

**Proceedings of the China-India-US Workshop on Science,  
Technology and Innovation Policy**

**Section VII  
Session V – Summary and Conclusions**

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## Remarks by the Chair

### Prof. Samir K. Brahmachar

I have been paying attention to what you have been discussing from the perspective of being the head of the largest public-funded civilian organization in the world, with around 5000 plus scientists spread all across India in 37 laboratories, As the Secretary, Government of India, of the Department of Scientific and Industrial Research, I was asked to be here to take your recommendations home.

Why is the world today suddenly worried about innovation? In 1899, Mr. Charles Duell, the then Commissioner of the US Patent and Trademark Office, reportedly suggested that all that can be discovered has been discovered, and so the American Patents Office could be closed down. When the movie was discovered, a very famous (I don't want to name the person) and great industrialist never believed it. He said, I can't believe it is possible that people will talk in the movies. J N Tata decided to build a steel plant in the late 1800s and we have a great institution today which is the largest – and we are talking about private-public partnership. You should realize that the place where we are sitting is a part of the Indian Institute of Science, which is the first private-public partnership, now a hundred years old, visualized by J N Tata and supported by the then Maharajah of Mysore who gave the land and the supporting money. It is celebrating its hundredth anniversary this year.

J.N. Tata was a great innovator to think of private-public partnership and building an institution of science one hundred years back. But when he wanted to build a steel plant, Sir Frederic Upcott, the then Chairman of the Board of Indian Railways promised to eat every pound of rail that India would produce. Today, Tata has bought Corus. So why are we discussing so much about innovation? Suddenly it has become fancy. Go to England. It is no longer the Department of Science and Technology Education; it has changed to Department of Innovation and Human Resources. So now you have a Secretary for Innovation and a Minister for Innovation and then the whole country is interested in innovation.

I think the reason why there is so much emphasis on innovation simple. Namely, too many people think that we have run out of enough new ideas. Nobody could have ever predicted that 40 years after Einstein discovered his famous equation that we would have atomic energy. Where, many ask, is the next Einstein whose discoveries will lead to new innovations?

Frankly, I think there is an over-emphasis on innovation. Innovation is not a profession. It cannot be a profession. Innovation has to be a natural process. China wants intellectual property rights (IPR) laws to be softened, and this year, China filed ten times more patent applications than India. According to China's IPR laws, you can file utility patents. Seventy per cent of the Chinese patents are utility patents. Utility patents lead to litigation. India avoided utility patents. But a utility patent gives you ten years' benefit. And I think the largest numbers of patent disputes in China are on utility patents.

Patenting electricity by Edison was actually a business failure. Nobody thought that electricity could be sold to make money. So innovation, according to me, is trying to put a circle into a box or a box into a circle – I don't know which. And if an innovator can do that, he has achieved his end. Now, if you show a picture and a circle and ask a child, he will say, "It is so simple. I will just cut the corners of the box. Or I can cut the circle into twenty pieces and put it into the box." But I could have left this puzzle here and gone home, and you would have thought and thought and thought about how to figure it out.

I think that every individual born in this world is innovative. As Vivekananda said, education is nothing but removing the layers of the dust of ignorance. Our present education system creates that dust and rust and kills innovation. And India has done it wonderfully because we inherited the education system from 200 years of colonization, which was very much to have clerical jobs. A friend says that if children are going across a road – and if you have seen how people cross roads in India – they have to be highly innovative. If you have to cross the road on this highway in front of the Indian Institute of Science, and if you can manage to do so without being run over, you have to be innovative.

If you ask me what my role as Director-General of the Council of Scientific and Industrial Research's (CSIR) role should be, it would be transforming the Council for Scientific and Industrial Research into the Council for Scientific Innovative Research – it will remain CSIR that does not change – with corporate social Indian responsibility. When we talk about corporate social responsibility, energy, affordable health, open-source drug discovery, all that we are essentially talking about is how to give all of these equitably to everybody – billions of people.

For China, it is very easy because 1.3 billion people just decide that they will share a little. They can afford to take care of 3 billion people. But for America, with 240 million people, it is difficult to take care of 3 billion people. Even if you cook food for ten people at home, you can manage to feed twenty. This is exactly the issue where China and India come in. When China and India come in, if they can create surplus knowledge, surplus ability and surplus intellectual property, then they can say 'let's share it' and forget about it. We have the luxury if we can do so. This is something Finland cannot do or Israel cannot do with 6.7 million people. They have to create so much that to give everybody something free is very difficult without changing their style of living. It is just that simple. As I said, if you have cooked for ten people, it is very easy to share with another ten. But if you have cooked for two people, it is very difficult to share with four. That is the principle.

The whole world wants India and China to be innovative. So what we have to do is to connect what is inconnectible, see beyond what is visible, expect the unexpected, celebrate the fact that what we do not know cannot be done, enjoy contradictions and shun consistency. But if you look at the culture of India, whenever anybody says anything different, this is difficult. Our children have to be obedient. And look at America. You come out of school, you strip off an old car and four-five young students

build a new car, pack into the car and drive out for some 5000 kilometres. This Indians can never do. In India, if you are a very good student and you have a car, nobody will even touch the car. Parents give it to them as a toy, and keep the toy in the almirah. It is an expensive toy that you will not allow them to play with it, just in case the toy breaks.

In order to break loose of this way of thinking, a National Innovation Foundation has been formed with the objective of making India innovative. I wish Dr Anil Gupta a very celebrated professor of the Indian Institute of Management at Ahmedabad and a great supporter of the foundation were here to talk about his vision of innovation.

I want to show you a slide illustrating what is basically a rural innovation. Here is a person who has designed a bicycle where he has put a spring. You can see that as the bicycle bounces, the energy is transmitted to the back. So as you go on a bouncy road, the cycle goes faster and faster. The man who invented this cycle has never been to a school. When this cycle is driven in a rural village, instead and struggling hard on bouncy roads, you get a considerable advantage. This cycle could probably become the basis for a better mountain bike.

This is an example of what innovation is. Innovation does not need education and hundreds and hundreds of thousands of dollars. India is actually very lucky. I can show you one more innovation which might be interesting to you. Somebody felt that having to spray a field was too much work as it were. So he came up with an idea. Again, a villager, an uneducated person, designed an apparatus. This is the pesticide or whatever he is putting into the field. He has put a nozzle which he has fitted to a shoe. Now, as he walks, the shoe pumps. So all he does is that he wears the shoe and walks around in the field, and it goes on spraying. So you can have a nice water-sprayer. And that is a villager's innovation. If you want to know about one of the largest documentations of village innovations, you have to go to the National Innovation Foundation (NIF) site.

The next question that comes up is, what innovations should we be protecting and what should we be keeping free? This is a big discussion. Should drug discovery become open-source? The answer is yes. CSIR has led a major program now – and I have been instrumental in that – to make infectious disease drug discovery into an open-source program. The government has earmarked \$38 million, of which the first \$12 million has been released, and tuberculosis is the first target.

If you are building something for which you can afford to pay, you can fence it off. That is your IPR. But if you want to have a low-cost product like paddy, and you want everybody to share it, it is foolish to put up a fence. Then you just put up a scarecrow. The software industry revolution, the worldwide web, and the internet are examples of innovations that were developed because they were not fenced off. The human genome project is a great example of how everybody worked together and shared, including China. I thank China for its contribution.

Tuberculosis is one area that we have taken up and you can see that it affects India and other parts of the world, including China, very seriously. The United States cannot be

happy, because the XDR, MDR, and drug resistant tuberculosis is everywhere. So everybody has to be worried about tuberculosis. The number of people who die from tuberculosis is almost equal to the number of people dying from cancer. But the number of drugs in the clinical stage is that there are only six in the tuberculosis development stage as against the 399 for cancer. Everybody knows that if you start from six, in the end you will get zero drugs. Even if these molecules are funded by the Bill Gates Foundation, PB Alliance and others, they are still not open-source. They are still protected.

How do we make drugs open-source? That is the whole exercise because drugs have to be affordable and drugs have to be a right for all. Health is more of a right for everybody than business is. This is an example and it is possible to make it so, because there is no commercial benefit. This is a great example where drug discovery is not reproducible. We can learn about it and eventually, we can utilize it. Of course, we have built a fantastic credit-sharing system into the software. Towards this, we have built a large database. We have launched the database and it is available on the CSIR website. Everything on tuberculosis has been included. This is our open-source community portal which will, most probably, come out by the 15<sup>th</sup> of August, so that people can start participating across the world. It is a very new model of collaborative and participative research where students, academics and even an intellectual who has nothing to do can go back to in the evening and say I am a software guy – I can help in these things.

Credit sharing, through a micro-credit system and eventually, the dream is that if you are contributing to the cause of tuberculosis, you carry a credit-card-like thing with you which gives you special favours in hospitals and insurance and so on, and there are sponsors to give awards. So there is no more IPR. Everything that you use, you have to pay it back. It is all click-wrap – not hard IPR as you wanted. But what is interesting here is that you still get credit as prizes and awards, and are not forgotten.

I just wanted to show you a few of these examples where new innovative approaches are being thought of. In areas where we are using rural innovations and structural innovations, our efforts should be to see how we can introduce more and more young people in innovation. I think that as far as the Government of India is concerned, we do realize that our education system does not make our children innovative enough. But my argument is that we have to change at home. We have to permit our children to question their parents. This, the Americans have done successfully, maybe sometimes going overboard. About China, I don't know. I have seen Israel – it is at an amazing balance. It is an amazing balance with fantastic parental affection and closeness with children.

I have looked at Israel very carefully and asked a question. How could 6.7 million people export three times of India's software exports? Just 6.7 million people, when we are a billion? We have no right to be very proud about saying that we do a great job in software. I know that all the people sitting here in Bangalore city will be angry with me. But the fact is that Israel, with its 6.7 million people exports three times our exports. One reason is that every child is creative. At home, they can question, they can discuss and they can argue. And I always say – I don't know how many of you have ever had a chance to give a talk in the Weitzman Institute of Science in Israel or the Newman Institute in Haifa – if

you have to go give a talk and survive, I think it will be an achievement. Even your titles are questioned! By the time you show your first slide, people question.

I think that is what innovation is – the ability to question; the ability to differ, to think out of the box, to completely throw away the existing paradigms. I lived in kibbutz in Israel for twelve days when I was very young, and I am influenced very heavily by that. That was 30 years ago. And I still remember those days of living in a kibbutz. So I have been interested in Israel's approach to its young people for many years.

There has to be a structure in order to promote innovation. We have to change our system of education where questioning, questioning and more questioning has to be permitted. I don't know how China will do it, because you still have a lot of respect for the elders, and any questioning is often considered as disobedience. In India, I am certain that no Indian has had the courage to question some of our illustrious people who spoke at this workshop.

I think this is the key issue. That villager has no fear. He has to do something and he does it. And you see each of them – hundreds of them – with completely new ideas about their surroundings and their local ways, and they have solved problems related to these.

These views are my personal rather than my views as an official of the Government of India. I believe that we need to look at the innovative capacity of children when they are very young. We must remember that Sabeer Bhatia founded hotmail.com when he was 24 and Net Star when he was 18. So, all those fantastic discoveries that we all enjoy today were done by people who were under 25.

So if we think of innovation, I am very glad to see so many young people in this room. I trust that India will continue to participate in workshops such as this one by including many young people. And that is the future. I think innovation is a game for the young. It is not a game for grey-haired people like me.

Now I will be pleased to try to answer a few questions.

**Question 1:** I'd like to know a little more about your TB drug development system. How are you in the process of developing some leading compounds and testing those? How are you bringing this all together, and how are you financing it?

**Prof. S K Brahmachari:** You can go through last month's *Cell* journal. There is a discussion article written on this in the analysis section. You can also go to osdd.net or osdd.org. We have given some information, but it is not enough. Nobody knows how to do it. So what we are doing is simple. We have already established a centre called the Centre for Genomic Application (CGA). It is a not-for-profit centre which has all the hi-tech genomics facilities where you can do all the tests, screening, sequencing, and proteomics analysis. Then we are looking for laboratories which can do molecular screening, and the CSIR has a large chain of laboratories which can do this. We are also looking at the private sector like ILS (Institute of Life Sciences). And then the whole

argument is that we are putting up thirty laboratories – thirty such places in universities and colleges. So assuming thirty students will participate in each, we will get about a thousand young people. It will be web-based. Sun Microsystems has joined in to help us. We have got a very large number of people from the software community to join. We even have support from Astra Zeneca. You will be surprised that although they had apprehensions, they have now joined in because they are the tuberculosis experts across the street here.

So the idea is that you have a portal. I don't know whether you have seen the *Arzoo* software. You have not? So let's say there is a work distribution store. Here is a database. The database is available, and here you can ask questions and see all the information. Let us say you now want to ask what the non-target molecules of tuberculosis are. Somebody would have put this up, through certain analysis, saying these are the ones. Now from that, we still want to know whether these targets are toxic or not. So people who have worked on those molecules can say that I have worked on this and this is how things are. It functions like Wikipedia. Initially, it shows up in blue when you submit it and then curation takes place and it changes colour.

When you come in, you have to become a registered member. So you get a registration card and you sign an agreement that this is an open source; you will not steal it and will give back whatever you take with a copy left. And then, as you start making more and more contributions, your position goes up. So from a blue card, you go on to a silver card and then to a gold card. When you have a gold card, you can write a paper. That means that you can acknowledge all the people who have contributed. This is a tracking system.

We are now finding that the most difficult part is the tracking in a database. NCBI has a big project – they do what we are doing as an S&B project. There is a handle. So a PI who gets into it – a person who gets into it – has a number, just like a credit-card number. Like with a credit-card, every contribution is recorded against that number, just as transactions are, wherever they may happen. So at a given time at the end of the year, you know how many transactions were made – how many contributions you have made and how many people have used your contributions. That is a little tricky. So that software is also being created.

We have now identified about 27 targets. In eleven of them, several people already have a protein, so they are giving that information. Sixteen have to be made. So we go for a bid – to whomever wants to make this protein, we will provide a grant. It is a reverse bid where I give the grant to whoever gives me at the lowest cost. I am not paying for anybody's manpower cost. Then there are these Laboratory of Molecular Biology and Chemistry students, whom we are using to do this. These students would normally have done very boring repeated practical tasks. Now they have an exciting summer.

The project problems are given on the website. So you enter the website, pick the problem and solve it. It is like a software docking problem. We have a hope that it will come up and eventually a generic lead molecule will emerge from it. Then a pharmaceutical company will take five companies together like a consortium, a de-

risking consortium. This is called the open-source consortium approach. Open-source consortium people become participants by donating maybe five per cent of the required money. When the molecule goes for its final clinical trial, the cost is very little because the government is subsidizing 75 per cent, and each has put up five per cent. When it comes out, it is again non-exclusive licensing, so the cost remains low. So no lawyer ever enters into the picture. If you go to our website, you will see that nine young lawyers across the world are working for me for free – pro-bono. Because once it is open-source tuberculosis, it is amazing how people come in to work.

**Questioner:** So the government has...?

**Prof. S K Brahmachari:** The government has earmarked – and we have earmarked – over \$120 million in the 11<sup>th</sup> Five-Year Plan towards an open-source approach to drug discovery and an open-source approach to pharmaco-genomics. It is very simple. Whereas the United States or Europe wants to discover a drug the process is personalized. We are doing it the other way. Which are the drugs from the 1960s, now out of patent? Let us say, Finotoine for epilepsy – seven per cent of the patients had side effects. Today I can figure out which seven per cent that was. All we need to do is to discover a bio-marker and tell every clinic not to take the drug. The other ninety per cent can take it. It is only one rupee per tablet, compared to \$1 per tablet. So I can have a public health system at one-fiftieth the cost.

So for this project of tuberculosis, we have Rs. 150 crores [Rs. 1.5 billion], which is about \$38 million. The first \$ 12 million has been released. Once we get there, the next \$ 25 million is for the clinical trials.

**Question 2:** That was a really stirring talk. We really enjoyed it. I was struck by one statement you made – that to be innovative; you do not even need to be educated. That is in stark contrast with thinking, especially in the US, that you need more education to produce more innovations. And in fact, there are worries that we are not producing enough scientists and engineers and they are the innovation ‘engines’.

So I guess my question to you is – is the statement you made based on empirical evidence?

**Prof. S K Brahmachari:** Oh, there is huge documentation. I have the whole presentation here, on the National Innovation Foundation. If you go to their website, the honey-bee network, there are a huge number of innovations – all rural innovations. You must remember that sixty-five per cent of Indian rural people live without any modern medicine. They get pains too. And most of the time, they work hard. And these innovators have come up with the largest number of pain-killer formulations. What honey-bee network people do is that they walk – three to four times a year, for up to 120 kilometres. They collect data from village to village. Then they find that two districts which have never seen each other are using the same pattern of formulation for the same therapeutic use. These now gets validated in the laboratory. So a whole laboratory system has been built up to validate them. And the actual success rate is very high.

I don't know if any of you are coming from Punjab or Haryana, but the *Jugar* is a great example. I tell you what the idea of a *jugar* is. You have a motor and a pump. You can use that same motor to move a vehicle and you can park that water and convert it into a water-pumping system. If you go to Haryana, this is all locally made. Every farmer has a *jugar*. They are doing multi-tasking using the same machine.

We had an innovation challenge and we are doing this to convert two things. One is to make the world's best pedi-cab – a cycle-rickshaw – which is solar operated and manual, with dual energy transmission. How do you transmit this as well as solar? The prototype is ready. It is being built at the Mechanical Engineering Institute in Durgapur. It has a lot of CAD (computer aided design), but it is based on a lot of innovation. And you will be surprised that in the innovation, 200 cycle-rickshaw pullers are actually sitting and looking at the design and making suggestions. We are using Dr. Sumantran (the Tata Indica designer)'s views on one side, but the other side are the rural people who actually build the cycle-rickshaw themselves. And they are giving a lot of inputs. We hope that by October 2, we will launch this solar operated dual-energy transmission cycle-rickshaw, which will move 18-20 kilometres per hour. It will be able to carry three people and replace an auto-rickshaw, especially in places like Chandni Chowk and Lal Qila where pollution is high and you cannot move fast. I am told that New York City will be a good customer because when people used to move on horseback, they would go at eight miles per hour; now in a Mercedes, they move at six miles per hour! So to me, eighteen kilometres – or eleven miles - per hour looks reasonable.

I am actually not surprised. After seeing our announcement, somebody from the UK has come down to meet us. He manufactures pedi-cabs – normal pedi-cabs for use in tourist places like Leicester Square where only pedal cycles are allowed in the evenings. That company has come down and they want to take our solar-operated technology.

So you can see how innovation has turned around. You don't need these innovations to come from an IIT (Indian Institute of Technology). There are, of course, IIT engineers working on the CAD design and the final part. But the concept of using solar energy was something I just thought of one day. I felt that this should be done and I checked with a cycle-rickshaw-wallah, who said yes. So it is a nine-month project we took up. It started in November and has to finish by October 2. The first two to four will be prototypes. Then production will go on for another nine months. We want 100,000 solar-power operated cycle rickshaws across the country. There is a Rs. 4000 carbon credit per cycle-rickshaw replacing an auto-rickshaw. So in five years, you get the capital return.

This is an example where you link energy, environment and innovation for sustainability. As I have said, one has to have a sustainable, inclusive growth. You cannot leave half the world behind and enjoy yourself. Those days are gone. You will have to take care of Africa – there is no question of not doing that. And I believe that China and India together can make a difference if America comes in and gives its wisdom and past experience.