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Feature Story

Can Artificial Intelligence Help Circumvent the Next Global Supply Chain Crisis?

— Jayant Borwanker

Today's globalised world has become irrevocably dependent on interconnected and multistakeholder supply chains for goods and services. Yet, the recent pandemic resulted in logistical disruptions of massive proportions across the world. Artificial intelligence and blockchain have the potential to revolutionise supply chain management and improve global supply chain efficiency, reduce costs, and enhance overall productivity.

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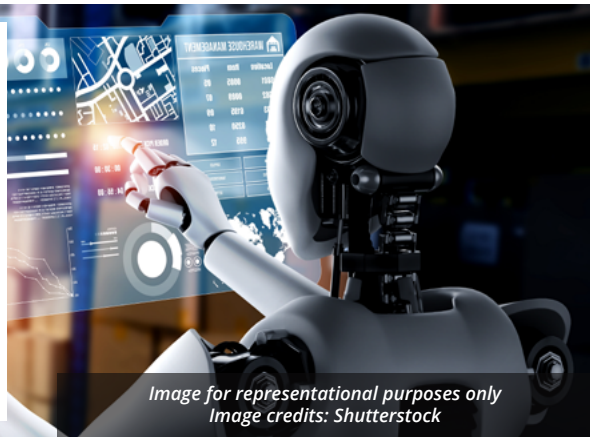

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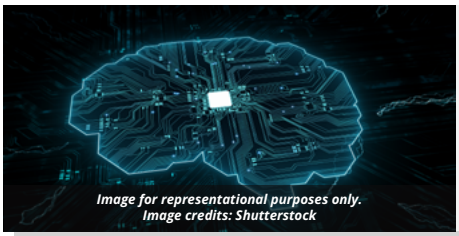

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India in Focus

Towards Sustainable Electronics: Building Brain-Inspired Computer Chips for Next-Generation AI

— Rachana Bhattacharjee, based on an exclusive interview with Prof Manan Suri

Today we, as a civilisation, are generating an enormous amount of data—trillions of bytes every day. What we need is more advanced forms of software and hardware, like artificial intelligence, to make sense of this data.

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GM Mustard plants in a growth chamber at the Department of Genetics, University of Delhi
Image credits: Dr Deepak Pental

India in Focus

Breakthrough in the Indian Agriculture Industry in the form of Genetically Modified Mustard

— Somesh Thapliyal and Krittika Sengupta

The characteristics of all living organisms are a result of their genetic makeup. But through genetic engineering technology, scientists possess the power to alter these characteristics or introduce new ones by creating genetically modified organisms (GMOs).

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Dr Toteja in his office at the Jodhpur City Knowledge and Innovation Foundation (JCKIF)
Image credits: JCKIF

In Conversation

A Dialogue with Dr G S Toteja, Chief Executive Officer, Jodhpur City Knowledge & Innovation Foundation

— Madhura Panse

The Jodhpur City Knowledge & Innovation Foundation (JCKIF) was launched in early 2021 as an initiative of the Office of the Principal Scientific Adviser (PSA) to the Government of India on the recommendation of the Prime Minister's Science Technology & Innovation Advisory Council (PM-STIAC).

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Prof Ajay Kumar Sood, the Principal Scientific Adviser to the Government of India, launching the Bengaluru Science and Technology Cluster.
Image credits: BeST

Science and Technology Clusters

Bengaluru Science and Technology Cluster Launched

— PSA Content Desk

On 16th November 2022, Prof Ajay Kumar Sood, Principal Scientific Adviser (PSA) to the Government of India, launched the Bengaluru Science and Technology (S&T) Cluster—or BeST Cluster, in short—at the plenary session of the Bengaluru Tech Summit.

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Project SAMEER
Image credits: CKIC–DRIIV

Industry–Academia Engagement

Project SAMEER: Curbing Air Pollution Through Collaboration

— Krittika Sengupta

Over the past few decades, air pollution has become a major public health issue in India. The need of the hour is for collaborative efforts to build an evidence-based strategic roadmap to a meaningful solution.

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FEATURE STORY

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Can Artificial Intelligence Help Circumvent the Next Global Supply Chain Crisis?

— Jayant Borwanker

Today's globalised world has become irrevocably dependent on interconnected and multistakeholder supply chains for goods and services. Yet, the recent pandemic resulted in logistical disruptions of massive proportions across the world. As per the WTO's World Trade Statistical Review 2021, compared with 2019, the global trade in goods and services declined by 12% in 2020.

Nonetheless, while the COVID-19 pandemic exposed many vulnerabilities in global supply chains, it is just one example of how these suffer disruptions. Events such as extreme weather, lingering infrastructure and structural bottlenecks, and geopolitical instabilities have all been periodically causing supply chain disruptions worldwide, even before the pandemic. And worryingly, a report by the World Bank suggests that such global supply chain disruptions are expected to persist unless we change the way we do things in this arena.

Globally, massive food wastage resulting from inefficient supply chains is partly to blame for lingering hunger problems. The shortage of certain components for key production sectors and high freight costs also contribute as bottlenecks to resilient supply chains. These challenges foretell a future wherein stakeholders will need to navigate a climate of persistent unpredictability. Needless to say, this calls for building resilience and agility in global supply chains.

In this context, artificial intelligence (AI) and blockchain have evinced the potential to revolutionise supply chain management and improve global supply chain efficiency,

reduce costs, and enhance overall productivity. *"As per a report by the NITI Aayog, AI can add 1 trillion dollars to India's economy by 2035, and in line with this potential, the Government of India has made sustained efforts to boost investments in AI,"* says Prof Ajit Kembhavi, Principal Investigator of the Office of Principal Scientific Adviser (PSA) to the GoI's Pune Knowledge Cluster, which has Big Data & AI as a focus area under its agenda.

These projections augur well for the Indian economy, especially against the backdrop of the COVID-19 pandemic. One example of using AI in supply chain management is leveraging a distributed ledger blockchain technology to expedite the delivery of COVID-19 vaccines. *"The COVID-19 pandemic has highlighted the importance of having a resilient supply chain. AI-powered solutions can help companies build such resilience by providing visibility into the entire supply chain, enabling faster decision-making, and reducing the risk of supply chain disruptions,"* says Sid Chakravarthy, Founder of StaTwig—a Hyderabad-based startup focusing on AI-enabled supply chain solutions to further this objective.

By integrating various advanced technologies, AI can plug the vulnerabilities in global supply chains. This includes:

- Real-time data analytics to identify bottlenecks and capacity limitations
- Predictive analytics to reduce lead times, improve inventory management, and minimise excess inventory
- Improved visibility and transparency by identifying potential risks and enabling quick response to disruptions
- Supply chain automation to reduce costs, improve efficiency, and minimise human error
- Enhanced collaboration and communication to improve coordination and quick response
- Route optimisation by reducing transportation costs, minimising delivery times, and ensuring timely delivery of supplies
- Quality control and user management

While these include only a few of the capabilities offered by AI, integrating them into crucial and time-sensitive sectors can ensure the timely and efficient delivery of products and services. AI can be particularly helpful for the healthcare sector in India, considering that it is one of the largest and fastest-growing sectors worldwide.

Recognising the important role of AI, the Government of India (GoI) has adopted a proactive approach to promote AI in the supply chain sector. This includes the launch of a National AI Strategy in 2018, the establishment of the Digital India Mission for the development of supportive digital infrastructure, and the AI Task Force for identifying opportunities and challenges for AI adoption in India. The GoI is also striving to promote and support startups for AI and supply chain optimisation. Some initiatives in this direction include the creation of the National AI Portal, AI for Agriculture, Logistics Efficiency Enhancement Programme, Startup India, Atal Innovation Mission, and National Logistics Policy.

Moreover, in the Union Budget 2023–24 the government has reiterated its resolve to 'Make AI in India and Make AI work for India'. As a part of this promise, the GoI will set up three centres of excellence for AI in top educational institutions. These centres will collaborate with academic institutions and industry players to conduct interdisciplinary research and develop cutting-edge applications and scalable solutions for complex problems.

Furthermore, the Office of PSA is also

supporting research and development, innovation, and entrepreneurship in AI through its Science and Technology (S&T) clusters. The initiatives being taken for supply chain improvement are primarily aimed at developing AI-based solutions for optimising supply chain management, promoting collaboration and innovation to facilitate the exchange of ideas and best practices, and supporting policy for the adoption of ethical and responsible AI practices.

With support from the GoI, startups like StaTwig (incubated under the PSA Office's Science and Technology Cluster, Research and Innovation Circle of Hyderabad), SigTuple, and MFine (both funded under the SIDBI Startup Fund of Funds) are working towards the enhancement of visibility, automation, and smart logistics solutions for the supply chain sector. Moreover, the GoI extends funding for AI-based startups via incubators housed in research institutes (such as IITs and Indian Institute of Science), Public Funded Labs, and the Digital India Programme.

AI-enabled drones are very useful in distribution for example, Marut Drones is using AI to develop end-to-end drone medical delivery solutions with support from CIE-IITH, a GoI-backed incubator supporting deep-tech startups. Collectively, these funds and initiatives can help increase efficiency, improve visibility, enhance decision-making, augment customer experiences, and enable better risk management with respect to supply chains.

AI also holds the promise to solve issues related to creating a resource pool of skilled workforce and the safe delivery of goods and services, which are some of the concerns for supply chains after the COVID-19 pandemic. Solutions for automating decisions, tracking and analytics, and integrated safety measures are some ways in which AI can help businesses navigate the rapidly changing supply chain landscape.

Given the recent pandemic-induced circumstances, the possibility of another global supply chain crisis cannot be denied. By investing in AI-powered solutions today, companies can better prepare for such crises and minimise their impact on their business and customers. Overall, AI as a disruptive technology, and in association with other new age technologies such as machine learning, blockchain, drones, etc., it offers great potential for efficient supply chain management.

ABOUT THE AUTHOR

Jayant Borwanker is a writer, science communicator, and keen enthusiast of creative pursuits.

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INDIA IN FOCUS

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Towards Sustainable Electronics: Building Brain-Inspired Computer Chips for Next-Generation AI

— Rachana Bhattacharjee, based on an exclusive interview with Prof Manan Suri

Today we, as a civilisation, are generating an enormous amount of data—trillions of bytes every day. Every time somebody carries their smartphone from one room to another or browses the internet, they generate some data. And this is in addition to all the information we're willingly putting out on the internet.

Over the last two decades, there has been an explosion of information and the electronics that hold this information. However, our current technology falls short when it comes to making sense of this data. What we need is more advanced forms of software and hardware, like artificial intelligence (AI) and nanoelectronics, that together can receive data, synthesise it, and make decisions similar to how one of nature's best data processors, the human brain, would.

Fortunately, research to achieve such technology is rapidly progressing globally today. Prof Manan Suri's work at IIT Delhi is part of this effort to build this next-generation technology.

Mimicking the Human Brain at IIT Delhi

The current electronic systems in semiconductors have two parts: one for storing data—the memory—and the other

for computing it—the processor. They have traditionally remained isolated in computer hardware. For instance, our home computers and smartphones have a hard disk to store information and a Central Processing Unit (CPU) to process it.

To mimic the human brain, one requirement is to fuse this hardware. The information must be processed at or close to its storage location.

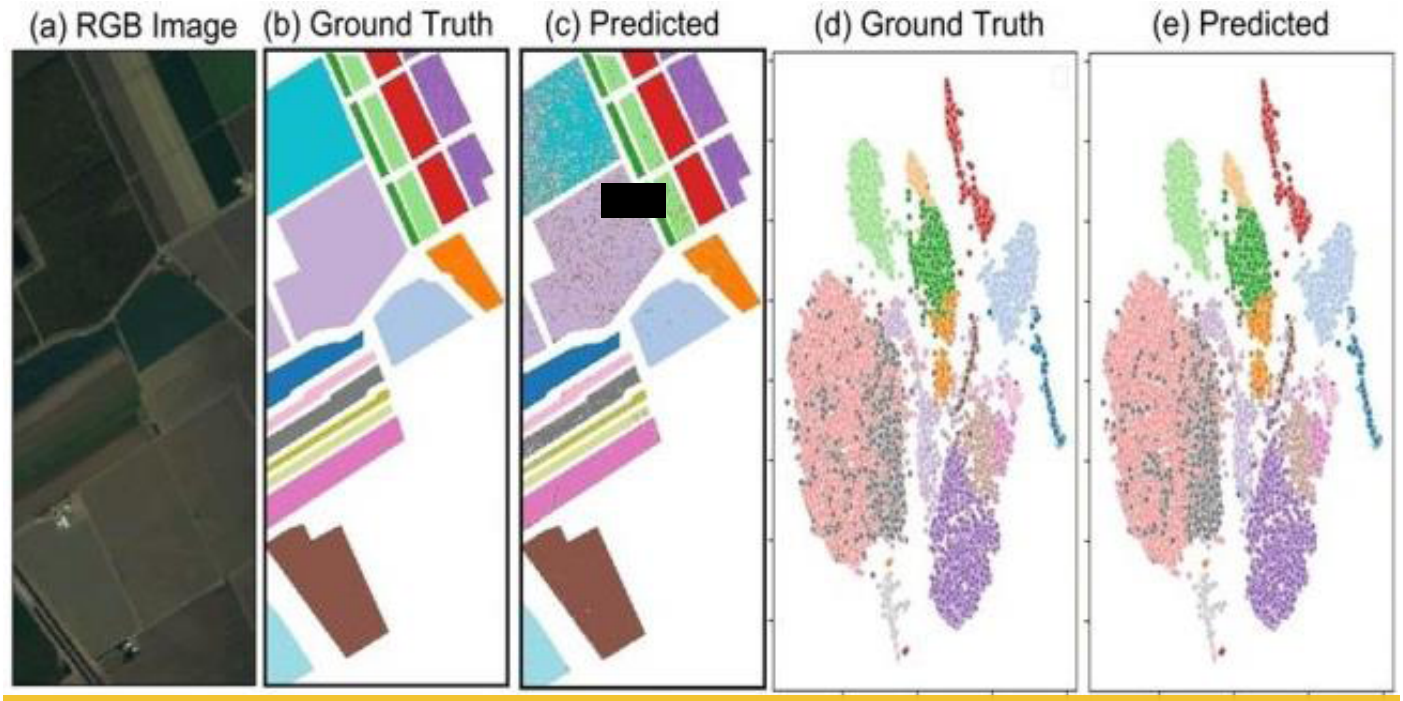
At IIT Delhi, Prof Manan Suri's team has discovered a novel means of achieving this by turning a property of emerging Non-Volatile Memory (eNVM) that is generally considered a computational flaw into a solution.

Non-volatile memory systems are those that can store data even after the power source is cut off, like a pen drive, as opposed to a volatile memory system, like Random Access Memory (RAM), where the information is lost when the computer is shut down. Over the past few decades, as electronic hardware systems advanced, NVM chips became increasingly compact. They have now reached the nanoscale in the form of eNVMs.

Now, the physics of a nanoscale chip makes its behaviour probabilistic and difficult to control, which is an engineering challenge when it comes to traditional electronics that compute data in binaries of 0 and 1. Yet, this very irregularity allows for the processing of information in multiple states between the 0s and 1s and makes the chip ideal for building devices capable of mimicking the complex learning and memory functions of the human brain.

Neuromorphic Computing for Edge AI

Using the inherent variability of eNVMs, Prof Suri's team has devised large-scale nanocircuits that mimic some of the neuro-biological architectures of the human brain. In effect, the memory becomes intelligent in these chips, contributing in real-time to data processing and analysis. The elimination of a



A figure demonstrating the accuracy of predictions by an eNVM-based AI chip developed and deployed in collaboration with the Israel-based startup Weebit Nano by Prof Manan Suri's team.
Image credits: IIT Delhi

back-and-forth of data between the processor and memory units during a computation, in addition to reducing the resources needed to implement storage and computation, results in much faster data processing with much greater energy efficiency.

This work by Prof Suri and his team lies at the intersection of computational neuroscience, computer science, and electronics and is a global first in many ways. It opens doors to creating processors capable of taking AI to the next level. Where can their principle be applied in real life today? To find out, they incubated a startup called Cyran AI Solutions.

Cyran AI Solutions: A Deep Tech Startup at IIT Delhi

Since 2018, their constantly evolving fundamental research at the university has laid the groundwork for the wide variety of user-specific AI solutions devised at Cyran. These are combined hardware–software solutions that process data at or close to where it is collected without connecting to the cloud.

For instance, in 2019, the team developed a hyperspectral image classification algorithm for low-power neuromorphic hardware on remote-sensing drones. After their preliminary studies showed promising results—an accuracy of close to 97% in a recognition time of 18.4 seconds, with an energy consumption of only about 10 μJ—it was deployed overseas in the Republic of Korea and was widely appreciated. This was a first-of-its-kind technology in terms of computational speed, energy efficiency, and the fact that it could be placed on the drone itself, eliminating the need to process the data separately and taking the functionality of such drones beyond data collection while reducing overall cost.

In 2020, the team at Cyran developed another first-of-its-kind edge AI solution, this time in a completely different sphere of interest: education. Known as BUDDHI (Build, Understand, Design, Deploy, Human-like Intelligence), this DIY kit enables a child or people from outside the AI field to learn its basics and build simple AI systems. The kit includes an AI computing engine, AI training / inference applications, real-world AI actuation circuit boards, and a high-quality AI handbook, forming a learning ecosystem. The goal is to make the subject area of AI more accessible and intuitive for people, removing the commonly held perceptions of complexity that come with it. These indigenous kits have been a success

Prof Suri and his team receiving the Raksha Mantri's Excellence Award for Defence and Aerospace innovations.
Image credits: Cyran AI Solutions

in many educational institutions nationally. Hopefully, along with the changing times, as AI increasingly penetrates our lives, so will our understanding of the technology.

These and other solutions, such as those for sensors, security, biometrics, facial recognition, and geospatial image analysis, have earned the team at Cyran national innovation awards such as the National Award for Technology Startups by the Technology Development Board, Department of Science and Technology, the iDEX DISC Award from the Ministry of Defence, and Raksha Mantri's Excellence Award for Defence and Aerospace. They also won the recent Dare to Dream contest organised by the Defence Research and Development Organisation for neuromorphic vision sensors.

Cyran's products might appear vastly different, but the underlying concept is the same—delivering highly customised and precise edge AI solutions for users.

Innovations through collaborations

Many of these innovations were collaborative efforts between Prof Suri's team at IIT Delhi and other national and international companies and institutes. Collaborations, when they involve complementary knowledge exchange and foster new capacity building on both sides, are crucial for innovation.

For instance, a lot of the team's fundamental research at IIT Delhi is conducted in collaboration with institutions, foundries, and startups in Europe, the US, and Taiwan. The eNVM-based semiconductors for security applications were the product of a collaborative project between IIT Delhi, IIT Bombay, and Semicounductor Laboratory, Mohali, supported by the Office of the Principal Scientific Adviser to the Government of India. In collaboration with Israel-based semiconductor startup Weebit Nano, the team is helping apply Weebit's unique eNVM technology to computer chips for AI.

Intelligent Memory is the Basis of our Future

Neuromorphic chips are the basis of semiconductors that become platforms on which edge AI can run. These enable processing speed, energy efficiency, and cost savings on a level that finally makes the possibility of ubiquitous edge AI real. If these chips can be produced indigenously, we can harness the potential of the enormous amounts of data we have today to a much greater extent.

Today, while a human brain computes extremely complex data across billions of neuronal junctions within seconds, using only about 20 Watts of power, our finest supercomputers require many gigawatts of power, elaborate infrastructure, and considerable time to process much less information. Imagine a future where this is no longer the case. Imagine a future where the devices in our hands make sense of data as well as our brains can while consuming as little power as our brains do. Now, that will be a truly sustainable future for electronics.

With the work at IIT Delhi and Cyran, Prof Suri's team has taken the first steps towards this future.

ABOUT THE AUTHOR

Rachana Bhattacharjee is an author, creative lead, and one of countless chroniclers of the information age.

INDIA IN FOCUS

GM Mustard plants in a growth chamber at the Department of Genetics, University of Delhi
Image credits: Dr Deepak Pental

Breakthrough in the Indian Agriculture Industry in the form of Genetically Modified Mustard

— Somesh Thapliyal and Krittika Sengupta

The characteristics of all living organisms are a result of their genetic makeup. But through genetic engineering technology, scientists possess the power to alter these characteristics or introduce new ones by creating genetically modified organisms (GMOs).

The most common examples of GMOs are found in agricultural plants—they are genetically modified to have increased crop yield, enhanced nutrient composition, or even resistance to adverse environmental conditions. New DNA is added to the existing genetic makeup of a plant, and the seeds of these genetically modified (GM) plants continue to possess the new DNA as part of their genes.

So far, cotton is the only GM crop grown in India. According to a report published by the International Service for the Acquisition of Agri-biotech Applications (ISAAA), India has the 5th largest area under cultivation of GM crops globally, and all of it is used for cotton cultivation. However, with the Genetic Engineering Appraisal Committee (GEAC)—which oversees the approval for the environmental release of GMO varieties in India—approving the field trials for Dhara Mustard Hybrid 11 (DMH-11), the country now has its first indigenous GM food crop poised for commercial cultivation.

Developed at the Department of Genetics, University of Delhi, by Dr Deepak Pental and his colleagues, DMH-11 is a high-yield,

herbicide-resistant variety of mustard. To develop this variety, the "bar" gene from a non-pathogenic soil bacterium has been introduced into the mustard genome using the barnase-barstar system of genetic modification. According to Dr Pental, *"It is a very clean system, and the two proteins involved have been shown to be non-toxic."* The introduction of the "bar" gene allows the variety to tolerate the herbicide glyphosate.

Before being commercially cultivated, GM crops need to undergo a rigorous assessment of their food and environmental safety. This is to ensure that there are no unintended negative consequences of introducing certain genes into the crop. While the GEAC has reported that DMH-11 is safe for human consumption, it has ordered further testing of its effect on insect pollinators and soil microbial diversity and has approved field trials for the same. The trials will be conducted at two locations—Punjab Agriculture University (PAU), Ludhiana, and the Indian Agricultural Research Institute (IARI), New Delhi. The data gathered through these trials will allow scientists to better evaluate the readiness of DMH-11 for commercial release. Speaking about the importance of field trials, Dr Pental says, *"The real performance of a hybrid can only be measured when it is environmentally released. So far, we have only data from six to eight locations spread over a period of three years."*

Today, India is one of the world's largest importers of vegetable oil. The GEAC approval for field trials for DMH-11 is a progressive step towards reducing India's dependence on imports to meet its domestic demand. While a better domestic yield of mustard would benefit the country, environmental concerns also need to be addressed. Ultimately, the commercial release of GM crops developed in India using Indian cultivars could facilitate the progress towards an *Aatmanirbhar Bharat* and serve as a gateway for producing more hybrids, thus strengthening the agricultural prowess of India.

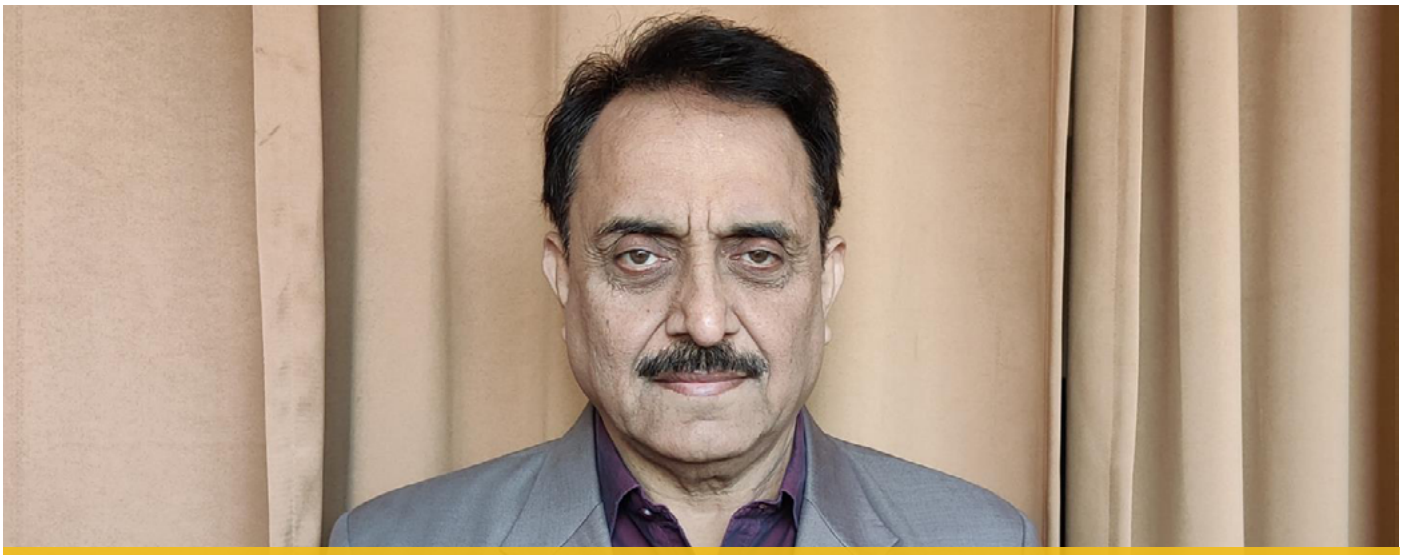
ABOUT THE AUTHOR

Somesh Thapliyal is a passionate storyteller who enjoys writing about science and its myriad mysteries.

Krittika Sengupta is a part-time content writer and editor, and a full-time content consumer

Dr Deepak Pental, Prof Akshay Pradhan, and Dr Vibha Gupta: Scientists involved in the development of DMH-11
Image credits: Dr Pental

IN CONVERSATION



Dr Toteja in his office at the Jodhpur City Knowledge and Innovation Foundation (JCKIF)
Image credits: JCKIF

A Dialogue with Dr G S Toteja, Chief Executive Officer, Jodhpur City Knowledge and Innovation Foundation

— Madhura Panse

The Jodhpur City Knowledge and Innovation Foundation (JCKIF) was launched in early 2021 as an initiative of the Office of the Principal Scientific Adviser (PSA) to the Government of India on the recommendation of the Prime Minister's Science Technology and Innovation Advisory Council (PM-STIAC). Registered as a section 8 company under the Companies Act 2013, JCKIF has been conceptualised with a vision of creating self-sufficiency in the region through innovations in science and technology. It has IIT Jodhpur as its nodal agency.

To understand JCKIF better, we spoke to Dr G S Toteja, its CEO. Before becoming the CEO of JCKIF in April 2021, Dr Toteja was the Director of ICMR-NIIR-NCD in Jodhpur. Later, he served as the Additional Director General of ICMR for a year. In this interview, he took us through JCKIF's journey, right from its conceptualisation during the COVID-19 pandemic, and its major accomplishments so far to its long-term vision and missions. He also talked to us about how his experience is helping him steer this JCKIF towards achieving future goals.

Organisational Structure and Primary Focus Areas

Reminiscing about JCKIF's early days and the development of its different focus areas, Dr Toteja said, *"When I joined in April 2021, the second wave of the COVID-19 pandemic was in full swing. So, it has been a difficult start. But this challenge has shaped what we do at the Cluster."* JCKIF started with four primary focus areas: water and environment, handlooms and handicrafts, medical technologies, and i-governance. Soon, on the advice of the

Office of PSA, it expanded and added two more verticals: artificial intelligence of things (AIOT), which acts mainly as a fabrication centre, and Thar DESIGNS.

The projects under these verticals are handled by an efficient core team composed of 11 people, including programme managers, assistant programme managers, and the CEO. The programme managers are allocated projects based on their expertise areas. The larger team is composed of a Board of Directors and an Advisory Committee that includes experts from academia and industry in the medical, technical, engineering, agriculture, and political spheres.

Handloom and Handicrafts

Jodhpur is a major hub of handlooms and handicrafts, so this is one of the major verticals that JCKIF works on. *"Jodhpur exports handicraft products worth almost 3000 crores rupees annually, contributing to a major chunk of the handloom export revenues in the country,"* Dr Toteja said. *"And this is just the data collected by the Export Council of India. A lot of local artisans and craftsmen directly contribute towards the handicrafts industry."* It was quite natural for JCKIF to contribute to the projects revolving around this industry.

The primary goal of these projects would be to help local artisans gain recognition and value for their work so that their economic condition can improve. One crucial project here is the automation of craft-making processes without compromising on the creativity and the signature elements of the craft itself. In this regard, Dr Toteja believes in "two P's: **Protecting** the interests of the artisans and **Preserving** the Indian culture."

JCKIF also regularly organises informative sessions with artisans from the unorganised sector of the handloom industry. These sessions aim to understand specific problems this sector faces and the ways they can be solved through right marketing and promotion.

Part of such promotion efforts in JCKIF's regular exhibitions is meant to generate awareness among people regarding the value of locally manufactured handloom products and generate admiration for the work. JCKIF has also created a digital museum for this craft and their artisans and is developing e-commerce websites to reach customers worldwide.

Dr Toteja believes that the digital universe and automation can be leveraged to revive this industry after the initial hit it took during the COVID-19 pandemic and take it to the next level. He stressed that many youths among the local artisans are educated and well-versed in the latest technological advancements, and so they can play a significant role in using these technologies to expand their family businesses. JCKIF will provide them with aid and support as they do so.

"With the tools we have today, if we keep working on the handloom and handicrafts industry, it will not only give people employment but also help preserve our traditional culture," says Dr Toteja.

A table at the Bone and Horn exhibition held by JCKIF in July 2022
Image credits: JCKIF

The Artificial Intelligence of Things (AIoT)

The AIoT vertical has been added recently, in line with the Semiconductor Mission launched by the Government of India. Under this vertical, a fabrication facility has been developed in the technology park at IIT Jodhpur for the end-to-end design, development, prototyping, and pilot production of AIoT systems and AI-powered sensors. The facility was developed in collaboration with RajCOMP Info Services Limited (RISL)—acting on behalf of the Govt. of Rajasthan and the Ministry of Electronics and Information Technology (MeitY)—along with other industries and academia knowledge partners. Apart from being a manufacturing hub for sensors, the facility is also expected to function as a capacity-building platform and incubation centre for upcoming startups while providing them with research and development facilities.

Dr Toteja said that all the projects under this vertical would be initiated and executed through a section 8 company which will be formed with the help of JCKIF and RISL members upon receiving approval from the Rajasthan cabinet. The goal here is to bring together the best minds from industry and academia to take cutting-edge innovation to where it is needed.

JCKIF as a Base for Inter-Institutional Collaboration

"Jodhpur is a hub of various institutions from different fields, from the medical sciences to agriculture, defence, and engineering. It is an opportunity for everybody to work together to create the future that we all envision," said Dr Toteja. He highlighted the unique objective that JCKIF has of leveraging this fertile environment for skill and knowledge building through collaborations. He talked about the recently launched Master's, PhD, and Master's–PhD dual degree programmes in Medical Technologies offered jointly by IIT Jodhpur and AIIMS Jodhpur, which JCKIF supports. This unique programme was conceptualised to combine the IIT's technical expertise with AIIMS' medical expertise to enable the in-house production of medical devices eventually. The program me is open for students from medical and technical backgrounds and is available as a post-graduate degree option. The classes are organised at the institutions, and the research work is conducted mainly in collaboration with the startups, which will help design and develop the invented products. These will then be eventually pitched to the industry for scale-up.

The Medical Technologies vertical has also launched a DeepTech Biodesign Centre at IIT Jodhpur to train, nurture, and transform clinicians and engineers into innovators in medical technology. It has also launched BioNEST, a startup incubator, supporting several unique initiatives, such as the one to develop cost-effective therapies for Duchenne muscular dystrophy disease and a pilot to test an AIoT-based hospital bed occupancy detection system.

This collaboration is also what underlies the work in the Water and Environment vertical—under which water purification, treatment, and supply technologies have been built to ensure clean water for everyone, particularly the underserved sections of society—and the I-Governance vertical, where AI is being leveraged to improve efficiency in traffic surveillance and crime management systems across Jodhpur.

Thar DESIGNS (Desert EcoSystem Innovations Guided by Nature and Selection)

The work of JCKIF cannot be complete without a mention of the vast Thar desert.

Clay ceramic water filters called "G-Filters" were provided to households without access to piped water infrastructure to ensure clean drinking water. Image credits: JCKIF

Thar DESIGNS was primarily initiated to study and understand the ecology of this desert, specifically its soil compositions and their relationship to the vegetation, such as plants that are involved in improving the natural microbial composition of the soil or those that harbour medicinal properties. This knowledge could be leveraged to improve existing healthcare, food security, and living conditions today and help navigate the effects of climate change in the region in the long term.

Personal Learnings

Dr Toteja is passionate about the work he does at JCKIF. This is not only because of its significance and potential to impact the nation but also because of how he perceives life. He said, he still *"feels like a higher secondary school student"* because learnings never end, no matter what position one reaches. *"One common thing between when I started my career in 1984 and now is that I continue to work with complete dedication, and I enjoy my work, regardless of the amount or the responsibilities handed to me."* He stressed the importance of working together, the role of collective leadership, and the value of collaboration. Talking about preparing for the future, he spoke about the importance of motivating and promoting talent among the youth via different capacity-building activities.

"One should always appreciate and motivate others and take them along while progressing in one's life and career," he concluded. *"This is the key to success."*

This value is perhaps one that underlies several JCKIF initiatives, from promoting handlooms and handicrafts to building capacity and equipping the nation's youth to take it forward.

ABOUT THE AUTHOR

Madhura Panse is an educator, career counsellor, and freelance science writer.

SCIENCE AND TECHNOLOGY CLUSTERS

Prof Ajay Kumar Sood, the Principal Scientific Adviser to the Government of India, launching the Bengaluru Science and Technology Cluster
Image credits: Office of PSA

Bengaluru Science and Technology Cluster Launched

— PSA Content Desk

On November 16, 2022, Prof Ajay Kumar Sood, Principal Scientific Adviser (PSA) to the Government of India, launched the Bengaluru Science and Technology (S&T) Cluster—or BeST Cluster, in short—at the plenary session of the Bengaluru Tech Summit. The launch took place in the presence of Prof G Padmanabhan, former Director, Indian Institute of Science (IISc), Mr Kris Gopalakrishnan, Co-Founder, Infosys, and other dignitaries.

At the launch ceremony, Prof Sood said, *"Bengaluru has enormous technological potential, and the state of Karnataka is among the leaders in science and technology advancements. The BeST Cluster will be a platform of active collaboration for the entire R&D ecosystem in the region."*

The purpose of establishing S&T clusters in six different regions of the country—for the first time in India's history—is to bring together local collaborators from industry, government, and academia and enable them to work in synergy while retaining their autonomy. The S&T clusters aim to provide collaborative solutions to their respective regions' unique environmental, socioeconomic, and developmental problems, which can then be scaled up to contribute to national missions, and finally be applied globally.

Prof Govindan Rangarajan, Director of IISc, remarked, *"The BeST cluster launch could be a landmark moment for science and technology in India and possibly the world. We aim to bring together stakeholders with shared ecosystems, such as I-STEM and Manthan, and then follow this ground-up pyramid model."*

The ground-up pyramid model refers to the three objectives which the S&T clusters across the country are expected to achieve: first, sharing high-end labs and equipment through the I-STEM portal of the government, allowing mobility of

researchers, and conducting high-quality human resource development programmes; second, becoming a regional solution provider through collaboration with local incubators, S&T councils, and innovation societies; and finally, becoming nationally and globally competitive by focusing on 1–2 domains of key strength.

Over the past few years, the five other S&T clusters in Delhi, Jodhpur, Pune, Hyderabad, and Bhubaneswar, have adhered to this mandate and made great strides in their areas of expertise, taking crucial steps to de-smog air, de-silt water, bring climate resilience to agriculture, improve access to healthcare, promote local handicrafts, support women in STEM, and much more.

Prof Sood addressing the Bengaluru Tech Summit, 2022.
Image credits: BeST

Now, with the Office of PSA having sanctioned the seed funding for BeST in September 2022 and given Bangalore's incredible R&D and innovation potential, it is time for BeST to follow in its footsteps.

Today, at its inception, BeST is composed of several organisations, including industry partners, academic institutions, start-ups, civil society organisations, and government bodies. It has identified health and wellness, urban life, and futuristic technologies as its focus sectors. It has set up teams to work in one health, digital health, precision agriculture, urban transportation, monsoon and climate change, quantum technologies, active matter and robotics, and jet engines.

Furthermore, the setting up a Section 8 company is in the works to provide organisational support and raise and manage resources to help the Cluster not only harness Bangalore's full potential to solve the pressing issues that Karnataka faces but also contribute to broader challenges that humanity is tackling.

"BeST can leverage Bengaluru's research and industry ecosystem for taking on ambitious multi-disciplinary, multi-year programmes which meet national strategic goals. This requires careful design of the programme, careful selection of participants, setting achievable goals, and tracking of these goals to ensure timely progress," said Kris Gopalakrishnan.

Given the support and vibrant innovation ecosystem it is beginning its journey with, BeST, the newest of the six S&T clusters, is sure to soon make valuable additions to India's efforts to achieve sustainability and self-sufficiency for a prosperous future.

INDUSTRY–ACADEMIA ENGAGEMENT

Project SAMEER
Image credits: CKIC–DRIIV

Project SAMEER: Curbing Air Pollution Through Collaboration

— Krittika Sengupta

Over the past few decades, air pollution has grown to become a major public health issue in India, with up to 35 of the 50 cities with the poorest air quality in the world being located in the country. Reports indicate that people living in India breathe air that is approximately 10 times more polluted than the levels deemed safe by the World Health Organization (WHO). Studies have shown that, Delhi is among the worst affected cities, making it a hotbed for worsening medical conditions such as lung cancer, asthma, and heart disease.

While there is no dearth of research and policies to control air pollution, these efforts have been largely discrete and not collaborative, leading to limited impact. The need of the hour is for citizens, researchers, innovators, government bodies, industries, corporations, funders, philanthropic organisations, and other involved stakeholders to align their ideas and build an evidence-based strategic roadmap to a meaningful solution.

This is where the City Knowledge Innovation Cluster, Delhi Research, Implementation, and Innovation (CKIC–DRIIV) comes into the picture. As one of the six Science and Technology (S&T) clusters set up by the Office of the Principal Scientific Adviser (PSA) to the Government of India, CKIC–DRIIV's mandate is to facilitate collaboration among various stakeholders and create an environment in which innovations can be taken from lab to market to address the country's socio-economic and developmental problems. To tackle air pollution in Delhi, DRIIV launched **Project SAMEER—Solutions for Air Pollution Mitigation through Engagement, Engineering, and Research** on October 19, 2022.

Team members of Project SAMEER
Image credits: CKIC–DRIIV

In an exclusive interview with *Vigyan Dhara*, Shipra Misra, CEO of DRIIV, explained, *"In order to truly solve the problem of air pollution, it is important to control emissions at source and DRIIV is working on renewable energy and sustainable mobility technologies to help achieve that. However, project SAMEER has successfully achieved the three objectives it was designed to deliver. Firstly, the well structured pilot with clearly defined outcomes brought together startups and public bodies—DPCC and GMDA—to address the problem of air pollution monitoring and mitigation in Delhi–NCR. Such an engagement, without any mediating platform such as DRIIV, would not be possible. Secondly, a framework for technology validation has been established where startups can get their solutions validated in real life conditions from the country's premiere institutes such as IIT Delhi and AIIMS. Finally, a number of corporations and government bodies have come forward to adopt the technology solutions or financially support their adoption."*

Project SAMEER is the first of its kind in design, as it involves all the stakeholders who have the responsibility, authority, and capability to tackle the problem—local government authorities, researchers from IIT Delhi, tech start-ups, corporates, NGOs, and citizens—working towards the goal to de-smog the capital. A three-pronged approach involving (i) awareness and community engagement, (ii) S&T interventions, and (iii) brainstorming ideas with the industry has been outlined for implementing the project.

Community awareness is targeted towards selective communities like farmers in the region who, over the past couple of decades, have been burning stubble or '*parali*' in their fields; urban slums where people still use *angithis*, which release thick smoke; school and college students; and residential welfare associations. It aims at providing these communities with alternative solutions to reduce their contribution to air pollution while educating them about the adverse health effects of current practices that contribute to air pollution and smog. For example, stubble burning—a technique implemented by the farming community in Punjab and Haryana to clear the fields for sowing new seeds at the start of the winter season—seriously impacts respiratory health.

As part of Project SAMEER, DRIIV has been conducting workshops and webinars to engage with these communities. One such webinar was conducted in collaboration with the Lung Care Foundation and the India Paryavaran Sahayak (IPS) Foundation, with a total of 200+ attendees comprising farmers, village healthcare professionals, and NGOs. It was hosted by Dr Arvind Kumar, Chairman, Lung Surgery, Medanta. During the session, the farmers were presented with alternative

options to burning stubble, such as a machine to pulverise it into manure or useful biomass. The goal was to encourage governing bodies and influential community members in villages to spread this information and ultimately persuade farmers to shift away from stubble burning. Dr PS Bakshi, a member of the National Core Team, Doctors for Clean Air and Climate Action (DFCA), who was part of the workshop, shared the success story of the village he hails from, where a similar initiative resulted in farmers completely moving away from *parali* burning—instead, the stubble is used to feed cattle and other livestock.

In association with the Lung Care Foundation, DRIIV's Effective Education Team and the Arun Duggal Centre of Excellence for Research in Climate Change and Air Pollution (CERCA) are also organising workshops on 'Sustainable Air Quality' in schools and colleges across Delhi and Gurugram. The aim of these workshops is to connect educators with air quality experts, regulators, scientists, and technological partners. Spreading community awareness among students in schools and colleges can inspire them to follow a scientific approach towards air pollution, think critically about the problem, and develop innovative solutions to shift to more eco-friendly alternatives.

For the second prong, which is S&T interventions, DRIIV reached out to start-ups in the National Capital Region (NCR) to volunteer technologies for a pilot study across the region. *"The idea is to analyse the extent to which air quality can be improved through tech intervention,"* said Amrita Dawn, Head of Tech Liaison at DRIIV, speaking of this prong of the project. Technologies ranging from those addressing small-scale pollution, such as Rena's device which can convert ceiling fan blades to air filters; to those dealing with large-scale industrial level pollution, such as Omnilon's air pollution control device; and everything in between, such as the mobile air pollution laboratory CarLab, roof-mountable vehicular air filter Shudhvayu, and energy efficient Ventilated Air Purifying Units (VAYU) are among the technologies whose efficacies are being tested at five hotspots in NCR. Some of these have already been deployed, while others are in the process of being installed. Two calibrated sensors—one within the impact area of the technologies being tested

A few of the technologies being implemented as part of the S&T interventions in project SAMEER
Image credits: CKIC–DRIIV

and the other outside the impact zone—will allow for a comparison of air quality to understand better how these technologies affect the air quality in the hotspots. The results will be validated by Prof Sagnik Dey, Institute Chair Professor, Centre for Atmospheric Sciences, IIT Delhi. Based on his findings, some of these technologies will then be scaled up to the national level.

The goal of Project SAMEER is not only to tackle air pollution but also to inspire other innovations in various aspects of sustainability and to elicit greater interest in such interventions from the corporate community. This is where conferences and brainstorming sessions with the industry come in. Under this prong, DRIIV, in collaboration with CERCA, is hosting a series of workshops with CEOs and the sustainability champions of various companies. These workshops, or industry roundtables, are expected to create awareness about the industry's role in actively reducing its negative environmental footprint and scaling up such initiatives that are not only practical but also economically feasible and beneficial in the long run.

The first of these roundtables was held on November 22, 2022 at IIT Delhi. It was attended by 15 industry leaders—from sectors such as automobile, power, energy, etc.—and 15 tech entrepreneurs. Meaningful industry engagements with governments and civic bodies were discussed; the importance of committing industry resources as a part of CSR initiatives was emphasised; several industry partners pledged their support for facilitating the large-scale implementation of the technologies currently being piloted under Project SAMEER.

Speaking of the long-term potential of Project SAMEER to take the country forward, Shipra said, *"Encouraged by its success, DRIIV shall strive to replicate this model in other areas of environmental concerns such as waste management and water security."*

Project SAMEER is just the beginning. It is the first step in a journey to steadily and surely not only curbing air pollution at source but also making systemic changes with socio-economic impact to create a sustainable economy.

ABOUT THE AUTHOR

Krittika Sengupta is a part-time content writer and editor, and a full-time content consumer

CKIC–DRIIV hosting an industry roundtable as part of Project SAMEER
Image credits: CKIC–DRIIV

ACTIVITIES

Representatives of the various countries at the planning meeting.
Image credits: Office of PSA

Planning Meeting on G20–Chief Science Advisers Roundtable (G20–CSAR) Organised

The planning meeting of the G20–Chief Science Advisers Roundtable (G20–CSAR) was held on Friday, January 20, 2023, in online mode, to discuss the agenda topics and planning for the proposed high-level roundtables.

Dr (Mrs) Parvinder Maini, Scientific Secretary at the Office of the Principal Scientific Adviser to the Government of India, chaired the meeting. Senior officials representing Argentina, Australia, Brazil, Canada, China, European Union, France, Germany, Indonesia, Italy, Japan, Korea, Mexico, Netherlands (invitee country), Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, and United States participated and provided their comments and suggestions on the topics of mutual interest for this initiative.

One Health, Open Access to Scholarly Scientific Knowledge, Emerging Technologies, and Scientific Data Sharing are indicative sets of agenda topics for G20–CSAR that emerged during the discussion.

G20–CSAR is a government-to-government level initiative conceptualised through India's G20 Presidency. The motivation of this initiative is to bring together the Chief Science Advisers and their equivalents of G20 member countries, as well as the invited countries, to deliberate upon and develop collaborative frameworks for some of the common pressing global science and technology (S&T) policy issues. This initiative will also help in establishing an effective and coherent global science advice mechanism.

More here: **https://g20csar.org/**

A snapshot of the meeting at the Whitehouse.
Image credits: ANI

Prof Ajay Kumar Sood Participated in the Inaugural Meeting of the iCET at the White House

Prof Ajay Kumar Sood accompanied National Security Adviser Shri Ajit Doval on an official visit to Washington DC, from January 30 to February 1, 2023. Other members of the delegation included senior officials of the Government of India as well as Indian industry leaders.

Together with US National Security Adviser Jake Sullivan, NSA Doval co-chaired the inaugural meeting of the initiative on Critical and Emerging Technologies (iCET) at the White House on January 31, 2023, translating into action the announcement made by Prime Minister Narendra Modi and President Joseph Biden during their meeting in Tokyo in May 2022. The NSA was joined at the launch by the Ambassador of India to the United States; Principal Scientific Adviser to the Government of India; Secretary of the Department of Telecommunications, Chairman of ISRO; Scientific Adviser to the Raksha Mantri; Director General of DRDO, and other senior officials from the National Security Council Secretariat and Ministry of Electronics and Information Technology. On the US side, the NASA Administrator; Director, National Science Foundation (NSF); Deputy National Security Advisor, amongst others, participated.

iCET aims to position the two countries as trusted technology partners by building technology value chains and support the co-development and co-production of items. It also aims to address regulatory restrictions,

export controls and mobility barriers through a standing mechanism. The US side also assured support to ease export barriers to India in a few critical areas, including through efforts towards legislative changes. Emphasis was placed on strengthening linkages between the startup ecosystems and building innovation bridges in key sectors between the two countries through expos, hackathons, and pitching sessions.

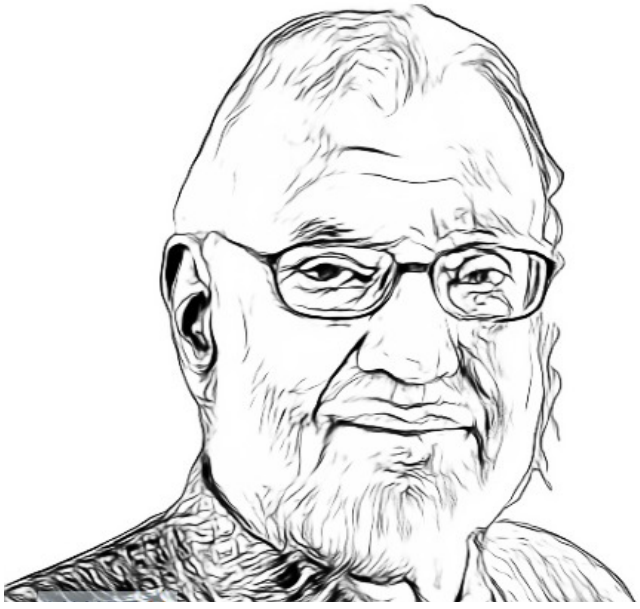
Among other issues, recognising the importance of quantum technologies, both sides established a quantum coordination mechanism with participation from industry and academia. In the field of semiconductors, the US supported the development of a fabrication ecosystem in India and encouraged joint ventures and partnerships for mature technology nodes and advanced packaging. It was agreed to constitute a task force involving India's Semiconductor Mission, India Electronics Semiconductor Association (IESA), and the US Semiconductor Industry Association (SIA) to develop a "readiness assessment" to identify near-term opportunities and facilitate longer-term development of semiconductor ecosystems.

Ambassador Taranjit Singh Sandhu, Shri Ajit Doval and Prof Ajay Kumar Sood at the inaugural meeting of the iCET at the White House
Image credits: Embassy of India, Washington DC

More here: **https://bit.ly/3JfgCiM**

Prof Ajay Kumar Sood receiving the Prof MGK Menon Award for 2022
Image credits: Office of PSA

Prof Ajay Kumar Sood Conferred the Prof MGK Menon Award by the National Academy of Sciences, India



The National Academy of Sciences, India, the oldest of science academies in India, conferred upon Prof Ajay Kumar Sood with the Prof MGK Menon Award for the year 2022, on February 28, 2023. Accepting the award, Prof Sood also delivered the Prof MGK Menon Memorial Lecture on Chirality in Action.

The Prof MGK Menon Award is given to an eminent Indian scientist for their contribution to any area of Science and Technology development, promotion, popularisation, and application.

Prof Menon, in whose honor this award is given.
Artistic rendition generated using AI. Source image credits: science.org

Bill Gates standing next to Prof Ajay Kumar Sood at the Meeting with the Office of PSA.
Image credits: Office of PSA

Bill Gates, Co-Chair and Trustee of Bill and Melinda Gates Foundation, Called on Prof Ajay Kumar Sood

On March 1, 2023, Bill Gates, Co-chair and Trustee of the Gates Foundation, visited the Office of the Principal Scientific Adviser to the Government of India to meet Prof Ajay Kumar Sood to understand priorities and explore further collaborations.

In this meeting, Prof Sood gave an overview of the work of the Office of PSA's wide-ranging engagements, including the National Missions on One Health; Quantum Technologies; Livelihood; Green Hydrogen; One Nation, One Subscription; etc. The discussion focused majorly on priority engagements of the One Health Mission and Waste to Wealth Mission with the Foundation.

Mr Gates appreciated the focus on science and technology initiatives. He expressed interest in supporting the Government of India's efforts on the upcoming One Health Mission and the power of environmental surveillance for disease control. He stressed the need for innovations to address animal health, disease modelling, and novel diagnostics technologies. He further emphasised the opportunity for India to support both domestic and global challenges in these areas.

More here: **https://bit.ly/3n0bzeE**

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Policy Analytics and Insights Unit (OPSA-PAIU) Established

The Office of PSA has set up the Policy Analytics and Insights Unit at the Indian Institute of Science (IISc) Bengaluru to provide data analysis and policy support for its various initiatives: Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC), Empowered Technology Group (ETG), National Research Foundation (NRF), and international initiatives such as G20, United Nations Climate Change-Conference of Parties (COP), S&T matters of Quadrilateral Security Dialogue (QUAD), Indo-US initiative on Critical and Emerging Technologies (iCET), Indo-EU Trade and Technology Council (TTC), etc.

VACANCIES

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Recruitment of Scientist D and Scientist F in the Office of PSA on Deputation / Direct Recruitment Basis

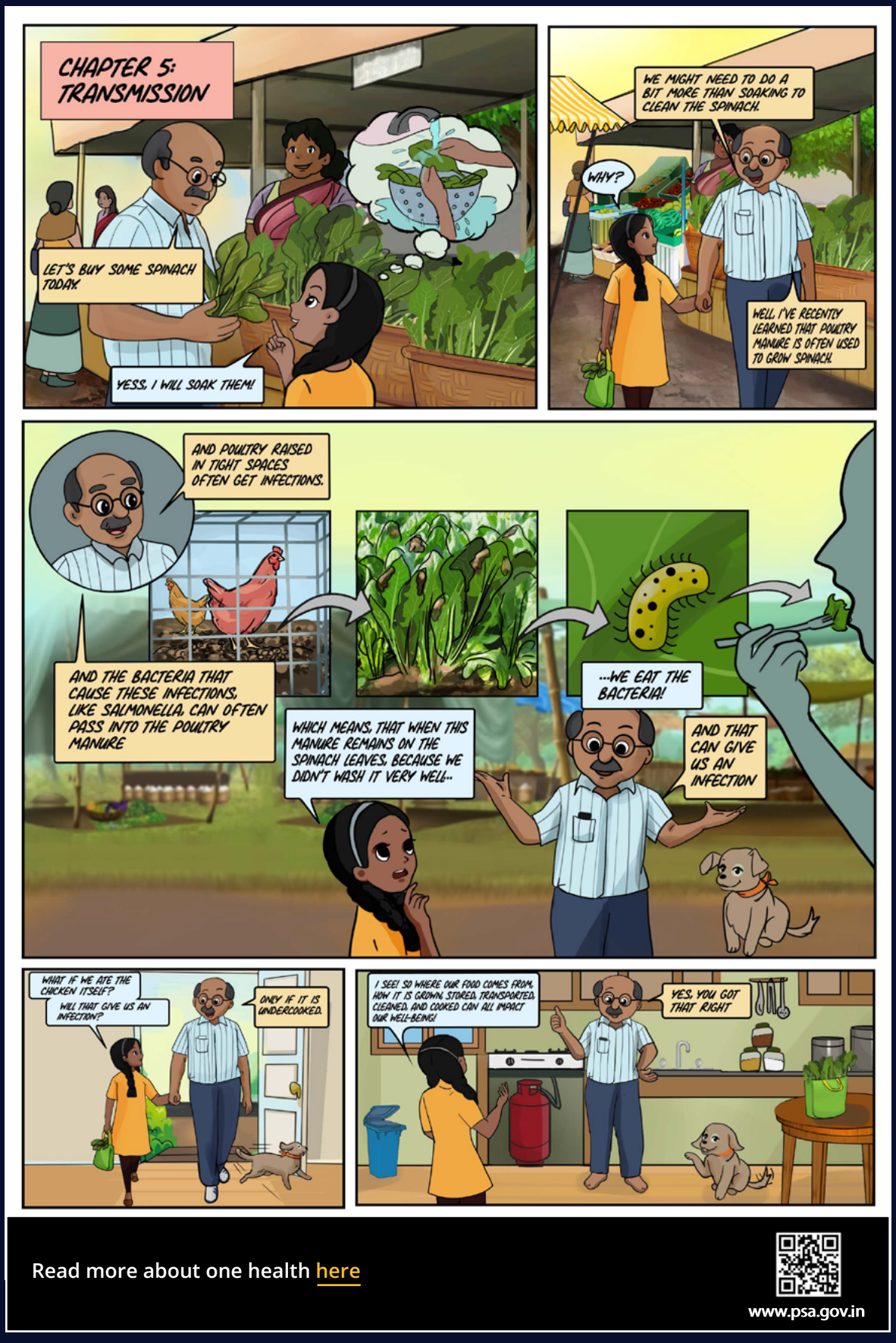
Applications are invited from Indian citizens for appointment to the following Scientific posts in the Office of the Principal Scientific Adviser to the Government of India on a deputation / direct recruitment basis:

Name of Posts	No. of Posts	Pay Level in the Pay Matrix
Scientist 'D'	02	Level 12
Scientist 'F'	02	Level 13A

More here: **https://bit.ly/3EpXuNN**

Adventures of Dadu, Mitti, and Samosa

— Concept and story: Ipsa Jain; Illustration: CrazzyPixels



Read more about one health here

www.psa.gov.in

ABOUT THE AUTHOR

Ipsa Jain is a scientist turned illustrator. She makes zines, books, stories, and images to share her love and joy for science.

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