. But in fact digital innovation allows us to track the delivery throughout the entire system to see if that healthcare worker showing up. Are they doing a good job? We can call the citizen and see what experience they had. And so we are already starting to see a digitally driven supply chain, digital dashboards, a system that tracks what is going on in education in the best way. And India really is building a great foundation for these kinds of tools to take governance to a much higher level of quality.

Now let me address the key building blocks for India to drive forward this innovative economy. The first of course is the incredible force you have. You have a large and growing youth population with over half a population before under-25, and nearly two-thirds under-35. You have world class universities – not only the IIT institutions, IIM – but also an emerging groups of private universities. You have an incredible set of talented people and not just in the IT sector. You see that across many sectors. In biology and engineering, you

have a lot to build on. We see that in terms of the great businesses that are being built here. This afternoon I got to meet with entrepreneurs working in the health and agricultural sector and I was very excited to hear about what they are going to do to improve the quality and productivity in those two areas. Cultivating entrepreneurship is important and it's been a priority for this country. Prime Minister Modi's start-up India initiative is encouraging entrepreneurs and we have more venture capital than ever before. And of course you have the traditional hubs Bangalore, Hyderabad, Delhi with a lot going on. But not only those cities, many others are stepping up and creating that kind of environment for new companies.

Next we have what India's done to build a world class digital foundation. The popularity of the mobile phone, the digital bank accounts, they have been created under the PMJDY flagship financial inclusion scheme, and over a billion people enrolled in Aadhaar. Aadhaar is an interesting case. It's something that had never been done by any government before, not even in a rich country. And there were lots of sceptics. Sceptics about the financial viability, the technology, the citizen acceptance. But now you have something that is going to underlie all of your digital systems, whether it's banking, tax payments, tracking healthcare records, it is an incredible asset and it took a lot of bravery and good government leadership to pull that together. And so when we talk about this jam platform, that's the real thing and you're just starting to see what you can do with that in terms of government payments of all types, even been able to track patients and been able to connect the government and the private sector in terms of delivering health interventions including things like ongoing Tuberculosis treatment. The unified payment infrastructure that was launched a few months ago is another key element to make this come together. This shared infrastructure at the core of the payment system really is cutting costs for every provider and encouraging innovation and competition. The bill payment service will make it easier for people to pay utility bills and that is just the start of full digitisation. In fact, it fits very well with the theme of okay let's get as many payments as possible into that digital realm.

Another great asset are the companies involved in vaccine manufacturing and pharmaceuticals. Our foundation worked closely with the Indian vaccine companies because they are world class. Serum Institute, Bharat Biotech, and Biological E, are providing the majority of all the childhood vaccination in the world. And in this entire sector there is huge opportunity. The world needs breakthroughs to solve these diseases whether it's drugs or vaccines and we will need both of those. We've also seen recently in the world that we have to think about epidemics Ebola and Zika showed up and we didn't have the right tools. And more infectious pathogens like the flu which is transmitted between

humans would be catastrophic. So we need to come together and get the technology all over the world to be able to create cures for those epidemics diseases very quickly. And we also need capacity to make those medicines very rapidly when the problem shows up. A new public-private partnership called the coalition for epidemic preparedness has been put together and India through DBT is the first chair of the board and actively shaping the agenda. So it is great to see India stepping up to help out with what is the problem for all of us to be ready for even an epidemic that would be the worse than the last two that even so have caused lots of challenges.

Financial inclusion is a very key platform and it's interesting that banking has only been used by people who have lots of money. And part of that is the transaction cost has been high enough that small amounts of money, very small transactions simply haven't worked. The digital realm is where that can get solved. In fact, there are many problems that the digital realm can solve. But we want to give advice to people on saving. We won't be able to do that by having lots and lots of people. Putting it into digital form, having thoughts where they can give you advice, will help make – help people manage their finances in a better way. The bold move to demonetise high value denominations and replace them with new notes with higher security features is an important step to move away from a shadow economy to an even more transparent economy. And digital transactions really I think will rise dramatically here. In fact, I think in the next several years India will become the most digitised economy. Not just by size but by percentage as well. All of the pieces are now coming together.

One piece of this that we enjoyed consulting with the government on making sure it comes together in the right way is the pending roll out of payment banks. This for the first time really will mean that you have full currency capability on those digital phones. Once you have that digital infrastructure, the whole way you think about government benefits can be done differently. Now imagine some example that when your health system sees the breadwinner from a family become ill, that immediately you understand that you need to make a payment or loan to that family so that they don't miss a meal. Imagine being able to advise a farmer as he is selling his harvested proceeds exactly what he should set aside so that for the next harvest he can buy the best seeds and the fertilisers in order to have high valued output when the next planting season comes around. Imagine being able to take any excess funds and letting people invest those in mutual funds and other investment products so that individual households can participate in India's growing economy. Imagine being able to have sewing units that can be easily turned on and off as you make payments, thus making it easier to extend off grid solar energy systems in the communities no matter where they are. Over

time all of these transactions will create a footprint and so when you go in for credit the ability to access the history that you've paid your utility bills on time, that you've saved up money for your children's education, all of those things in your digital trail, access in an appropriate way will allow the credit market to properly score the risk, and therefore loosen up more money for investments not only in the agricultural sector but for all the entrepreneurs in the country. Now this vision of a digital financial platform does require vigilance to make sure that it works well for everyone. We have to make sure that people aren't taking on too much debt. We have to make sure they understand the fees. We have to make sure that our ranking algorithms are not working in a discriminatory way that doesn't let poor households participate. But all of these things are possible. Once it's in the software realm, once it's transparent, the idea of seeing what is going on giving appropriate advice to the consumers, all of that will be possible.

Next let me talk about education. The digital revolution has not yet changed education but it will. The idea that young kids can play on a low cost cell phone, try out their numeric skills and play games that even if they don't know of are helping them with their literacy. That's an exciting vision. The idea that a teacher will have a tablet that will help them know exactly what material they should present, that they can see if their students are doing homework on their cell phones, they can see how well they did with that. We can use their time in a far more effective way. The very best content, the very best lectures in the world can be available to all the students at very low cost.

So the idea of educational material being out there on all of these devices is very clear. There are already pioneering efforts like EkStep, which is trying to build a platform that gets all that material there for very young kids. This is something that not only will be great work in India but there will be a global community trying to bring together educational software. Improving education is kind of a prime boost for the entire economy and it's stunning how little R&D has been done on education. But finally by trying out different approaches, some really good software for very young kids all the way up to college kids is being created. Software that will do far better than the average lecture bringing across the material and helping you out when you are confused.

Agriculture of course still employs the majority of the Indian workforce. Over the last half century India has made amazing progress thanks to the green revolution with heroes like MS Swaminathan, and institutions like the Indian Council of Agricultural Research. But agriculture has been challenges. Growing population, we need to solve malnutrition as diets shift. We have to have even more output. And as I mentioned earlier, the challenge of climate change. If we stick with the seeds we have today, just a three-degree sea rise

in temperature could cut rice yield by 40%. Wheat would be even worse. And of course this would be devastating. India would go from being self-sufficient to no longer being self-sufficient. The ability to double farmer income by 2020 wouldn't be achievable. Well the good news is that science is advancing those seeds, changing them to be more heat resistant, changing them in some cases to have natural bio fortification, the kind of research that does that is now available. And a lot of this work can be done by foundations and government through the public agricultural system.

A lot of great international scientific partners, one of my favourite examples was what was done with rice. Scientists in India adopted the Swarna variety that instead of dying when they got submerged, it could last for up to 17 days. And that news rice variety which is called Swarna-Sub1 is now been used by millions of small-holder farmers especially in eastern India. Well that's just a glimpse of what can be done. Making crops more resilient, have better nutrition and having them to be far more productive is within reach. We need better breeding systems to do that and in some cases we need to look towards advances in genetics which hold great promise. A fairly new technique called gene-editing allows scientists to accelerate the trait creation in new plant varieties. And there are already some very interesting things being done with this. How quickly this is done, making sure that it meets the needs of poor farmers, its all done very carefully -there is work to do there but the promise is quite incredible.

Technology can also help agriculture, not just at the seed level but also by providing new models of reaching out to farmers and educating them and explain to them about the prices, when they should plant and helping them do multi-cropping, that's the smartest thing for them. These advances in remote sensing and communication can deliver immense amount of information whether its satellites or drones, the ability to recognize exactly what's going on in the fields, does it need more water, more fertilizer, is there a disease there, what is the likely production. Should an insurance policy pay off for that combined with digital land records, this will let us inform farmers even with the smallest plots in a way that never would have been possible for. They are receiving on their mobile phones the very best advice.

When we talk about sanitation, the government has to be congratulated for taking a topic not often mentioned but is very key for nutrition, for health, for quality of life. The government has set very ambitious goals to improve sanitation. The Swachh Bharat Mission is off to a very strong start with the ambitious goals. We need to make sure that we not only have a quantity of toilets but the quality out there so that they get used. Our foundation will help with this in any way we can. Two years ago we hosted a "Reinvent the Toilet" fair here in New Delhi, and already prototypes of self-contained toilets systems

are being tested here. These are designs that don't require running water to come in and dirty water to go out. Rather, they effectively burn the waste in a self-contained fashion, avoiding the problems of smell, cost and all the things that have problems with previous innovations. So there is a lot of innovation that can take place. The cities in India are now being asked to look at their sanitation management, and understand how its been treated. We believe that new machines can take the sanitation and process it in a way that generates electricity and clean distilled water.

Finally, the digital revolution, the Digital India Mission, where the My.Gov platform will help promote active citizen participation. We definitely are just at the beginning of this, the idea of getting rid of paper forms, helping citizens not have to understand all the different governments, departments, helping them not have to fill out the same information, the digital world can help do that lot better. There will be so many data sets for the government to be able to look at, some of the geo spatial data systems that can be laid down on a map and seen what's going on with different groups of citizens and as I mentioned earlier the feedback that are the government systems working at the cost of gathering that data, will be far lower. So every government system will have some type of feedback mechanism that will let you know which groups are doing the best and go and adopt the best practices of those who get the best work. There is a lot of way that the government itself can be digitized. The communication between the different departments, setting up a new project, all of the IT vendors are looking at great new forms of digital communication collaboration where the government should be a really model user of these new ways of getting productivity worked on. The innovation potential I talked about certainly requires investment in people and it requires an enabling environment.

Let me focus here a little bit on health. Health is a priority for our foundation and when we look at Indian health, we can see amazing progress over the past years. The child death rate has been cut more than half, new resources were put in through the National Rural Health Mission. But still there is a lot more to be done. Every minute a child dies for causes related to malnutrition. Every 2 minutes a baby dies without living through an entire day, so we still have a lot to do. So we have to focus on the number of resources and the quality of delivery. We should look what China, Brazil and other countries did well on healthcare as they moved towards full middle income status. It's very important to focus on some key areas - maternal health, vaccination. The public healthcare system has a vital role to play in this very high impactful invention. It is great to see that not only new vaccines have been introduced but that there is a focus now also on coverage and on how do we get them out to a 100% of kids. As we get the rotavirus vaccine rolled out nationwide and

on the same trajectory, we will see diarrhea and pneumonia deaths come down very dramatically.

Healthcare is a system where even within India we see very high variation. Making that visible and understanding what are the people doing, who are doing this best. How is this monitored in terms of quality of their care, being there when they need to be there. How are we monitoring the cold chain, supply chain, making sure we are communicating with the patients in the best way possible. Feedback systems for all of this information about the jobs that are filled, the experience people have, all of this will roll up into the government and be visible up to the highest levels. There will be a challenge to attract and train people in the best way possible, to attract them to work in the government healthcare system including the parts out in the world areas.

Let me focus on nutrition. If I had one wish I can get rid of any disease, any health problem, I will pick nutrition. That's saying a lot because there are other challenges – HIV, Malaria, TB – those are incredible problems as well. But malnutrition causes the greatest problem, not only for the kid who dies but the kid who survives, who never fully develops physically and mentally. India has the highest number of stunted children in the world. Once they reach age 14, there is no way to go back and get the mental and physical development. Particularly for girls, stunting means that when they are mothers, they are more likely to have premature births, low birth weight babies, so it's almost a generational problem that if we tackle it now, it will pay dividends for all future generations. So malnutrition can be looked at any lens, it could be looked at from economic lens. I was looking at an estimate that said that malnutrition will cost the Indian economy a staggering \$46 billion by 2030. I don't think that should be the only lens that it should be looked at but its certainly one that motivates us all to think about the investments that can be done there.

India has done a great job on universal sanitation, with over 90% coverage and now the government is looking hard at food fortification – not only having standards but making these standards mandatory starting with Vitamin A for cooking oil.

If we can get mothers to move to the optimal practice of exclusive breastfeeding in the first 6 months that alone will save 170,000 children in a year. So we think of that as a nutrition intervention. There is an opportunity to get some efficiencies to get some commitment to do deworming and add to that the vitamin A supplementation, reaching the child through one program but getting double benefit, that's something that's been done quite a bit in Africa with great results.

Now let me focus on education. I thought the Deputy Prime Minister of Singapore was very eloquent on this so let me add a few things that I think complement what you heard from him. I think this is another area where dashboards are very important – and I was very glad to hear that the government is going to charge NITI with coming up with very comprehensive, accurate figures. The ones that I've tend to look at in the past are the Annual Status of Education Report (ASER) – and it does show again very high variations – parts of the country that are doing very well but overall still some deficits. One I remember is that only 40% of children in Class 5 can read at a Class 2 level. Only one in five Class 5 children can do simple division. So if you get these figures and make them more accurate, they can be turned into feedback systems to understand, how do you train teachers to be the best they can be? When we looked at educational systems around the world, we see that not enough is invested in helping teachers be very very good. Teachers need feedback; they need to learn from the best – and again, we can use digital tools to have education training and monitoring; those things are very helpful here. Education really is the key source of inclusive growth and social mobility. It's great to see funding directed to things like teacher professional development, assessment systems for mediation – all things that will improve learning outcomes. Our foundation has done a lot of work on this in the United States, and I can say in of all the work that we do, that it's been some of the most difficult. And everytime I go to a school that's adopted the new practices, it reenergises me. I can go to the poorest communities in the United States and see, what are called charter schools, and the best one of these are doing an amazing job. So we know for sure that just growing up in poverty does not limit what the child can do, if we're able to get them into a great school. A lot of countries have done very well with this – and so that's a challenge and a proof-point that it can be done. The quality of the teachers is a very, very important part of this, but also the kids on their cellphones alone – there's a lot they can do to engage, even in early years, and get the right exposure.

Another key actor, of course, will be the private sector. India's private sector is incredibly dynamic, but when it comes to the boundary between the public sector and the government sector, there's definitely room for innovation. We just looked at a few innovations in the agriculture sector and the health sector earlier this morning – there are great examples of innovation in these sectors. The government, as much as possible, should be a policy enabler and regulator so that the private sector is contributing to the public good. Being a smart regulator, allowing innovation but not allowing the market that's not working for the consumer – that is a huge challenge. One of the areas that we've been looking at this is – What can be done in healthcare? Can public-private partnerships help build out the infrastructure and staffing effectively

and quickly? Can businesses who run very good supply-chains help for drugs and vaccines? Can we pool private out-of-pocket expenditures using insurance type products such as those under the National Health Protection Scheme (NHPS) so that even middle-income families are required to buy such products and improve the total resources available for healthcare? The availability of care today simply isn't where we want it to be. Households are paying almost 71% of their costs almost entirely out-of-pocket at point-of-service, so over 10 million households fall into poverty due to the cost of drugs and outpatient care. And no doubt, more government tax resources and some form of mandatory insurance purchase are both necessary to see our way to great health.

The last area I'll talk about is this culture of innovation. Again, regulators need to avoid being risk-averse – whether it's in medicines or telecommunications products – there's so many new things happening and the default is often to hold back the new products.

Another element whether the government plays a role is in basic R&D funding. It was publicly funded research that created most of the advances that define our age – the internet, the micro-processor; going back earlier, antibiotics like - penicillin - it is the underpinning of the advances we've made in science. It's actually government research, along with some philanthropic money, that drove the Green Revolution that saved hundreds of millions of people from starvation. It's great to see that Prime Minister Modi has taken steps to supporting increased R&D, with a commitment to help 20 autonomous universities attain world-class standards in their research work. This is a big step. I believe that research is something that pays huge dividends and should continue to be a national priority. Often, at the basic level, you don't even know what great things might come out of it, but that's why it's called the basic level. In health and life sciences, so many of the things that have been breakthroughs were initially just exploration by scientists. Really, the world is looking to India – with the number of minds it has and the capability it has, not only to solve its own problems but to come up with innovations that help the entire world.

So yes, I'm an optimist. I'm an optimist about the world. I'm an optimist about India. A big part of that is because of advances in science; a big part of that is taking technology, including digital technology, and using it for things that might seem surprising, like using it to make sure the government is always doing a great job. The scale of the challenge here in India is bigger than anywhere. What India's trying to do has never been done before, but it's a government that's very committed to solving these big problems. The talent pool, the building blocks that I talked about – all of this I think will lead to an

amazing innovation economy. So it's a pivotal moment in India's history. By focusing on the right things I believe the human condition can improve more here in the next two decades than anywhere in the world. And the benefit, to India and to the world, is incalculable. It requires smart investments; it requires leveraging this country's long administrative tradition in bold new ways. By doing this, India will write a new chapter in the history books about how a people and country can rise to big challenges.

Mr. Prime Minister, I want to thank you and your colleagues for allowing me the opportunity to share my thoughts here today. It's been a great privilege. I look forward to hearing the thoughts of the distinguished panel and continuing the dialogue during the question-and-answer session.

Yeh Hai Mere Mann Ki Baat.

Thank you!