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Q U A N T U M L E A P I N
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Address of Prime Minister Shri Narendra Modi at 108th Indian Science Congress

N

amaskar!

Many congratulations to all of you for organizing the 'Indian Science Congress'. The role of India's scientific power will be very important when India will be at its pinnacle in the next 25 years. Unprecedented results follow when the determination to serve the country is combined with the passion in science. I am confident that the scientific community of the

country will help India achieve the position it deserves in the 21st century. I also want to share the reason for this belief with you. You all know that observation is the basic foundation of science. Scientists follow patterns through observation and they reach a conclusion after analyzing those patterns.

It is very important for a scientist to collect and analyze data at every step. We have two things in abundance in today's 21st century India. First - data and second - technology. Both of them have the power to take India's science to new heights. The field of Data Analysis is progressing at a fast pace. It helps in converting information into insight and analysis into actionable knowledge. Whether it is traditional knowledge or modern technology, both of them are helpful in scientific discovery. Therefore, we have to develop investigative attitudes towards different techniques to make our scientific process stronger.

Friends,

We are also seeing the results of the scientific approach with which today's India is moving forward. India is fast becoming one of the top countries of the world in the field of science. Out of 130 countries, we were at number 81 in the Global Innovation Index till 2015. But we have jumped to 40th position in 2022. Today India is among the top three countries in the world in terms of PhDs. Today India is among the top three countries in the world in terms of start-up ecosystem.

Friends,

I am happy that the theme of the Indian Science Congress this time is such which is being discussed the most in the world. The future of the world is secure only with sustainable development. You have linked the topic of sustainable development with women empowerment. I believe that these two are related to each other practically also. Today the country does not think about women empowerment through science only. Rather, our aim is that we should empower science with the participation of



women and give new momentum to science and research. Recently, India got the responsibility of chairing the G-20 group. Women-led development is also a major priority among the major topics of the G-20. In the last eight years, India has accomplished many such extraordinary things from governance to society and economy, which are being discussed today. Whether it is participation in small industries and businesses through Mudra Yojana or leadership in the start-up world, women are displaying their mettle everywhere in India. The participation of women in extramural research and development has doubled in the last eight years. This increasing participation of women is proof that the society as well as science is also progressing in the country.

Friends,

The real challenge for any scientist is to convert his knowledge into applications that can help the world. When a scientist goes through his experiments, he always has this question in his mind whether it will improve the lives of the people or will his discovery meet the requirements of the world? Scientific efforts can turn into great achievements only when they hit the ground from the lab, when their impact is from global to grassroots, when they expand from journals to reality and when the innovations from research reflect in real life.

Friends,

An important message is conveyed when great achievements of science progress from experiments to experiences of people. This influences the youth a lot. They think that they can influence the whole world through science. Institutional framework is needed to encourage such youth so that their aspirations can be expanded and new opportunities are offered to them. I would like the

scientists present here to develop such an institutional framework which would attract young talents and give them an opportunity to progress. For example, talent hunts and hackathon events can be organized to spot scientifically minded children. Then the perception of those children can be developed through a proper roadmap. Senior scientists can help them in this regard. Today we see India scaling new heights in sports. There are two important reasons behind this. First, the institutional framework was strengthened in the country to develop sports talents. Second, the existence and influence of the 'guru-shishya' tradition in sports was developed so that new talents are recognized and nurtured and where the Guru sees his success in the achievement of his disciple. This tradition can also become the mantra of success in the field of science.

Friends,

Today, I want to put forward some issues before you, which will be helpful in deciding the direction of science in India. The basic motivation of our scientific community should be the development of science in India to meet the needs of the country. Science in India should be such which will make India self-reliant. We also have to keep in mind that today 17-18 percent of the world's human population lives in India. Scientific works should be such which will fulfill the needs of India and will give momentum to 17-18 percent of the world's humanity. And its effect will be on the entire humanity. Therefore, we should work on such issues which are important for the entire humanity. For example, if we take the issue of energy. India's energy needs are going to grow continuously. In such a situation, if the scientific community of India makes innovations related to energy requirements, then it will be of great benefit to the country. In particular, the country is working on the National Hydrogen Mission for the immense possibilities in hydrogen energy. To make it successful, it is necessary that various essential components like electrolyzers should be made in the country itself. If there is scope for any new options in this direction, then research should be carried out in that direction also. Our scientists and the industry have to work together in this regard.

Friends,

Today we are living in such an era when humanity is facing the threat of new diseases. We have to promote research and development to prepare new vaccines in the same way we are prepared in advance to deal with catastrophes like floods or earthquakes. Similarly, we have to identify diseases well in time through Integrated Disease Surveillance and take measures to deal with them. Different ministries will have to work together to achieve this goal. All of you my friends are very well aware about LiFE i.e. Lifestyle for Environment. Our scientific community can be of great help in this direction.

Friends,

The United Nations has declared this year i.e. 2023 as the International Year of Millets

on the call of India. This is a matter of great pride for every Indian. Work can be done to improve India's millets and their use. Effective steps can be taken by the scientific community to reduce post-harvest losses with the help of biotechnology.

Friends,

Today there are immense possibilities of scientific research in the waste management sector as well. Municipal solid waste, electronic waste, bio-medical waste, agricultural wastes are such areas, which are continuously expanding. This is the reason the government laid a lot of emphasis on the circular economy in last year's budget. Now we have to further strengthen the Mission Circular Economy. For this, we have to work on such innovations which can make better use of metal and plastic scrap. We have to work simultaneously on curbing pollution and making scrap useful.

Friends,

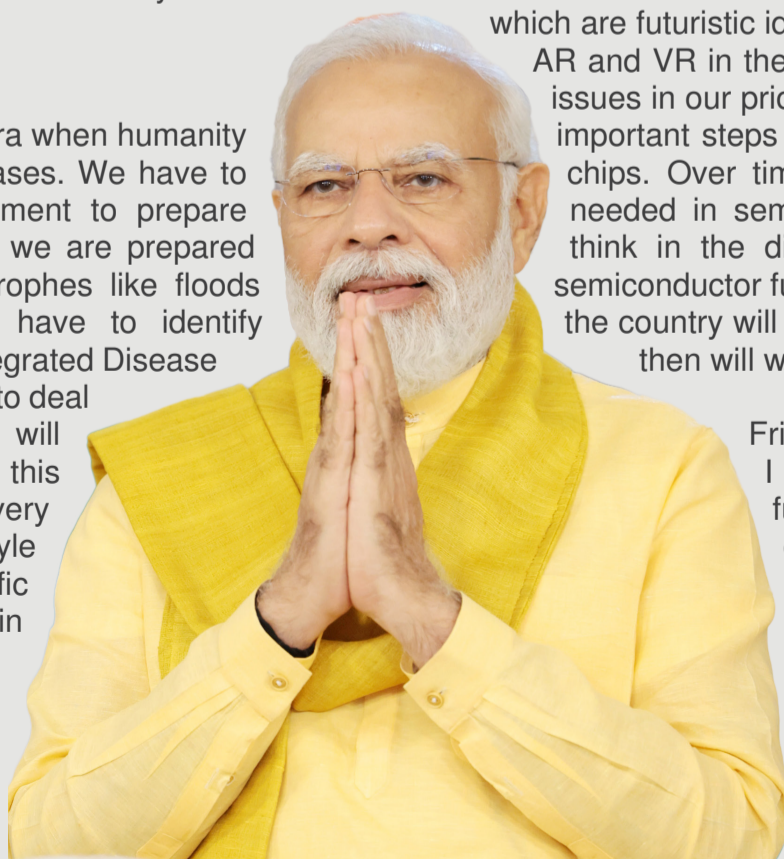
Today India is also scaling new heights in the space sector. Due to low-cost satellite launch vehicles, our capacity will increase and the world will come forward to use our services. Private companies and start-ups can take advantage of these opportunities. Start-ups can find a way forward by associating with R&D labs and academic institutions. Similarly, Quantum Computing is another such issue. Today India is making its mark in the world as a quantum frontier. India is moving fast in the direction of quantum computers, quantum chemistry, quantum communication, quantum sensors, quantum cryptography and new materials. I would like our young researchers and scientists to gain expertise in the field of quantum and lead in this field.

Friends,

You also know that the one who takes the initiative takes the lead in science. Therefore, we not only have to take note of what is going on in the world but at the same time to focus on the works which are not being done anywhere and which are futuristic ideas. Today there is debate on AI, AR and VR in the world. We have to include these issues in our priorities. The country is taking many important steps in the direction of semiconductor chips. Over time, new innovations will also be needed in semiconductor chips. Why don't we think in the direction of making the country's semiconductor future ready from now itself? When the country will take initiative in these areas, only then will we be able to lead Industry 4.0.

Friends,

I am sure a clear roadmap for the future will be prepared on various constructive points in this session of the Indian Science Congress. We have to make India the most advanced laboratory of modern science in the 'Amrit Kaal'. With this wish, many thanks to all of you and my best wishes for this summit. Namaskar!

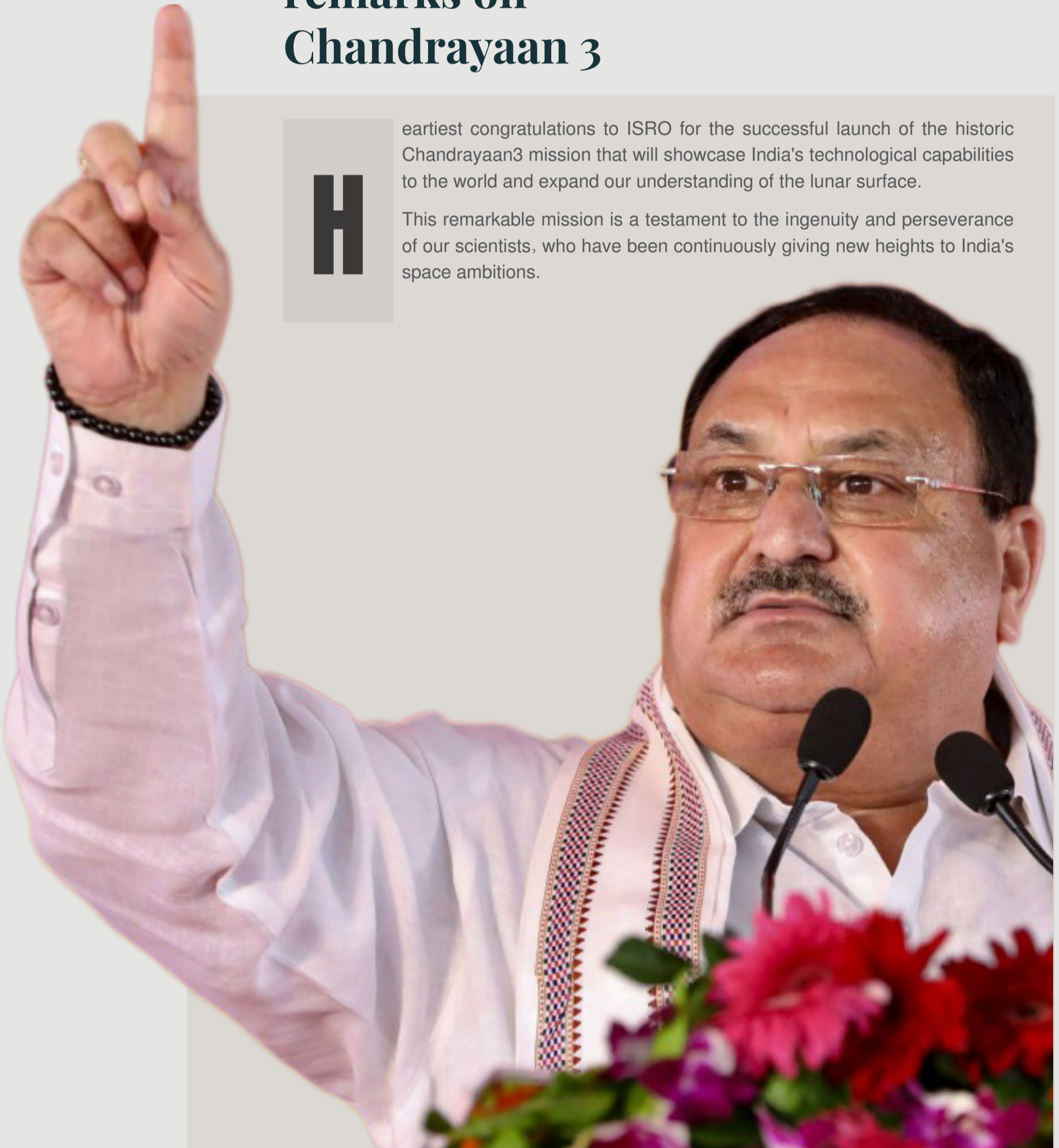


Shri J.P. Nadda's remarks on Chandrayaan 3

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earliest congratulations to ISRO for the successful launch of the historic Chandrayaan3 mission that will showcase India's technological capabilities to the world and expand our understanding of the lunar surface.

This remarkable mission is a testament to the ingenuity and perseverance of our scientists, who have been continuously giving new heights to India's space ambitions.





Message from the BJYM President Shri Tejasvi Surya

Namaskar!

From the outset, the Modi government has prioritised science and technology as key drivers of growth and development. We have seen a significant increase in budget allocation for research and development, which has led to a surge in innovation and technological advancements. Our scientists and technologists have been given the freedom and resources they need to push the boundaries of knowledge and create solutions that address our unique challenges.

O

ne of the most significant achievements has been in the realm of space technology. Under the Modi government, the Indian Space Research Organisation (ISRO) has reached new heights. We have successfully launched the Mars Orbiter Mission, making India the first Asian nation to reach Mars orbit and the first in the world to do so in its maiden attempt. Our Chandrayaan-2 and Chandrayaan-3 missions have furthered our understanding of the moon, and the upcoming Gaganyaan mission will take Indian astronauts to space, a testament to our capabilities.

In the field of digital technology, the government's 'Digital India' initiative has transformed the way we live and work. It has made government services more accessible to the common man, promoted digital literacy, and fostered a culture of innovation and entrepreneurship. The Unified Payments Interface (UPI) has revolutionized digital payments, making transactions seamless and secure for millions of Indians.

In healthcare, our scientists have made significant strides. The development and production of COVID-19 vaccines in record time is a shining example of our scientific prowess and resilience. Our biotechnology sector is booming, with advancements in genomics, personalized medicine, and bioinformatics.

In the realm of renewable energy, we have made significant strides towards achieving our goal of 175 GW of renewable energy capacity by 2022. Our efforts in solar and wind energy have put us on the global map as a leader in clean energy.

The 'Atal Innovation Mission' has fostered a culture of innovation and entrepreneurship at the grassroots level, encouraging young minds to think creatively and solve problems.

The focus on making India a global manufacturing hub has also led to advancements in industrial technology, with increased automation and the use of AI and IoT in manufacturing processes.

In telecommunications, we have made significant progress in expanding the reach of high-speed internet to the country's remotest corners. The upcoming 5G rollout will revolutionise our digital infrastructure, opening up new avenues in fields like telemedicine, remote education, and smart cities.

The Modi government has also been proactive in addressing the challenges posed by climate change. We have undertaken numerous initiatives to promote sustainable practices, from large-scale afforestation drives to promoting electric mobility. Our commitment to the Paris Agreement and our ambitious renewable energy targets reflects our dedication to creating a sustainable future for our nation.

The last nine years under the Modi government have been transformative for India's science and technology landscape. We have laid a strong foundation for a future where science and technology drive our growth, prosperity, and global standing. We remain committed to fostering a culture of scientific curiosity, innovation, and technological advancement as we move forward. We will continue investing in our scientific institutions, supporting our researchers, and creating an environment encouraging innovation and entrepreneurship.

Vande Mataram

Tejasvi Surya

National President
Bharatiya Janata Yuva Morcha

Editorial

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ince assuming office in 2014, the Bharatiya Janata Party (BJP) government led by Shri Narendra Modi has placed significant emphasis on fostering innovation, research, and development in the fields of science and technology. Recognizing

the crucial role of science and technology in driving economic growth, social progress, and national security, the government has launched numerous initiatives and programs to propel India's technological landscape forward. One of the flagship initiatives of the BJP government is the "Digital India" campaign. Launched in 2015, Digital India aims to transform India into a digitally empowered society and knowledge economy. The initiative focuses on harnessing the power of digital technologies to bridge the digital divide, promote digital literacy, and enable access to government services electronically. Projects such as the BharatNet initiative, which aims to provide high-speed broadband connectivity to rural areas, and the National Knowledge Network (NKN), which connects educational and research institutions, have expanded digital access and connectivity across the country. The campaign has also spurred the growth of the digital ecosystem, encouraging the development of startups and fostering innovation in areas such as e-commerce, fintech, and digital payments. The Digital India campaign has played a pivotal role in transforming India into a digitally inclusive nation and positioning it as a global technology hub. Another flagship initiative of the BJP government is "Make in India." Launched in 2014, Make in India aims to transform India into a global manufacturing hub and promote entrepreneurship and innovation. The initiative focuses on attracting domestic and foreign investment, fostering a favorable business environment, and promoting skill development. Make in India has particularly emphasized key

The Digital India campaign has played a pivotal role in transforming India into a digitally inclusive nation and positioning it as a global technology hub. Another flagship initiative of the BJP government is "Make in India."

sectors such as electronics, automobiles, defense manufacturing, pharmaceuticals, and renewable energy. The government has introduced policy reforms, streamlined regulations, and launched specialized programs such as the Modified Special Incentive Package Scheme (M-SIPS) and the Electronics Manufacturing Clusters (EMC) scheme to promote domestic manufacturing and incentivize



investment. Additionally, the government has taken steps to strengthen intellectual property rights (IPR) protection, encourage research and development (R&D) activities, and promote technology transfers. These measures have contributed to the growth of the manufacturing sector, job creation, and the development of indigenous technologies. To nurture a culture of innovation and entrepreneurship, the BJP government launched the Atal Innovation Mission (AIM) in 2016 with the aim of promoting innovation and creating a network of incubation centers, tinkering labs, and research and development centers across the country. It focuses on fostering a spirit of creativity, critical thinking, and problem-solving among students and young entrepreneurs. Under AIM, Atal Tinkering Labs (ATLs) have been established in schools to provide hands-on experience in innovation and emerging technologies such as robotics, 3D printing, and the Internet of Things (IoT). The mission also supports the establishment of Atal Incubation Centers (AICs) to nurture startups and facilitate their growth. AIM has played a significant role in nurturing a vibrant startup ecosystem in India, fostering a spirit of innovation, and encouraging young entrepreneurs to develop disruptive technologies and solutions. The mission has been instrumental in creating an enabling environment for startups, providing mentorship, funding, and access to resources. Besides this, recognizing the importance of high-performance computing (HPC) in scientific research, weather forecasting, and national

security, the BJP government launched the National Supercomputing Mission (NSM) in 2015. The mission aims to establish a network of supercomputers across the country and enhance India's computational capabilities. Under the NSM, the government has collaborated with industry and academia to build indigenous supercomputers and high-performance computing facilities. The mission also focuses on developing human resources in the field of supercomputing through training programs and skill development initiatives. The NSM has bolstered India's computational capabilities, enabling advanced simulations, data analysis, and scientific research. It has played a crucial role in areas such as weather forecasting, drug discovery, climate modeling, and defense research. Speaking of computation, the Union government has taken the initiative in facilitating frontier research and development in areas such as quantum information processing, artificial intelligence, and machine learning, cloud computing as well as augmented/virtual reality for societal benefit. Another area of great progress has been in space technology. India's space agency, the Indian Space Research Organisation (ISRO), has achieved significant milestones under the BJP government. The successful Mars Orbiter Mission (MOM), also known as Mangalyaan, in 2014 placed India as the first Asian nation to reach the Red Planet. Additionally, the successful launch of the Chandrayaan-2 mission in 2019 aimed to explore the Moon's south pole and demonstrate India's lunar landing capabilities, with the Chandrayaan-3 mission on the verge of being launched. Furthermore, the government has encouraged private sector participation

Under the leadership of Shri Narendra Modi, the BJP government has placed science and technology at the forefront of India's development agenda.

in space exploration and satellite manufacturing through initiatives such as the Indian National Space Promotion and Authorization Centre (IN-SPACe) and the Space Activities Bill. These measures aim to create a conducive environment for commercial space activities, stimulate innovation, and foster collaboration between ISRO and private entities. Under the leadership of Shri Narendra Modi, the BJP government has placed science and technology at the forefront of India's development agenda. The government's commitment to fostering innovation, research, and development has created an ecosystem conducive to the growth of startups, entrepreneurship, and indigenous technologies. As India continues to progress in science and technology, it is poised to become a global leader in innovation and drive the nation toward a prosperous and technologically advanced future. In this edition of the BJYM Magazine, we have an interesting collection of articles on programmes and policies ranging from the nuances of Bharat's new quantum dawn and intellectual property rights' developments to transports' electrification and bioinformatics, which have seen the light of day under the able guidance of Shri Narendra Modi. The sky is the limit, as we move forward in the Amrit Kaal, and we, at BJYM, only look forward with utmost optimism and sincerity for a new age of scientific and technological progress in the country, with the Bharatiya Janata Party at the helm of national progress. Jai Hind!



A New Quantum Dawn in Bharat

- Dr. Mrittunjoy Guha Majumdar is an Assistant Professor of Physics at Amrita Vishwa Vidyapeetham. He is a member of the editorial board of BJYM Magazine and leads outreach to young professionals in the science and technology sector.

Since assuming office in 2014, the NDA government, under the able leadership of Shri Narendra Modi, has recognised the transformative potential of quantum information processing and has taken significant steps to propel the country's advancements in this cutting-edge field. India has witnessed a remarkable surge in research and development efforts, infrastructure building, and international collaborations in quantum information processing. The Modi government is strongly committed to fostering indigenous research and development in quantum information processing by establishing national initiatives and research programs.

The Department of Science and Technology (DST) has been pivotal in driving these efforts. In 2018, the DST launched the Quantum-Enabled Science and Technology (QuEST) program to advance research in quantum technologies, including quantum communication, quantum computing, and quantum cryptography. The QuEST program has provided substantial funding and support to researchers across the country, enabling them to push the boundaries of quantum information processing. In addition to QuEST, the Indian government launched the National Mission on Quantum Technologies and Applications (NM-QTA) in 2020. This mission has set ambitious goals to position India as a global quantum research and development leader. It has played a vital role in catalysing India's progress in quantum information processing, bringing together top scientists, researchers, and industry leaders to collaborate on advanced quantum projects.

Under the Modi government, India has actively pursued collaborations with international partners to accelerate progress in quantum information processing. The



government has fostered partnerships with countries such as the United States, Canada, the United Kingdom, and European nations to exchange knowledge, share best practices, and promote joint research projects. These collaborations have allowed Indian researchers to leverage global expertise and resources, enhancing their capabilities in quantum information processing. One notable international collaboration is the Quantum-Enabled Science and Technology (QuEST) program's partnership with the United Kingdom Research and Innovation (UKRI) in 2021. This collaboration aims to support joint research projects and facilitate exchange programs between Indian and UK researchers in the field of quantum technologies. Such collaborations foster innovation and contribute to the global advancement of quantum information processing.

Recognising the importance of robust infrastructure, the Modi government has invested significantly in building state-of-the-art facilities for quantum information processing. These infrastructure development initiatives aim to provide researchers and scientists with the necessary resources to conduct advanced experiments and drive technological advancements. As part of the NM-QTA, the government has promoted the establishment of Centers of Excellence (CoEs) across the country.

The Modi government has emphasised education and skill development programs to address the shortage of skilled professionals in quantum information processing. The government has taken steps to integrate quantum technologies into the curriculum of higher education institutions, ensuring that students have exposure to this emerging field. Efforts have also been made to establish

specialised courses and training programs focused on quantum information processing to equip students and researchers with the necessary knowledge and skills. In 2018, the DST initiated the Quantum Science and

Technology Undergraduate Research Initiative (Q-STEP) program to engage undergraduate students in quantum research projects. This program promotes early exposure to quantum information processing and encourages students to pursue advanced studies and careers. Such initiatives are crucial in nurturing a skilled workforce that can contribute to India's quantum ambitions.

National Mission on Quantum Technologies and Applications (NM-QTA)

This mission aims to position India as a global quantum research, development, and application leader. The primary objectives of the National Mission on Quantum Technologies & Applications are multifaceted. The mission seeks to nurture and promote indigenous research and development in quantum technologies, fostering a vibrant ecosystem of scientists, engineers, and entrepreneurs. It aims to facilitate cross-disciplinary collaborations between academia, industry, and government agencies to propel India's quantum capabilities. The NM-QTA has outlined several key research and development initiatives to realise its objectives. These initiatives encompass a wide range of areas, including quantum communication, quantum computing, quantum sensing and metrology, and quantum materials and devices. The mission promotes fundamental research, applied research, technology development, and training human resources to build a strong foundation in quantum technologies.

The mission encourages the establishment of Centers of Excellence (CoEs) across the country, where cutting-edge research and innovation can flourish. These CoEs will act as knowledge hubs, bringing together experts from academia, industry, and research institutions to work on advanced quantum projects. The NM-QTA also seeks to attract top talent worldwide through international collaborations, fellowships, and exchange programs. Recognising the significance of robust infrastructure, the NM-QTA strongly emphasises building state-of-the-art facilities and resources. It aims to develop and strengthen quantum computing platforms, quantum communication networks, and quantum simulation and metrology facilities. This infrastructure will provide researchers and scientists with the necessary tools and resources to conduct cutting-edge experiments and advance the frontiers of quantum technologies.

The success of the NM-QTA relies on creating an enabling ecosystem that fosters collaboration, innovation, and entrepreneurship in quantum technologies. The mission promotes partnerships between academia, industry, and startups to accelerate the translation of quantum research into practical applications. It aims to support technology transfer and commercialisation efforts, facilitating the growth of a vibrant quantum industry in India. The NM-QTA also recognises the importance of skill development and human resource capacity building. It strives to provide quality education

and training programs to equip students, researchers, and professionals with the necessary knowledge and skills in quantum technologies. By nurturing a skilled workforce, the mission aims to address the shortage of quantum experts and ensure India's competitiveness in the global quantum landscape.

The National Mission on Quantum Technologies & Applications holds tremendous potential for India's technological advancement and economic growth. By investing in quantum research and development, India can foster innovation and create a knowledge-driven economy. The mission's initiatives can potentially drive breakthroughs in computing, secure communications, precision measurements, and advanced materials, among other fields. Furthermore, developing indigenous quantum technologies can lead to strategic advantages in defence, cybersecurity, and healthcare. Quantum encryption and secure communication systems can bolster national security, while quantum computing can address complex computational challenges across various industries. The NM-QTA positions India at the forefront of the global quantum race, enabling the country to contribute significantly to scientific advancements and technological solutions. The National Mission on Quantum Technologies & Applications represents a visionary step by the Indian government to harness the transformative potential of quantum technologies.

Quantum-Enabled Science and Technology: Unleashing the Power of the Quantum Realm

Quantum-Enabled Science and Technology (QuEST) represents a groundbreaking scientific exploration and technological innovation frontier. This emerging field



leverages the principles of quantum mechanics to unlock new possibilities in computing, communication, cryptography, and more. QuEST has captured the attention of researchers, governments, and industry leaders worldwide, as it holds the potential to revolutionise various sectors and reshape our understanding of the universe. At the heart of QuEST lies the enigmatic world of quantum mechanics. In stark contrast to classical physics, which governs our everyday experiences, quantum mechanics describes the behaviour of subatomic particles, revealing a fascinating array of phenomena. Concepts such as superposition, entanglement, and quantum tunnelling challenge our conventional notions of reality and offer unparalleled opportunities for scientific exploration and technological breakthroughs.

One of the most promising applications of QuEST lies in quantum computing. Traditional computers rely on bits representing information as either a 0 or a 1. In contrast, quantum computers use qubits, which can exist in multiple states simultaneously due to superposition. This ability to process vast amounts of information in parallel holds the potential to revolutionise computing, enabling solutions to complex problems that were previously intractable.

Quantum communication is another area where QuEST is poised to make a significant impact. Quantum cryptography harnesses the principles of quantum mechanics to create unbreakable encryption protocols. By utilising quantum entanglement, detecting any attempt to intercept or tamper with encrypted information becomes possible, ensuring secure communication channels for sensitive data transmission.

QuEST also offers exciting possibilities in the realm of sensing and metrology. Quantum sensors have the potential to surpass the sensitivity and precision of their classical counterparts. For instance, quantum-enhanced magnetic field sensors can detect minute magnetic fields with exceptional accuracy, opening doors to applications in medical imaging, geological surveys, and materials science.

Additionally, quantum metrology techniques enable highly precise measurements, surpassing the limitations imposed by classical measurement devices. These advancements have the potential to revolutionise fields such as navigation systems, timekeeping, and gravitational wave detection,

leading to unprecedented accuracy and scientific discoveries. The quantum realm is an ideal platform for simulating complex physical systems that are challenging to model using classical computers. Quantum simulators allow researchers to explore chemical reactions, material properties, and quantum dynamics. By gaining insights into the behaviour of quantum systems, scientists can accelerate the development of new materials, drugs, and energy technologies.



The National Mission on Quantum Technologies & Applications represents a visionary step by the Indian government to harness the transformative potential of quantum technologies.

The advent of QuEST promises to disrupt numerous industries and pave the way for transformative advancements. In healthcare, quantum-enabled simulations could lead to the discovery of novel drug candidates and personalised treatment approaches. Quantum algorithms could optimise supply chains, financial transactions, and logistical operations, enhancing efficiency and reducing industry costs. Furthermore, quantum communication networks could revolutionise cybersecurity, ensuring the secure transmission of sensitive information in an increasingly interconnected world. Recognising the immense potential of QuEST, governments, research institutions, and industry leaders worldwide have embarked on ambitious initiatives and collaborations.

Furthermore, international collaborations are forming to foster knowledge exchange, joint research projects, and the establishment of quantum testbeds. These partnerships bring together the brightest minds from diverse backgrounds to tackle the challenges and accelerate progress in the field of QuEST. Quantum-Enabled Science and Technology represents a remarkable journey into the quantum realm, where the rules of classical physics cease to apply. As our understanding of quantum mechanics deepens, the potential applications of QuEST continue to expand, promising transformative

advancements in computing, communication, sensing, and simulation.

QSim: Empowering Quantum Computing Simulation

The field of quantum computing has gained significant attention in recent years due to its potential to revolutionise computation, cryptography, and scientific research. Recognising the importance of quantum computing in India's technological landscape, the Ministry of Electronics and Information Technology (MeitY) has launched QSim - the Quantum Computer Simulator Toolkit. QSim represents a crucial step in advancing the country's quantum computing research and development. Building and operating quantum computers is incredibly challenging

due to the delicate nature of quantum states and qubits' susceptibility to environmental disturbances. As a result, practical quantum computers with large numbers of qubits are still in the early stages of development. To bridge this gap, quantum computer simulators have emerged as crucial tools in the field.

Quantum computer simulators enable researchers and developers to emulate quantum algorithms and evaluate their performance without relying on physical quantum hardware. Simulators provide a virtual environment that mimics the behaviour of quantum systems, allowing scientists to experiment, analyse, and optimise quantum algorithms before implementing them on actual quantum computers. The launch of QSim by MeitY represents a significant milestone in India's quantum computing journey. QSim is a comprehensive toolkit that provides researchers, scientists, and developers with a powerful platform to simulate and study quantum algorithms and circuits. It offers a user-friendly interface, extensive libraries, and a

Countries like the United States, China, Canada, and Europe are investing heavily in quantum research and development, aiming to lead the quantum revolution.

range of functionalities to facilitate quantum computing research and development.

QSim allows users to design and simulate quantum circuits, execute quantum algorithms, and analyse the results. It supports various quantum gates, measurement operations, and quantum error correction techniques, providing a versatile environment for exploring quantum computing concepts. Additionally, QSim integrates with popular programming languages such as Python, enabling users to leverage existing coding skills and libraries to develop and test quantum algorithms.

The launch of QSim holds immense promise for India's quantum computing ecosystem. By providing a dedicated simulator toolkit, MeitY aims to catalyse research and development efforts in quantum computing across academia, industry, and government institutions. QSim will facilitate the exploration of quantum algorithms, enabling researchers to deepen their understanding of quantum computing principles and develop innovative applications. The availability of QSim will also play a crucial role in skill development and education in quantum computing. It will enable students, researchers, and professionals to gain hands-on experience in quantum algorithm design and simulation, fostering a skilled quantum workforce in India. It will strengthen the country's position in the global quantum computing landscape and attract top talent and investments.

Furthermore, QSim will be a valuable tool for collaboration and knowledge sharing. Researchers and developers can leverage QSim to exchange quantum algorithms, benchmark their performance, and collaborate on solving complex computational problems. This collaborative

ecosystem will foster innovation and accelerate the development of practical quantum applications. The launch of QSim by MeitY marks a significant step forward in India's quantum computing journey. By providing a robust and accessible quantum computer simulator toolkit, QSim empowers researchers, scientists, and developers to explore and innovate in quantum computing. QSim's impact extends beyond simulation, supporting skill development, collaboration, and advancing quantum computing research and applications in India. As quantum computing continues to evolve, QSim will play a vital role in propelling India's quantum capabilities and positioning the country at the forefront of this transformative technology.

Prospects and Perspectives

Quantum computing is on the cusp of revolutionising various industries and scientific research globally. Quantum computing has the potential to revolutionise several sectors, including healthcare, finance, logistics, cryptography, and materials science. In healthcare, quantum computing can accelerate drug discovery and personalised medicine, leading to breakthroughs in treatments and therapies. Financial institutions can benefit from quantum computing's ability to optimise complex algorithms, enhancing risk analysis, portfolio management, and fraud detection. Quantum cryptography can strengthen cybersecurity measures, protecting sensitive information from potential threats. Logistics and supply chain industries can leverage quantum algorithms to optimise routes, reduce costs, and improve efficiency. Quantum computing's simulation capabilities can revolutionise materials science, allowing researchers to design new materials with desired properties, leading to advancements in energy storage, electronics, and manufacturing.



To foster quantum computing capabilities, the government has allocated substantial funds to support research and infrastructure development in the field. Initiatives such as the National Mission on Quantum Technologies and Applications (NM-QTA) and the Quantum-Enabled Science and Technology (QuEST) program have been launched to promote indigenous research, collaboration, and skill development in quantum technologies. Additionally, Prime Minister Modi's "Digital India" and "Make in India" campaigns have provided a conducive environment for the growth of the quantum computing ecosystem. These initiatives have attracted global technology companies and startups to invest in India, bringing expertise, resources, and opportunities for collaboration in the quantum domain.

In recent years, India has witnessed a significant increase in quantum computing research and development activities.

Premier research institutions, including the Indian Institutes of Technology (IITs), Indian Institutes of Science Education and Research (IISERs), and the Council of Scientific and Industrial Research (CSIR), are actively engaged in quantum research projects.

Under the leadership of Prime Minister Modi, India is making significant strides in quantum computing. With strong government support, investments, research initiatives, and emphasis on skill development, India is well-positioned to become a global leader in this transformative technology. The prospects of quantum computing in India are immense, with potential applications spanning various industries and scientific research domains. The government's vision and initiatives have laid a solid foundation for the growth of quantum computing in India, attracting global collaborations, investments, and talent.



Unlocking the Secrets of Life: The Rise of Bioinformatics in India

- Atharva Pawde is a Consultant - Communications and Research in the Ministry of Electronics and Information Technology, Government of India, and has been a LAMP Fellow. He is associated with the BJYM outreach to young professionals in the science and technology sector.

In the vast realm of biotechnology, a powerful and rapidly expanding field has emerged - Bioinformatics, also known as Theoretical and Computational Biology (TCB). This field, supported by the Department of Biotechnology (DBT) under the Ministry of Science and Technology, has witnessed remarkable growth and innovation in India. The DBT has established the Biotechnology Information System Network (BTISnet) to bridge interdisciplinary gaps and foster collaboration. This national bio-information network catalyzes advancements in bioinformatics research and education.

The impact of these collective efforts becomes evident when we examine the growth of bioinformatics projects and publications in India. From 2015-16 to 2019-20, the number of projects supported by the DBT increased from 35 to 58, reflecting the escalating significance of bioinformatics research in the country.

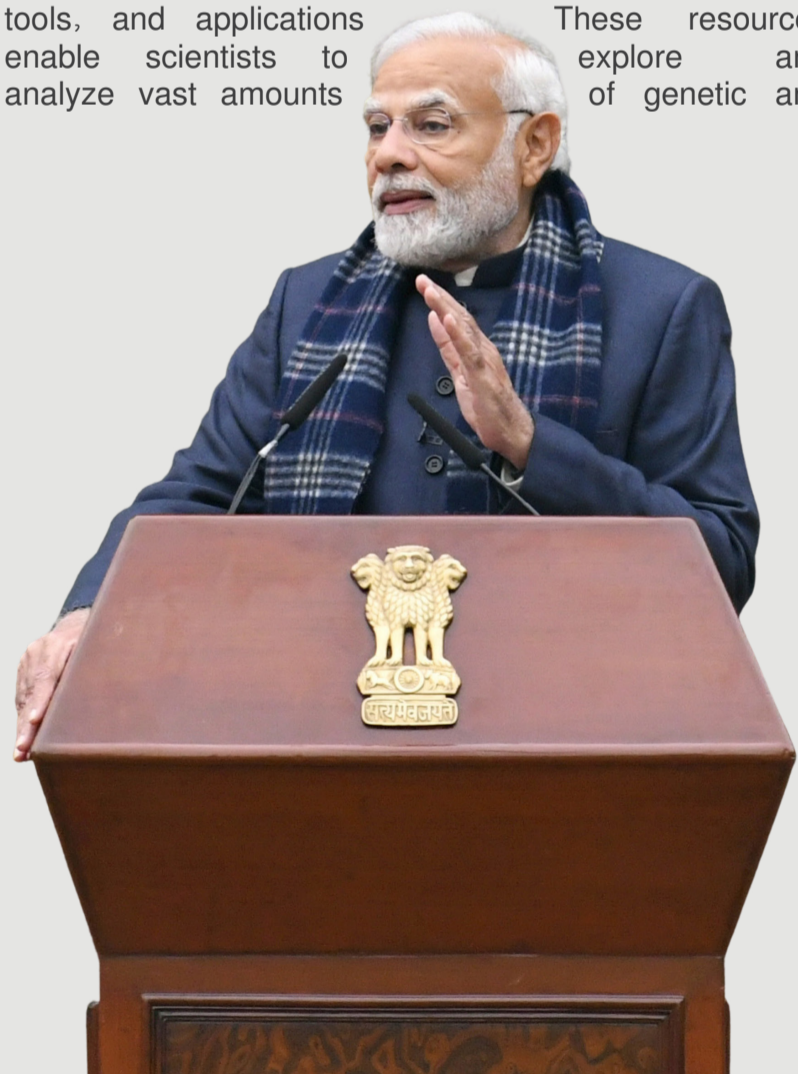
The primary aim of BTISnet is to provide a robust infrastructure for bioinformatics, equipped with supercomputers and comprehensive databases, information resources, tools, and techniques for biotechnology applications. Moreover, this network extends its support by offering information and computer services to the national community of scientists and researchers working in biotechnology and allied fields. This inclusive approach promotes knowledge-sharing and empowers professionals across the country.


Recognizing the significance of bioinformatics, the DBT has launched several initiatives to propel research and education in this field. One notable effort is the Bioinformatics National Certification (BINC) examination, which serves as a benchmark for evaluating the competency of bioinformatics professionals. The Star College Scheme has also been implemented to strengthen undergraduate science education, cultivating a strong foundation for aspiring bioinformatics scholars. To ensure that the benefits of biotechnology reach farmers, the Biotech-Krishi Innovation Science Application Network (Biotech-KISAN)

empowers them with biotechnology tools. At the same time, the Biotechnology Industry Research Assistance Council (BIRAC) fosters innovation and entrepreneurship in the biotechnology sector.

The DBT's commitment to promoting bioinformatics extends beyond national borders. Collaborating with esteemed national and international agencies and institutions, such as the National Bioresource Development Board (NBDB), the National Institute of Biomedical Genomics (NIBMG), the Centre for DNA Fingerprinting and Diagnostics (CDFD), the Indian Council of Medical Research (ICMR), the Council of Scientific and Industrial Research (CSIR), the World Health Organization (WHO), the European Molecular Biology Laboratory (EMBL), and the International Centre for Genetic Engineering and Biotechnology (ICGEB), the DBT ensures access to a global network of expertise and resources.

To facilitate bioinformatics research, the DBT has supported the development of numerous databases, portals, tools, and applications. These resources enable scientists to explore and analyze vast amounts of genetic and





molecular data, ultimately driving breakthrough discoveries. Notable examples include IndiGen, a genome database of the Indian population; IndiMed, a database of Indian medicinal plants; IndiBioMart, a portal for accessing biological data resources; IndiSeq, a tool for analyzing next-generation sequencing data; IndiSat, a tool for predicting satellite DNA; IndiGEM, a tool for gene expression microarray analysis; IndiSNP, a tool for SNP genotyping; IndiDrug, a tool for drug discovery; and IndiProt, a tool for protein structure prediction.

The impact of these collective efforts becomes evident when we examine the growth of bioinformatics projects and publications in India. From 2015-16 to 2019-20, the number of projects supported by the DBT increased from 35 to 58, reflecting the escalating significance of bioinformatics research in the country. Furthermore, the chart depicting the number of publications and citations by Indian researchers in bioinformatics from 2000 to 2019 unveils a remarkable upward trajectory. The number of publications surged from 77 in 2000 to an impressive 1,163 in 2019, accompanied by a corresponding increase in citations from 1,024 to a staggering 28,698. These figures unequivocally demonstrate the high quality and impact of bioinformatics research conducted in India.

This surge in interest and recognition of bioinformatics is also reflected in the educational landscape. As of 2020, there were 125 bioinformatics courses offered by various institutions in India. Universities accounted for 47 courses, followed by colleges with 31, institutes with 24, and 23 offered by other organizations. The proliferation of these courses highlights the growing demand for skilled bioinformatics professionals in academia and industry.

India's journey in bioinformatics has been nothing short of remarkable. With unwavering support from the DBT and its comprehensive initiatives, the nation has emerged as a hub of cutting-edge research and innovation in this field. The collaborative efforts with national and international partners, the development of critical databases and tools, and the surge in projects and publications reflect India's commitment to unravelling the secrets of life through bioinformatics. As the nation continues to invest in this field, we can expect a future filled with groundbreaking discoveries that will revolutionize biotechnology and shape how we understand and harness the power of life itself.

The Modi Government's Support for Science Education in India: A Decade of Progress (2014-2023)

- Jay Ambani, student at SRCC, Delhi University

The Narendra Modi-led government in India has made significant strides in promoting science education since it came to power in 2014. Recognising the importance of scientific literacy as a cornerstone of national development, the government has implemented several initiatives to foster a culture of scientific learning and inquiry in the country.

One of the most notable initiatives is the establishment of new Indian Institutes of Technology (IITs), Indian Institutes of Management (IIMs), Indian Institutes of Information Technology (IIITs), All India Institute of Medical Sciences (AIIMS), National Institutes of Technology (NITs), and National Institutes of Design (NIDs). Since 2014, a new IIT and IIM have been opened every year, expanding the reach of high-quality science and technology education nationwide.

The government has also increased the budget allocation for science education. In the 2023-24 budget, the Ministry of Science & Technology was allocated Rs. 16,361 crore (US\$ 1.97 billion). The Union Budget 2023-24 also allocated Rs. 2,000 crore (US\$ 242 million) for the proposed National Research Foundation, which is set to support India's research capabilities.

The Department of Science & Technology (DST) has revamped the FIST (Fund for Improvement of S & T Infrastructure in Universities and Higher Educational Institutions) programme to align it with the objective of Atman-

irbhar Bharat by developing R&D infrastructure for use by start-ups, manufacturing companies, and MS-MEs, in addition to R&D operations in academic organisations.

The government has also launched several initiatives to promote gender equality in science education. The Women Science programme of DST has started a new initiative to support women PG colleges under the CURIE (Consolidation of University Research for Innovation and Excellence in Women Universities) Program and invited proposals for the same.

In addition to these initiatives, the government has also focused on promoting science education among disadvantaged groups. In October 2021, the government announced plans to establish 75 science, technology & innovation hubs in India for scheduled castes (SCs) and scheduled tribes (STs) and empower them to contribute to the socio-economic improvement of the country.

The government has also significantly invested in digital infrastructure to support science education. To further India with High-Performance Computing (HPC), four new Supercomputers have been installed since July 2021 - one each at IIT-Hyderabad, NABI- Mohali, CDAC-Bengaluru, and IIT Kanpur.

The government has also launched several initiatives to promote innovation and entrepreneurship among science students. The Atal Innovation Mission and Vigyan Prasar col-



laborated to drive synergies between Atal Tinkering Labs and Vigyan Prasar's unique platform, Engage With Science.

Furthermore, the Modi government has supported several initiatives in science education to promote it among the youth:

National Science Talent Search Examination (NSTSE): The government has revamped the NSTSE to identify and nurture talented students

in the field of science. The examination is now conducted online, with a wider reach across the country. The top performers are provided with scholarships and mentorship opportunities to further their interest in science.

Science Education Research and Innovation (SERI): The SERI initiative is aimed at promoting research and innovation in science education. It provides funding and resources for schools and colleges to set up sci-

ence labs and conduct research projects. The initiative also encourages collaboration between educational institutions and industry to drive innovation.

Science Teacher Training Program (STTP): Recognising the crucial role of teachers in shaping the scientific temperament of students, the government has launched the STTP. This program provides intensive training to science teachers, equipping them with the latest pedagogical techniques and knowledge in their respective fields.

National Science Olympiad (NSO): The NSO has been expanded to include more students and cover a wider range of topics. The Olympiad now includes competitions in areas like robotics, artificial intelligence, and data science, reflecting the changing landscape of science and technology.

Science Communication Initiative (SCI): The SCI is designed to improve the communication of science to the general public. It includes programs to train scientists and students in science communication, and initiatives to promote science in popular media.

Online Science Education Platform (OSEP): In response to the increasing digitisation of education, the government has launched the OSEP. This platform provides online science courses, interactive learning tools, and resources for students and teachers. It also facilitates virtual science fairs and competitions, providing a platform for students to showcase their scientific projects.

Science Education for Girls (SEG): The SEG initiative is aimed at en-



couraging more girls to pursue science education. It includes measures like scholarships for girls studying science, mentorship programs, and awareness campaigns to break gender stereotypes in science.

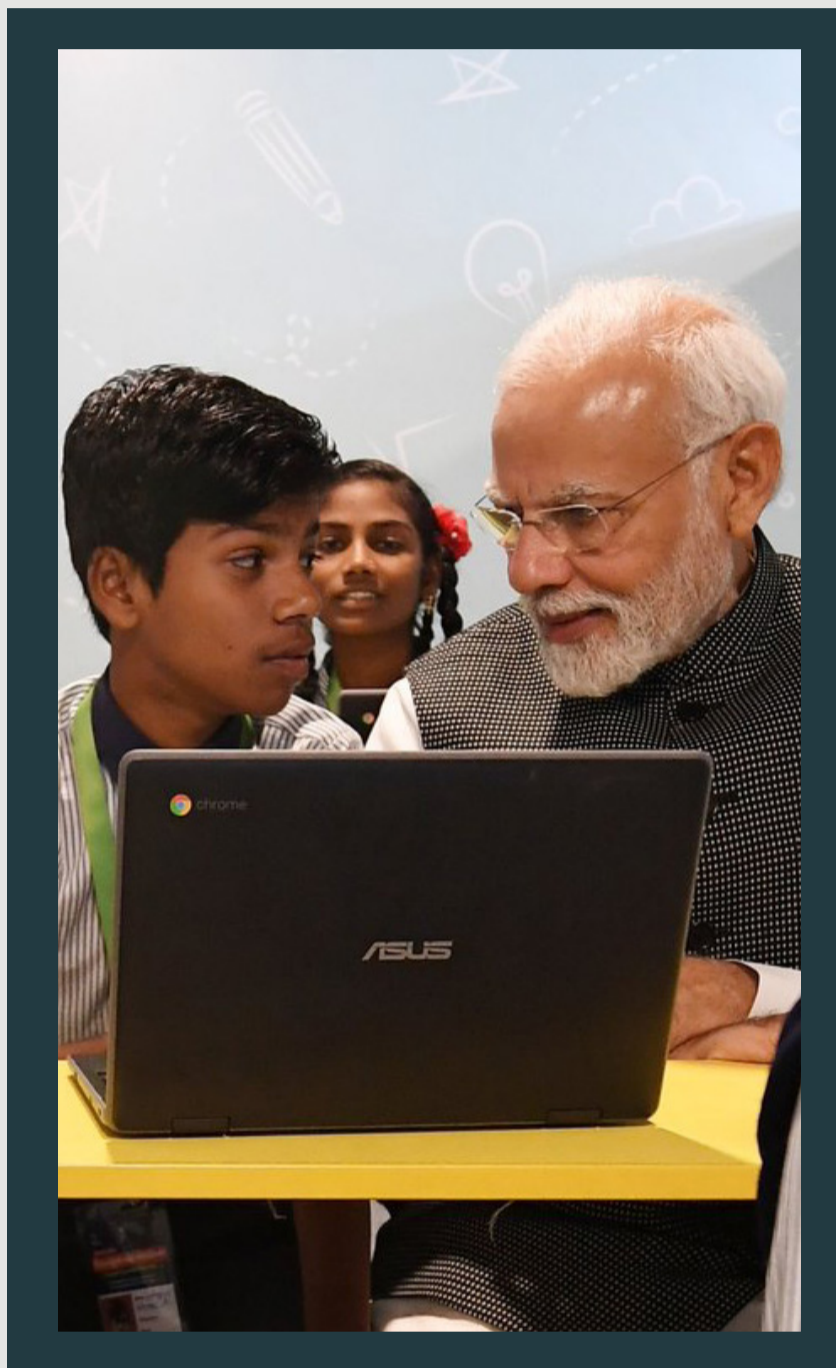
One of the most notable initiatives is establishing the Prime Minister's Research Fellows (PMRF) scheme. Launched in 2018, the PMRF scheme aims to attract the best talent into research, thereby realising the vision of development through innovation. The scheme offers direct admission to the PhD programs in the Indian Institutes of Technology (IITs) and Indian Institute of Science (IISc) for students graduating from the Indian Institutes of Technology (IITs), Indian Institutes of Information Technology (IIITs), National Institutes of Technology (NITs), and others. The fellows receive a generous stipend and research grant for five years.

The government has also focused on international collaborations to boost research in basic sciences. Partnerships with countries like the USA, UK, Germany, Israel, and others have been strengthened. These collaborations have led to joint funding calls, exchange programs, and the establishment of joint research centres, thereby providing Indian researchers with international exposure and access to state-of-the-art facilities.

The government has launched several new initiatives aimed at promoting collaboration between researchers and industry. These initiatives are designed to facilitate the transfer of knowledge and technology from the research sector to the industry, promoting innovation and economic growth. One such initiative is the "Industry-Academia Research and Development Program", which provides funding for collaborative research projects between academic institutions and industry partners.

The Modi government has also taken steps to promote entrepreneurship in science. The Atal Innovation

Mission (AIM), launched by the NITI Aayog, aims to promote a culture of innovation and entrepreneurship. It has established Atal Tinkering Labs in schools nationwide to foster curiosity, creativity, and imagination in young minds. The Atal Incubation



Centers provide researchers with the necessary infrastructure and support to transform their scientific ideas into viable products.

It has introduced new policies to attract and retain talented researchers in India. These policies include increased salaries for researchers, more opportunities for career advancement, and improved working conditions. The government has also introduced special programs for young researchers, such as the "Young Scientist Program", which provides funding and mentorship for promising young scientists.

In addition, the government has continued to invest in infrastructure for basic science research. It includes the construction of new research facilities, the upgrade of existing facilities, and the provision of state-of-the-art research equipment. The government has also invested in digital infrastructure, such as high-speed internet and cloud computing services, to facilitate online collaboration and data sharing among researchers. Furthermore, the government has strengthened its focus on promoting research in emerging fields such as artificial intelligence, quantum computing, and biotechnology. It includes establishing new research centres and programs in these fields and increased funding for research projects.

Finally, the government has emphasised the importance of basic scientific research in addressing societal challenges. It includes research on climate change, public health, and sustainable development. The government has launched several research programs to develop innovative solutions to these challenges.

These initiatives reflect the government's commitment to promoting science education and fostering a scientific temperament among the youth. They are expected to significantly impact the quality of science education in the country and the number of students

pursuing careers in science and technology. The Modi government is committed to promoting science education in India. The government has created a conducive environment for science education through increased funding, policy initiatives, infrastructure development, and a focus on inclusivity and innovation. The New Education Policy (NEP) in India, updated in 2023, has introduced several changes to the way science education is approached, focusing on conceptual understanding, interdisciplinary approach, practical applications, focus on emerging fields and inclusion of all sections of society.

Tech Against the Virus: CoWIN and the Indian Vaccination Drive

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cience policy is concerned with allocating resources for the conduct of science to serve the public interest. As a result, there are interactions between science and policy in which the policy is employed to advance science to produce good results for society.

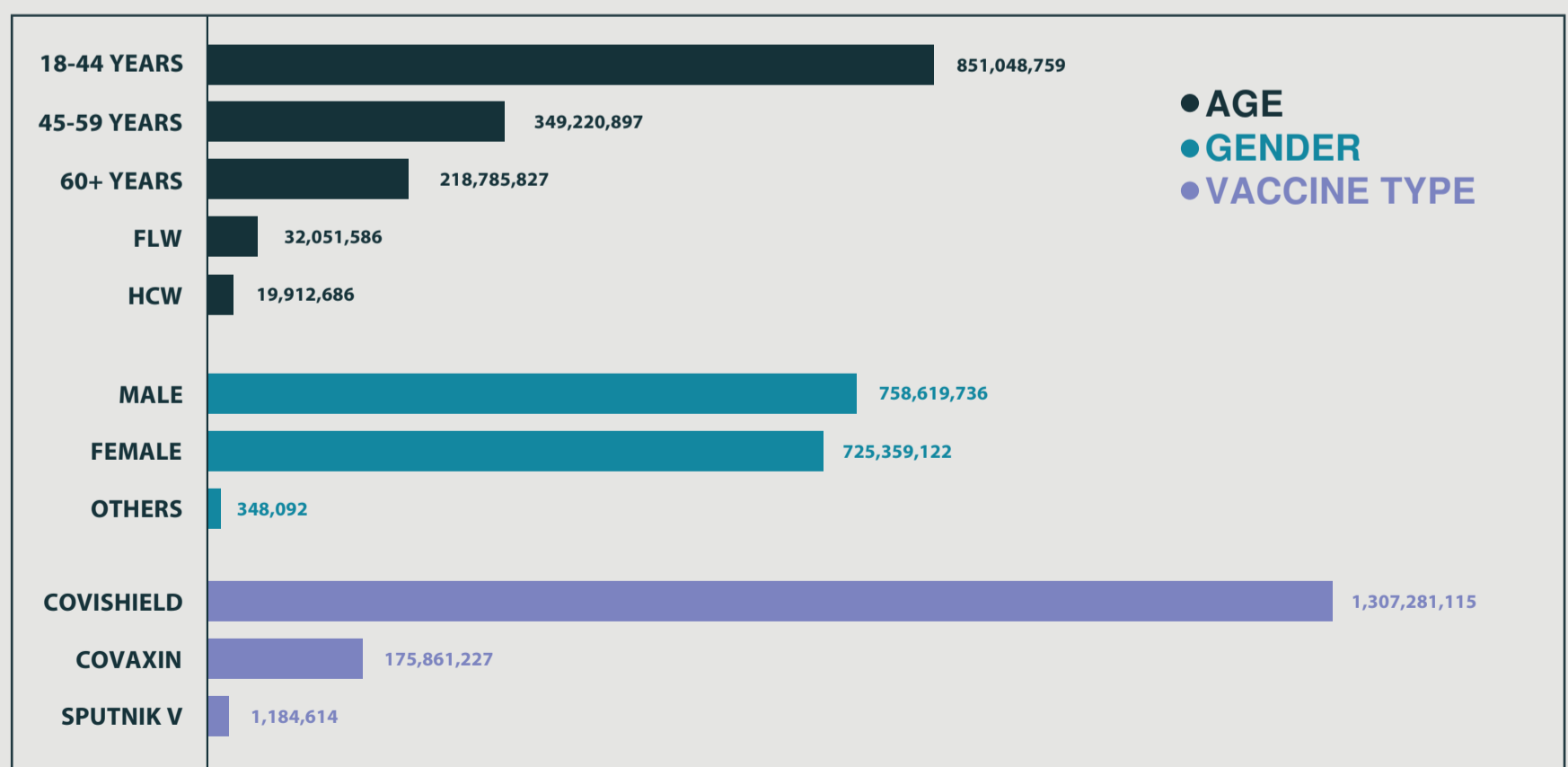
The nodal organization that creates policy pertaining to science and technology is the Department of Science and Technology (DST). These initiatives are coordinated by the specialized branch of DST known as the Policy Research Cell (PRC). It extends beyond the Ministry of Science and Technology to several other departments, offices, and organizations, including the Department of Scientific and Industrial Research, the Department of Agricultural Research and Education, the Ministry of Earth Sciences, the Ministry of Electronics and Information Technology, the Ministry of Human Resources Development, and others. There have been four policy declarations in India on science, technology, and innovation (STI). These include the Scientific and Technological Policy (STP2013), Technology Policy Resolution (SPR1958), Technology Policy Statement (TPS1983), and Scientific Policy Resolution (SPR1958).

Shri Jitendra Singh, Union Minister of Science and Tech-

nology, stated that India made a “giant leap” in the field of Science and Technology in the past seven years under Prime Minister Narendra Modi.

Various policies have been initiated under the Modi government, under which CoWIN became one of the most fascinating frameworks under the STP. CoWin in India has become the 'Digital Backbone' for The Covid-19 Vaccination Program. To increase efficiency, assure access to COVID-19 vaccinations and optimize resource usage, India created the COVID-19 Vaccine Intelligence Network (CoWIN) in the latter half of 2020. The platform performed the task of registration, organization of appointments, confirming identities, and managing vaccinations, whilst also being a portal for everybody who has received vaccinations. The Electronic Vaccine Intelligence Network (eVIN), Digital Infrastructure for Vaccination Open Credentialing (DIVOC), DigiLocker, Surveillance and Action for Events Following Vaccination (SAFE-VAC), etc. are a few examples of digital resources.

CoWIN has delivered an accelerated vaccination program, with over 940 million registered. Its scalable planning allowed it to vaccinate over 25 million people in one day. The vaccination process was phased, with phases focusing on healthcare workers, people aged 45 and above, and peo-



ple aged 18 years and above.

The orchestration module, the cold chain vaccination module, the citizen registration module, the vaccinator module, and the certificate, feedback, and adverse event after immunization reporting module were the five modules that made up CoWIN. Biometric digital identity tools like Aadhaar and DigiLocker entered the system in July 2020. The certificate, feedback, and other components were also created using open-source tools such as DIVOC, DigiLocker, and SAFE-VAC. CoWIN enables integration with external apps by using platforms with API rules, like Paytm and MakeMyTrip. By the end of December 2021, CoWIN had added features, and 900 million people had registered. This statistic does not indicate all registrations because offline modules supplement CoWIN, and there are a lot of individuals in India.

CoWIN, a digital health platform, has been incorporated into India's healthcare system, allowing administrators to assess vaccination campaigns through user input. The National e-Governance Division of India's Rapid Assessment System has been connected with the CoWIN platform to collect input on the vaccination procedure. Integrating India's healthcare infrastructure with the CoWIN platform is governed by the Ayushman Bharat Digital Mission, which the National Health Authority, Ministry of Health and Family

Welfare manage.

Dr. Ram Sewak Sharma, the National Health Authority chief executive officer and chairman of the Empowered Group on Vaccine Administration for COVID-19, mentioned that "Realizing our Honorable PM's [prime minister's] vision, it has been a privilege to roll out CoWIN to cater to the vaccination needs of a billion plus Indians. Adding to India's successful digital public goods like Aadhaar, UPI [Unified Payments Interface], and DigiLocker, CoWIN has served as India's digital backbone for COVID-19 vaccination. No other platform in the world has scaled so swiftly in such a short period. The credit for this is attributable to CoWIN's open and interoperable architecture. Based on the success seen in India, we are now diversifying this platform to re-purpose it for the Universal Immunization Programme and other digital healthcare services. We are also working on taking CoWIN global to let other governments benefit from such an efficient and transparent system."

CoWIN has helped 90 per cent or more people in India to get vaccinated as of December 2021, with at least a single dose. It highlighted how to utilize existing technology for quick analysis in collaboration with the government and the significant impact made by the Modi government in the development of Health Care using Science and Technology.



CoWIN has served as India's digital backbone for COVID-19 vaccination. No other platform in the world has scaled so swiftly in such a short period.

Stellar Aspirations: India's Expanding Space Frontier

- Dr. Pooja Paswan is an Assistant Professor of Public Administration, Jamia Millia Islamia University, New Delhi.



India's space program is poised to embark on an exciting and optimistic future filled with remarkable possibilities, groundbreaking discoveries, and unprecedented technological achievements. As the Indian Space Research Organisation (ISRO) continues to push boundaries and expand its horizons, the country's space program stands on the cusp of a new era, ready to soar to new heights of exploration and innovation. With a track record of notable accomplishments, India has firmly established itself as a prominent player in the global space community. India has consistently demonstrated its prowess in space science and technology, from pioneering missions to the Moon and Mars to advancements in satellite technology and remote sensing capabilities.

Under the visionary leadership of Prime Minister Shri Narendra Modi, India's space program has witnessed a remarkable transformation, ushering in an era of immense optimism and boundless possibilities. The Modi government has strongly emphasised advancing India's space capabilities, propelling the nation to the forefront of global space exploration and technological innovation.

Looking ahead, the Indian space program is set to embark on a journey that holds immense promise. From plans for a manned mission to sending astronauts into space to ambitious lunar exploration missions, India's vision for the future of space exploration is both ambitious and inspiring. With

each mission, the boundaries of human knowledge will be pushed, and our understanding of the universe will be expanded. India's space program future also holds immense scientific research and technological innovation potential. From studying the mysteries of the cosmos to developing cutting-edge satellite systems, India's efforts in space will continue to contribute to advancements in various fields, including telecommunications, meteorology, agriculture, and disaster management.

India's space exploration future holds great promise as the ISRO continues pursuing ambitious missions and pushing scientific discovery's boundaries.

Gaganyaan - India's Manned Mission

One of India's most eagerly anticipated ventures is the Gaganyaan mission, which aims to send Indian astronauts to space. This landmark project will make India the fourth nation to achieve human spaceflight capabilities. ISRO is actively developing the necessary infrastructure, crew training programs, and spacecraft technologies to realise this ambitious goal, further establishing India's position in manned space exploration. The objectives of Gaganyaan extend beyond the mere act of sending humans to space. The mission seeks to address a range of scientific, technological, and societal aspects. It will facilitate research in microgravity environments, human physiology, and life support systems. Additionally, Gaganyaan holds immense potential for inspiring the younger generation, igniting a passion for science and technology, and fostering innova-

tion and research in various domains.

Gaganyaan represents India's commitment to pushing boundaries and realising audacious goals. By venturing into manned spaceflight, India will gain valuable experience and expertise, laying the foundation for future endeavours, such as long-duration space missions and establishing a space station. Gaganyaan symbolises India's technological achievements and embodies the nation's spirit of exploration, unity, and aspirations for a brighter future in space.

India's space program has witnessed a remarkable transformation, ushering in an era of immense optimism and boundless possibilities. The Modi government has strongly emphasised advancing India's space capabilities, propelling the nation to the forefront of global space exploration and technological innovation.

Lunar Exploration:

India's lunar exploration program is set to continue with the Chandrayaan-3 mission. Building upon the experiences and lessons learned from Chandrayaan-2, this mission aims to achieve a successful soft landing on the lunar surface and deploy a rover to explore and study the Moon's terrain in greater detail. Chandrayaan-3 will contribute to understanding the Moon's geology, water resources, and potential for future scientific and commercial activities.

Mars and Beyond:

India's successful Mars Orbiter Mission (Mangalyaan) has laid the foundation for further exploration of the Red Planet. Future missions may include sending orbiters, landers, or rovers to Mars to delve deeper into its atmosphere and surface conditions and search for signs of life. Additionally, ISRO is actively studying the feasibility of interplanetary missions to other celestial bodies, such as Venus and asteroids, to expand our knowledge of the solar system.

Space Infrastructure and Research:

India is working towards strengthening its space infrastructure and research capabilities. It includes the development of advanced launch vehicles, satellite systems, and communication networks. As proposed by ISRO, establishing a space station is also under consideration, which would enable extended human presence in space and support scientific research in microgravity environments.

International Collaborations:

India's space program increasingly collaborates internationally to foster knowledge exchange, joint research, and shared missions. Collaborative efforts with other space agencies and countries can lead to more ambitious projects, pooled resources, and accelerated technological advancements. Such partnerships may involve joint missions to explore uncharted territories, share data and expertise, and promote global scientific cooperation.

NASA Collaboration

ISRO's collaboration with the National Aeronautics and Space Administration (NASA) of the United States has been instrumental in fostering cooperation in space exploration.

The NASA-ISRO Synthetic Aperture Radar (NISAR) mission is a prime example of this collaboration. NISAR aims to launch a dual-frequency radar satellite to study Earth's dynamic processes, such as climate change, land deformation, and natural hazards. This joint mission combines the expertise of both agencies, utilising India's advanced remote sensing capabilities and NASA's cutting-edge technology.

Japan Aerospace Exploration Agency (JAXA) Partnership

ISRO has collaborated with the Japan Aerospace Exploration Agency (JAXA) on lunar exploration missions. The Chandrayaan-3 and SLIM (Smart Lander for Investigating Moon) collaboration is a joint endeavour to develop a lunar lander and rover. The collaboration aims to conduct scientific investigations, explore the lunar surface, and advance our understanding of the Moon's geology and resources. This partnership showcases the synergy between Indian and Japanese space agencies in pushing the boundaries of lunar exploration.

France's CNES Collaboration

ISRO has a longstanding collaboration with the Centre National d'Études Spatiales (CNES), the French space agency. The partnership encompasses various areas such as climate change monitoring, Earth observation, and satellite technology. Joint missions like the Megha-Tropiques satellite, launched in 2011, exemplify this collaboration's focus on studying the water cycle, climate dynamics, and tropical meteorology.

Australia-India Space Partnership

India and Australia have strengthened their collaboration in the space sector through the Australia-India Space Partnership. This partnership aims to enhance cooperation in space science, satellite navigation, Earth observation, and space research. It facilitates exchanges of scientists and joint research projects and promotes sharing of data and expertise. The collaboration between the two countries is poised to bolster capabilities in space exploration and open new avenues for scientific discovery.

Multilateral Engagements

India actively participates in multilateral engagements, such as the United Nations Office for Outer Space Affairs (UNOOSA), to promote international cooperation in space. Through such engagements, India collaborates with various countries worldwide on space-related projects, research initiatives, and capacity building. These multilateral collaborations foster knowledge sharing and technology transfer and create opportunities for joint missions and research endeavours.

The Modi government's vision for India's space program extends beyond scientific exploration. It recognises the immense potential of space technology in addressing societal challenges, driving economic growth, and fostering innovation. Initiatives such as the utilisation of satellite data for agriculture, disaster management, and telecommunication services showcase the government's commitment to leveraging space technology for the betterment of the nation.

FAME: The Policy Enabling the Transportation Electrification

- Dr Prabhat Ranjan Tripathi is Lead for Power Systems in FleetRF Private Limited and is associated with the BJYM outreach to young professionals in the science and technology sector

India, soon to be the third biggest economy, is also home to some of the most polluted cities in the world. India is one of the world's largest markets for transportation. In 2022, the Indian transportation sector accounted for 14% of the country's total carbon emissions. A significant part of this pollution is by tail-pipe emissions from the transportation sector. To alleviate this situation, the Modi government is targeting the electrification of the transportation sector. The government of India has set ambitious goals for the electrification of transportation. By 2030, the government aims to have 30% of private cars, 70% of commercial vehicles, 40% of buses, and 80% of two-wheelers and three-wheelers powered by electricity. The government of India launched the faster adoption and manufacturing of (hybrid &) electric vehicles in India (FAME-India) Scheme, which is now successfully running in its second phase with promising results from Phase I. The FAME scheme is a key policy initiative that is helping to promote the adoption of electric vehicles in India.

What is FAME:

The scheme encourages the progressive induction of reliable, affordable, efficient electric and hybrid vehicles (xEV). The scheme's First Phase was approved for two years, commencing on 1st April 2015. The scheme has been extended from time to time, with the last extension allowed up to 31st March 2019. It is under the framework of the Demand Incentive Disbursement Mechanism. The incentive amount has been determined for each vehicle category like Mild Hybrid, Strong Hybrid, Plug-in Hybrid, and Pure Electric technologies and battery specification. It is implemented and monitored by National Automotive Board under the direction of Heavy Industry. It is one of the direct benefit transfers (DBT) schemes categorized under in-kind mode.”

After the success of FAME-I, the government has approved Phase II of the FAME Scheme with an outlay of Rs. 10,000 Crore for three years from 1st April 2019. Out of total budgetary support, about 86 per cent of the fund has been allocated for Demand Incentives to create demand for Electric



Vehicles (xEVs) in the country. This phase aims to generate demand by way of supporting 7000 electric buses (e-bus), 5 lakh electric three-wheelers (e-3W), 55000 electric four-wheeler passenger cars (including strong hybrid) (e-4W), and ten lakh electric two-wheelers (e-2W). However, depending upon the off-take of different categories of xEVs, these numbers may vary as the provision has been made for inter and intra-segment-wise fungibility. In addition, the development of charging infrastructure will also be supported under the scheme. Vehicles fitted with only advanced chemistry batteries, meeting minimum technical criteria, and registered as “Motor Vehicles” as per CMVR shall be eligible for incentive under the scheme. With greater emphasis on providing affordable & environment-friendly public transportation options for the masses, the scheme will apply mainly to vehicles used for public transport or those registered for commercial purposes in e-3W, e-4W,

and e-bus segments. However, privately owned registered e-2Ws are also covered under the scheme as a mass segment.

Impact of FAME:

The FAME scheme has had a significant impact on the Indian EV market. In the years since the scheme was launched, the sales of EVs in India have grown exponentially. In 2015-16, only 1,707 EVs were sold in India. By 2022-23, the number of EVs sold in India has reached 1,147,608. The FAME scheme has also helped to create a strong EV manufacturing industry in India. Several Indian companies, including Mahindra Electric, Tata Motors, and Hero Electric, have emerged as major players in the global EV market. The FAME scheme has been a success in promoting the adoption of EVs in India. The sales figure of EVs from the inception of the FAME scheme is shown in table-1.

Table 1: Sales of EVs in India (2015-2023)

Year	Two-wheelers	Three-wheelers	Four-wheelers	Total
2015-16	1,295	397	12	1,704
2016-17	1,954	588	10	2,552
2017-18	3,398	1,116	40	4,554
2018-19	7,688	2,824	150	10,562
2019-20	10,384	4,022	80	14,486
2020-21	20,918	7,917	233	38,058
2021-22	41,714	12,436	607	54,757
2022-23 (April-March)	720,733	399,540	27,325	1,147,608



The Indian EV market will enjoy higher growth rates in the coming years. The government of India has announced plans to invest \$100 billion in the development of the EV sector. This investment is expected to help accelerate the adoption of EVs in India. According to a report by the International Energy Agency, the number of EVs in India is expected to reach 10 million by 2030. It would represent a significant increase from the current level of EV sales in India.

The growth of the Indian EV market will be driven by several factors, including:

1. The government's ambitious goals for the electrification of transportation.
2. The increasing availability of affordable EVs.
3. The growing awareness of the benefits of EVs.

The Challenges for EV Sales in India

Despite the growth of the Indian EV market, some challenges still need to be addressed to accelerate the transition to electric mobility. The primary challenges faced by EV adoption in India are shown in table-2

Challenge	Description
High cost of EVs	EVs are still more expensive than traditional gasoline-powered vehicles. This is due to the high cost of batteries, a significant component of EVs.
Lack of charging infrastructure	There are not enough charging stations in India, which makes it difficult for EV owners to charge their vehicles. This is a major barrier to the adoption of EVs, especially for people who live in rural areas.
Range anxiety	Range anxiety is the fear that an EV will run out of power before reaching its destination. This is a major concern for many people, and it is one of the reasons why some people are hesitant to adopt EVs.
Public awareness	There is still a lack of public awareness about EVs. Many people are unaware of the benefits of EVs, and they need to be educated about their positive impact on the environment.

The FAME scheme has been a major driver of the growth of the Indian EV market. The Indian EV market is expected to grow rapidly in the coming years. By 2030, the number of EVs in India is expected to reach 10 million. It would represent a significant increase from the current level of EV sales in India. The government is working to address these challenges. The government has announced plans to build a network of 500,000 charging stations across India by 2025. The government is also working to reduce the cost of batteries. However, it is not a silver bullet in our fight against pollution. A major part of electricity still comes from

coal-fired power plants in India. Therefore, just electrification of transportation would not suffice. The government is pushing for renewable energy sources and has been successful to a great extent in solar installations. If the government successfully addresses the challenges of power demands through renewable energy sources, transportation electrification will be more beneficial in curbing pollution.



Orbiting the Future: Recent Space Launches and Applications

- Gourav Lama is Vice-president BJYM, West Bengal and an Assistant Professor at Presidency University, Kolkata.

There has been a remarkable liberalization of India's space sector within a short span of time in the last few years. New startups have been unleashing innovative potentials today, and there are 102 startups in India engaged in cutting-edge arenas of research, nanosatellites, space waste (debris) management, launch vehicle etc. This scenario is that integrating various stakeholders from industry, R&D and academia and having equal stakes gives us a positive assurance that a space revolution is on the way, led by ISRO in cooperation with private stakeholders and startups. It is historic that India is all ready for the Chandrayaan 3 launch. Similarly, last year, the first private initiative, Vikram - a suborbital VKS rocket, was launched, setting a new milestone in Indian

Today we have reached a point where we are proud of its development because its applications have exceeded its initial intentions to showcase that both the Government and the scientists are doing their best to bring in all the stakeholders at a common platform for ensuring the best Space Program for the Nation

Space Program. In this article, we will look into some of the latest development and achievements of ISRO this year.

Regarding space transportation, we have seen the successful launch of the second developmental flight of SSLV - PU, in February 2023 with the successful injection of all three spacecraft, i.e. EOS-17, JANUS-1 and AzadiSAT-2, into the intended orbit. ISRO also completed the Acoustic test on the Semicryo Inter Tank structure (SITS) sub-assembly required to develop the semi-cryogenic stage (SC 120 stage). Another important epoch was the launch of the LVM3-M3 /ONEWEB India-2 mission, which was accomplished on 26th March 2023 with the deployment of 36 satellites in the desired orbit. It is to be noted that this was the third operational and second commercial mission of the LVM3 vehicle. Another milestone is the launch of PSLV-C55 a dedicated commercial mission of NSIL that was accomplished in April 2023, which launched two satellites for Singapore and, in addition, hosted 7 payloads from India Space Startups and Academia in the PSLV Orbital Experimental Module (POEM 2). It is to be mentioned India Today ranks 3rd globally in terms of the number of startups and also in terms of attracting investments related to technology transfer.

Similarly, GSLV F12/NVS-01 mission was successfully accomplished and completed up to the GS1 stage at SDSC, Sriharikota.

In May this year, the GSLV OR geosynchronous Satellite Launch Vehicle deployed an NVS-01 navigation satellite weighing around 2232 kg into a Geosynchronous Transfer orbit. The vehicle was launched on 29th May at 10:42 hours from the second launch pad at SDSC-SHAR, Sriharikota and injected the satellite after about 19 minutes of flight. Finally, one of the most critical projects is the LVM3-M4/Chandrayaan 3 mission, which commenced on 3rd May at SDSC SHAR and completed the stacking of S200 motors. The Chandrayaan 3 was successfully launched on 14th July.

ISRO has been developing a Geospatial solution for planning and monitoring MGNREGA activities for DoRD. It has also developed Aman



Paddy crop for Kharif 2022-23 was developed for West Bengal under Crop Insurance Decision support for AICIL. Morphological Spatial pattern analysis was done covering forest fragmentation for Eravikulam regional landscapes, Kerala and Purna regional landscapes, and Gujrat to observe and understand changes within a decade under a community level Biodiversity characterization project for the Department of Biotechnology (DBT). Recently an important 2 day National Meet on Disaster Risk Management -Trends and Technologies - was organized with the Ministry of Home Affairs, where 165 delegates from 39 institutions and organizations from all over the country participated. In a similar line Disaster Management Support(for various ministries) Algorithms are developed and implemented for automating flood map generation, demarcating long-duration fire events (LDFE) and Rapid Assessment of Forest Fire Affected Areas(RFAA). Therefore ISRO and its space program are cultivating a holistic approach devoted to developing world-class technological space crafts and

satellites and generating applications that directly benefit the agricultural arenas and solve disaster-related problems with better-advanced satellite communications.

To conclude, if we go back into the past, in the 1960s, which witnessed the genesis of the Indian Space program under the stalwarts like Vikram Sarabhai and Homi Bhabha, we find that the program's intentions were directed towards broadcasting, remote sensing, weather forecasting and telecommunications. However, today we have reached a point where we are proud of its development because its applications have exceeded its initial intentions to showcase that both the Government and the scientists are doing their best to bring in all the stakeholders at a common platform for ensuring the best Space Program for the Nation. It is where various aspects of the country and its people are considered while being an advanced Space Program in the World.



Driving Development: Promoting Science and Technology for India's Growth

- Reem Talukdar, State Invitee Member, BJYM Assam and content creator & influencer.

Science and technology play a vital role in our daily life as they make our lives simpler, faster and safer. Science has allowed man to create cultures, pursue societal concerns such as ethics, aesthetics, and justice and improve human conditions. Science and technology feed each other, propelling both forward. Scientific knowledge allows us to make new observations about the world, build more scientific and technical knowledge, and build new technologies - thus improving our working memory, fluid intelligence and multitasking skills.

India is one of the top-ranking countries in the field of basic research. Indian Science has come to be regarded as one of the most powerful instruments of growth and development, especially in the emerging scenario and competitive economy. India has a rich legacy in science, technology, innovation, data, demography, demand and democracy to achieve world-class scientific solutions. In the wake of the recent developments and the new demands that are being placed on science and technology, we must embark on some major science projects which have relevance to national needs and which will also be relevant for tomorrow's technology.



India has made enormous progress in science and technology in the past nine years under Prime Minister Narendra Modi's government. Different countries are looking towards India after it registered achievements in different fields, including space technology, and it was possible because Prime Minister Modi has given priority to the field of science and technology and accordingly enhanced budgetary allocations. Despite scepticism

and doubts raised in unscrupulous quarters, the country successfully fought the Covid19 pandemic. Indian pharmaceutical companies developed indigenous vaccines with proactive support from the government. The government combatted the spread of Covid19 and exported the vaccine to the developed world and WHO commitments. And on the other hand, NASA has been obtaining pictures taken by the Indian Space Research Organisation (ISRO) through its Chandrayaan and Mangalyaan missions, while countries like Nepal, Bhutan and Bangladesh use India's technology for weather forecasts. The new weather technology helps pilgrims, tourists, students and farmers, in a significant way and helps them plan their activities accordingly.

India has set its sight on becoming energy independent by 2047 and achieving Net Zero by 2070. To achieve this target, increasing renewable energy use across all economic

The poor farmer of the village is also making digital payments! Today a large population of India has joined Smartphone-based apps. Today India is becoming the centre of the Evolution and Revolution of Global High-tech Power. The country is now ready to create and adopt high-tech solutions to provide world-class education, health, and connectivity to every poor village.

spheres is central to India's Energy Transition. Green Hydrogen is considered a promising alternative for enabling this transition. Hydrogen can be utilized for long-duration storage of renewable energy, replacement of fossil fuels in industry, clean transportation, and potentially decentralized power generation, aviation, and marine transport.

Science can also help achieve the goal of doubling farmers' income and creating job opportunities for the youth. For example, The Ministry of Science and Technology initiated the Lavender Revolution in 2016 through the Aroma Missions of the Council of Scientific and Industrial Research (CSIR) to promote the indigenous aromatic crop-based agro-economy by shifting from foreign aromatics to home-grown kinds with the government's objective of doubling agricultural earnings by 2022; providing a livelihood for aspiring farmers and agri-entrepreneurs, as well as strengthening the Start-Up India programme and encouraging an entrepreneurial spirit in the region. Over 500 young peo-



ple benefited from the purple revolution, which eventually led to the doubling of their income.

India created a massive jump in its global ranking on the Global Innovation Index (GII) from 81st in 2015 to 40th in 2022 among 130 world economies. The Gross Expenditure on R&D (GERD) has increased more than three times in the last 10 years. India is ranked 9th in resident patent filing, while Women's participation in extramural R&D has also doubled in the last 9 years. The adoption of technology has opened new shores for the participation of women in the field of science and technology. The increasing participation of women is proof that women and science are both progressing in the nation; that was most definitely the Prime Minister's agenda. The government also runs the Prime Minister's Research Fellowship Scheme for Quality Research. The aim is to ensure that the country's best talent should get more facilities to research a field of his choice. This scheme provides considerable financial help to the students in all the IITs of the country, all the IISERs, the Indian Institute of Science in Bangalore and some Central Universities and NITs.

Digital technology has also given strength to ordinary Indians and has assured of direct & fast delivery of government assistance. Today the number of Internet users in the village has exceeded that of the cities. The poor farmer of the village is also making digital payments! Today a large population of India has joined Smartphone-based apps. Today India is becoming the centre of the Evolution and Revolution of Global High-tech Power. The country is now ready to create and adopt high-tech solutions to provide world-class education, health, and connectivity to every poor village.

India is making rapid strides in investment in the science and technology sector and education to build a strong base for India@2047. Two thousand years ago, great Tamil saint and social reformer Thiruvalluvar said- 'In sandy soil when deep you delve, you reach the springs below; The more you learn, the freer streams of wisdom flow.' That is, the deeper you dig in the sandy soil; you will definitely reach the water one day. Just like, one day, you are certain to reach the flow of knowledge and intelligence with greater learning.

The Modi Era: How Science and Technology are Driving India's Progress

- Amarjeet Verma, Policy and Research Team, BJYM Bihar

The technological and scientific revolution under the Modi government has empowered India, propelled the nation to unparalleled progress, and opened up unlimited opportunities for every citizen, regardless of background or geographic location. The visionary outlook of Prime Minister Modi includes a deep conviction that science and technology must be used magnificently for the betterment of humankind. Recognizing the incredible potential of scientific advancements, he firmly asserts that they must serve as practical solutions to the myriad challenges prevalent in our society. From education to infrastructure, healthcare to defence, social security to the economy, and industry to every aspect of our lives, optimal use of science

The NRF aims to foster a robust research ecosystem and strengthen India's position as a global knowledge hub. India ranks 9th globally in terms of resident patent filings, highlighting the country's strong intellectual property ecosystem. In addition, women's participation in extramural research and development has doubled over the past nine years, promoting gender inclusiveness in the scientific community.

and technology is essential. Prime Minister Modi has actively encouraged scientists, innovators & researchers to go beyond the confines of laboratories and harness the power of science and technology as a catalyst for development. This visionary approach means moving from theoretical inquiry to practical applica-

tion, enabling the discovery of solutions to many of our nation's problems.

During the COVID-19 pandemic, Indian pharmaceutical companies played a vital role in developing vaccines in record time. The government not only successfully fought the spread of the virus in the country and exported vaccines to the developed world, and met WHO commitments under 'Vaccine Maitri'. This achievement demonstrated India's scientific prowess and ability to address global health issues with scale and speed. India has seen a remarkable jump in its Global Innovation Index ranking, from 81st in 2015 to 40th in 2022. This phenomenal improvement reflects the government's focus on promoting innovation, research and development in various sectors of the economy.



Over the past decade, India has witnessed a more than threefold increase in gross expenditure on research and development (GERD). This increase in funding has facilitated the growth of scientific research, technological innovation and collaboration between academia, industry and government. Furthermore, the National Research Foundation (NRF) Bill received Cabinet approval and established a specialized body to fund and support research and innovation across disciplines. The NRF aims to foster a robust research ecosystem and strengthen India's position as a global knowledge hub. India ranks 9th globally in terms of resident patent filings, highlighting the country's strong intellectual property ecosystem. In addition, women's participation in extramural research and development has doubled over the past nine years, promoting gender inclusiveness in the scientific community.

India ranks third globally in the number of startups, with more than one lakh startups, and the number of unicorns

has reached 115. This thriving startup ecosystem demonstrates an entrepreneurial spirit and innovation-based culture that is greatly supported & promoted by the government. In a first-ever, India's Deep Ocean Mission aims to explore and exploit the vast potential of the ocean's resources. This initiative will lead to advances in deep-sea mining, ocean climate change studies, and the development of underwater robotics. It is strategically vital for India's blue economy, energy security and sustainable development. India's space agency, the Indian Space Research Organization (ISRO), achieved several significant milestones during this period. Notable achievements include the Chandrayaan-2 lunar mission and the successful launch of the Mars Orbiter Mission (Mangalyaan), alongside getting ready for Chandrayaan 3 launch on July 14, 2023. India's signing of the Artemis Accords recently will boost its space/lunar exploration efforts and help get the technology transfer and necessary training for India's astronauts with the help of NASA. These achievements strengthened India's presence in space ex-

health services across the country with various schemes like Ayushman Bharat etc. More than 10,000+ Atal Innovation Labs have been set up across schools in India to foster innovation and entrepreneurship among students since 2016. These labs provide hands-on experience, mentorship and resources to foster a culture of innovation and problem-solving.

India is also putting a lot of emphasis on renewable energy sources to tackle climate change and ensure energy security. Successful solar and wind energy initiatives have positioned India as a global leader in adopting clean energy. India's IT sector has grown significantly, contributing to economic development and job creation. Government initiatives such as Digital India and Skill India have further accelerated the expansion of the sector. The historic 'Make in India' campaign launched by the Modi government has been a driving force behind promoting domestic manufacturing and technology development. This initiative attracted



The Modi government's unyielding commitment to putting science and technology at the centre of its plans demonstrates a holistic vision of India's progress.

ploration. India's biotechnology sector has also seen significant growth, contributing to healthcare, agriculture and environmental sustainability advances. The country's pharmaceutical industry is thriving, providing affordable generic drugs to the domestic and international markets.

Not to forget, the JAM (Jan Dhan-Aadhaar-Mobile) trinity has completely transformed the delivery of social welfare systems and services through digitization and direct benefit transfers. This initiative has remarkably reduced leakages, improved transparency and financial inclusion for millions of Indians. The Modi government has prioritized the development of health infrastructure, ensuring access to quality

foreign investment and spurred the growth of domestic research and development (R&D) centres, promoting innovation and technology transfer.

In conclusion, the Modi government's unyielding commitment to putting science and technology at the centre of its plans demonstrates a holistic vision of India's progress. By leveraging these advancements, the government wants to make India a global leader in science and technology and ensure that the benefits are available to all citizens. This approach reflects a comprehensive understanding of the transformative power of science and technology and its potential to uplift the nation.

विज्ञान और प्रौद्योगिकी से सशक्त होता भारत

- वृंदा काल्हेर, प्रांत कार्यकारिणी सदस्य, भाजयुमो हरियाणा

भा

रतीय विज्ञान की परंपरा विश्व की प्राचीनतम वैज्ञानिक परंपराओं में एक है। विज्ञान और प्रौद्योगिकी के क्षेत्र में भारत की एक अमीर विरासत है। प्राचीन काल से ही भारतीय वैज्ञानिकों

ने आपने आविष्कारों से विश्व को महत्वपूर्ण योगदान दिया है, जैसे कि चिकित्सा विज्ञान के क्षेत्र में चरक और सुश्रुत, खगोल विज्ञान व गणित के क्षेत्र में आर्यभट्ट, ब्रह्मगुप्त और आर्यभट्ट द्वितीय और रसायन विज्ञान में नागार्जुन की खोजों का बहुत महत्वपूर्ण योगदान है। इनकी खोजों का प्रयोग आज भी किसी-न-किसी रूप में हो रहा है। आधुनिक वैज्ञानिकों में, जगदीश चन्द्र बसु, प्रफुल्ल चन्द्र राय, सी वी रमण, सत्येन्द्रनाथ बोस, मेघनाद साहा, प्रशान्त चन्द्र महलनोबिस, श्रीनिवास रामानुजन्, हरगोविन्द खुराना आदि का वनस्पति, भौतिकी, गणित, रसायन, यांत्रिकी, चिकित्सा विज्ञान, खगोल विज्ञान आदि क्षेत्रों में महत्वपूर्ण योगदान है। लेकिन जैसे कि लुटेरों ने भारत की संपत्ति को लूटा, इन महान वैज्ञानिकों के श्रेय को भी लूट लिया। परंतु भारत के वैज्ञानिकों ने बेमिसाल कार्य किए हैं, जिन पर प्रत्येक भारतीय गर्व कर सकता है। विभिन्न क्षेत्रों में भारतीय वैज्ञानिकों का योगदान इस प्रकार है:

- प्रसिद्ध जर्मन खगोलविज्ञानी कॉपरनिकस से लगभग 1000 वर्ष पूर्व आर्यभट्ट ने पृथ्वी की गोल आकृति और इसके अपनी धुरी पर घूमने की पुष्टि कर दी थी।
- इसी तरह आइजक न्यूटन से 1000 वर्ष पूर्व ही ब्रह्मगुप्त ने पृथ्वी के गुरुत्वाकर्षण सिद्धान्त की पुष्टि कर दी थी।
- कणाद ऋषि ने छठी शताब्दी ईसा पूर्व ही इस बात को सिद्ध कर दिया था कि विश्व का हर पदार्थ परमाणुओं से मिलकर बना है। उन्होंने परमाणुओं की संरचना, प्रवृत्ति तथा प्रकारों की चर्चा की है।



● अधिकतर खोज और आविष्कार जिन पर आज यूरोप को इतना गर्व है, एक विकसित गणितीय पद्धति के बिना असंभव थे। यह पद्धति भी संभव नहीं हो पाती यदि यूरोप भारी-भरकम रोमन अंकों के बंधन में जकड़ा रहता। नई पद्धति को खोज निकालने वाला वह अज्ञात व्यक्ति भारत का पुत्र था। मध्ययुगीन भारतीय गणितज्ञों, जैसे ब्रह्मगुप्त (सातवीं शताब्दी), महावीर (नवीं शताब्दी) और भास्कर (बारहवीं शताब्दी) ने ऐसी कई खोजें कीं, जिनसे पुनर्जागरण काल या उसके बाद तक भी यूरोप अपरिचित था। इसमें कोई मतभेद नहीं कि भारत में गणित की उच्चकोटि की परंपरा थी।

● माप-तौल और व्यापार क्या बिना अंकों और संख्याओं के संभव हो सकता था? ब्रह्मगुप्त (छठी शताब्दी) पहले गणितज्ञ थे जिन्होंने शून्य को प्रयोग में लाने के नियम बनाए। इस तरह से संसार को संख्याएँ लिखने की आधुनिक प्रणाली भारत ने ही दी है।

● सुश्रुत को पूरे संसार में आज प्लास्टिक सर्जरी का जनक कहा जाता है। सुश्रुत संहिता में नाक, कान और आँठ की प्लास्टिक सर्जरी का

पूरा विवरण दिया गया है। सुश्रुत भूज नलिका में पाए जाने वाले पत्थर निकालने में, टूटी हड्डियों को जोड़ने और मोतियाबिंद की शल्य चिकित्सा में बहुत दक्ष थे। चरक और सुश्रुत की ही परंपराओं को अनेक सुप्रसिद्ध चिकित्सकों ने आगे बढ़ाया। महर्षि अजेय ने नाड़ी और श्वास की गति पर प्रकाश डाला। महर्षि पतंजलि ने योग से शरीर को निरोग रखने के उपाय बताए। आधुनिक चिकित्सक भी अब हृदय के रोगों के लिए योग का सहारा लेते हैं। आचार्य जीवक भगवान बुद्ध के चिकित्सक थे। उन्होंने अनेक असाध्य रोगों की चिकित्सा की विधियाँ बताई हैं।

● दिल्ली के महारौली इलाके में कुतुबमीनार के निकट खड़ा लौह स्तंभ (चौथी शताब्दी) 1700 वर्षों की सर्दी गर्मी और बरसात सहकर भी जंगविहीन बना हुआ है। यह भारत के उत्कृष्ट लौह कर्म का नमूना है। महारौली के लौह स्तंभ जैसा ही लगभग 7.5 मीटर ऊँचा एक प्राचीन लौह स्तंभ कर्नाटक की पर्वत श्रृंखलाओं में खड़ा है। इस पर भी जंग का कोई प्रभाव नहीं हुआ है। यही नहीं उड़ीसा के कोणार्क मंदिर (तेरहवीं शताब्दी) में लगभग 10.5 मीटर लंबा तथा 90 टन के भार वाला लोहे का स्तंभ भी आज तक जंगविहीन है। यही नहीं इतने भारी स्तंभ को ढालकर बनाना ही भारत की मध्यकालीन प्रणाली की विस्मयकारी उपलब्धि है। लोहा ही नहीं सोना, चांदी, ताँबा, टिन, जस्ता जैसी अनेक धातुओं के अयस्क खोजने तथा उन्हें गलाकर शुद्ध धातु प्राप्त करने में भारतीय वैज्ञानिकों को महारत हासिल थी। अनेक धातुओं की तो वे भस्म बनाकर औषधि के रूप में प्रयोग करते हैं।

● इनके अतिरिक्त जलयान निर्माण में मध्यकाल तक भारत यूरोप से आगे था।

● वस्त्र निर्माण में भारत ने असाधारण दक्षता प्राप्त की थी। शताब्दियों पहले भारत में कपड़े रंगने के लिए 100 से अधिक वनस्पति और खनिजों से प्राप्त रंगों का उपयोग होता था।

विज्ञान की अन्य अनेक शाखाओं में भारत की उच्चकोटि की उपलब्धियाँ थीं। दसवीं शताब्दी के बाद विदेशी आक्रमणकारियों ने समस्त उत्तर भारत को पदाक्रांत कर दिया था। चारों ओर अव्यवस्था और अराजकता थी। ऐसी स्थिति में वैज्ञानिक अनुसंधान करने का किसे होश था। केवल दक्षिण भारत के कुछ भागों में वैज्ञानिक गतिविधियाँ चलती रहीं। अंग्रेजों के आगमन के बाद काफ़ी समय तक छिटपुट लड़ाइयाँ चलती रहीं। अंग्रेजों का लगभग पूरे भारत पर आधिपत्य हो जाने के बाद विज्ञान के क्षेत्र में कुछ भारतीयों ने महत्त्वपूर्ण उपलब्धियाँ प्राप्त कीं, मगर अंग्रेजों की द्रष्टि सिर्फ भारत को लूटने की ही थी। इसलिए हमारा देश लगभग हर वस्तु, सुई, टूथपेस्ट जैसी रोज़मर्रा की आवश्यक वस्तुओं के लिए भी दूसरे देशों पर निर्भर था। धीरे धीरे अंग्रेजों ने भारतीय वैज्ञानिक अनुसंधान को पंगु बना दिया। और संपूर्ण भारतीय जनमानस में हीनता की भावना भर दी। जिस से उभरने में भारत को आजादी मिलने के बाद भी कई दशक लग गए। निश्चित ही स्वतन्त्रता के बाद विज्ञान व अनुसंधान के क्षेत्र में कई सराहनीय काम हुए और भारत आत्मनिर्भरता की ओर अग्रसर हुआ। स्वतंत्र भारत ने अंतरिक्ष में कदम रखा, भारत एक परमाणु महाशक्ति बना। अंतर्राष्ट्रीय स्तर के अनुसंधान केन्द्र, विश्वविद्यालय व प्रयोगशालाएं होंद में आईं। मगर इन समस्त प्रयासों के बावजूद अभी वो भारत बनना बाकी था, जिसकी धाक पूरा विश्व माने। वो भारत जो समस्त संसार का अपने ज्ञान-विज्ञान के माध्यम से नेतृत्व कर सके। वो भारत जहाँ समस्त विश्व अपनी समस्याओं की कुंजी ढूँढे। और उस सपने को सच होता अगर 140 करोड़ भारतीय देख रहे हैं तो



उसका एकमात्र कारण भारत के प्रधानमंत्री नरेन्द्र मोदी हैं। और ये बात सिर्फ उनके भारतीय प्रशंसक ही नहीं कहते, मगर समस्त विश्व एक स्वर में कह रहा है। मोदी ने दिखाया कि कुछ भी नामुमकिन नहीं है तो उसी विश्वास से देशवासियों ने भी कहा कि मोदी है तो मुमकिन है। सिंगापुर के अखबार जहां उनकी तुलना अपने महान नेता ली कुआन यू से करते हैं, तो समस्त वैश्विक मीडिया उन्हें विश्व का सबसे लोकप्रिय नेता मानता है। और यह वैश्विक स्वीकृति उनके द्वारा लिए गए निर्णयों की वजह से है। जिनसे भारत ने प्रत्येक क्षेत्र में एक लंबी छलांग लगाई है। और सबसे बड़ा बदलाव अगर आया है तो वह आया है विज्ञान और प्रौद्योगिकी के क्षेत्र में। जिसके कुछ उदाहरण निम्नलिखित हैं:

● एन एस एफ के आंकड़ों के अनुसार भारत वैज्ञानिक उपकरण बनाने के मामले में विश्व में तीसरे पायदान पर आ गया है।

● पी एस एल वी - सी 44, कलाम सैट, माइक्रो- सैट, कारटो सैट व मिशन शक्ति की सफलता से भारत ने अंतरिक्ष में एक नई कहानी लिखी है। उम्मीद है कि चन्द्रयान-3 की सफलता हर भारतीय को गर्व के क्षण देगी।

● पीएम नरेन्द्र मोदी ने भारतीय राष्ट्रीय अंतरिक्ष संवर्धन एवं प्राधिकरण केंद्र का गठन किया है। जो अंतरिक्ष बुनियादी ढांचे को निजी क्षेत्र के लिए खोलना चाह रहा है। पीएम मोदी के नेतृत्व में केंद्रीय मंत्रिमंडल ने जून 2020 में अंतरिक्ष क्षेत्र को खोलने और इस तरह वैमानिकी और अंतरिक्ष प्रौद्योगिकियों के पूरे क्षेत्र में भारतीय निजी क्षेत्र की भागीदारी को सक्षम करने का ऐतिहासिक निर्णय लिया है।

● कोविड- 19 से निजात पाने के लिए भारत ने मानव इतिहास की सबसे बड़ी टीकाकरण मुहिम चलाई। यहां तक कि विश्व के कई देशों की सहायता भी की।

● पीएम जन धन योजना के माध्यम से 500 मिलियन से अधिक बैंक खाते खोले जाने के साथ ही यह संख्या रिकॉर्ड समय में हासिल किया गया विश्व का सबसे बड़ा वित्तीय समावेशन कार्यक्रम बन गया है।

● यू पी आई के माध्यम से गांवों में भी डिजिटल भुगतान की सुविधा प्रदान करके भारतीय अर्थव्यवस्था को एक नई उड़ान मिली है। एक सामान्य रेहड़ी वाला, चाय के ठेले वाला भी यू पी आई के माध्यम से डिजिटल भुगतान प्राप्त कर रहा है, यह आश्चर्यचकित करता है। समस्त भारतीयों के लिए गर्व की बात है कि अब फ्रांस में भारतीय छात्र, पर्यटक और एनआरआई लाइरा नेटवर्क द्वारा समर्थित किसी भी टर्मिनल पर अंतरराष्ट्रीय मोबाइल नंबरों का उपयोग करके यूपीआई और रुपये के माध्यम से भुगतान कर सकते हैं।

● भारत सरकार ने ऑनलाइन बुनियादी ढांचे में सुधार और इंटरनेट कनेक्टिविटी को बढ़ाकर नागरिकों को सरकारी सेवाएं इलेक्ट्रॉनिक रूप से उपलब्ध कराने के लिए डिजिटल इंडिया अभियान शुरू किया। इसका उद्देश्य देश को प्रौद्योगिकी के क्षेत्र में डिजिटल रूप से सशक्त बनाना है।

और डिजिटल इंडिया ने भारत के विकास में एक महत्वपूर्ण भूमिका निभाई है।

● सरकार द्वारा जनहित में चलाई जा रही विभिन्न योजनाएं जैसे जनधन, आधार व मोबाइल नंबर से बैंक खातों को जोड़ना व सहायता राशि सीधे खाते में पहुंचाना, यह सब विज्ञान व तकनीक से ही संभव हो पाया है। एवम इससे सरकार भ्रष्टाचार पर भी अंकुश लगा पाई है व सामान्य जन लाभान्वित हुआ है।

● प्रधानमंत्री दूरदर्शिता से क्षेत्र में विश्व में

नरेन्द्र मोदी की ही भारत सौर ऊर्जा के शीर्ष स्थान पर पहुंचा है।

● सरकार ने

कालिटी रिसर्च के लिए प्रधानमंत्री रिसर्च





फेलोशिप योजना भी शुरू की है। इसका उद्देश्य यह सुनिश्चित करना है कि देश की सर्वश्रेष्ठ प्रतिभा को अपनी पसंद के क्षेत्र में शोध करने के लिए अधिक सुविधाएं मिलें। यह योजना देश के सभी आईआईटी, सभी आईआईएसईआर, बेंगलूर में भारतीय विज्ञान संस्थान और कुछ केंद्रीय विश्वविद्यालयों और एनआईटी में छात्रों को काफी वित्तीय मदद प्रदान कर रही है।

● हाल ही में भारत ने वैभव शिखर सम्मेलन की मेजबानी भी की है। एक महीने तक चले इस शिखर सम्मेलन में दुनिया भर से भारतीय मूल के वैज्ञानिक और शोधकर्ता एक मंच पर जुटे थे। इसमें करीब 23 हजार लोगों ने हिस्सा लिया था। इन सभी प्रयासों का उद्देश्य भारत को वैज्ञानिक शिक्षा के लिए सबसे भरोसेमंद केंद्र बनाना है। यह हमारे वैज्ञानिकों को एक्सपोजर और अवसर दोनों देता है।

● सरकार ने सुपर-कंप्यूटिंग और साइबर-फिजिकल सिस्टम पर प्रमुख मिशन लॉन्च किए हैं। इनमें कृत्रिम बुद्धिमत्ता, रोबोटिक्स, सेंसर और बड़े डेटा एनालिटिक्स जैसे क्षेत्रों में मौलिक अनुसंधान और अनुप्रयोग का विस्तार किया गया है। इससे भारतीय विनिर्माण को काफी बढ़ावा मिलेगा।

● सुपरकंप्यूटिंग और क्वांटम कंप्यूटिंग अनुसंधान ने भारत को न केवल इस क्षेत्र में अग्रणी बनाया है बल्कि औद्योगिक क्रांति 5.0 के लिए भी तैयार किया है।

● कृषि क्षेत्र पर अगले 5 वर्षों में 25 लाख करोड़ से अधिक खर्च करने की योजना है और अधिकांश निवेश बिग डेटा और एआई से प्राप्त विश्लेषण

से प्रेरित होगा।

● कृषि क्षेत्र को उभरती प्रौद्योगिकी को अपनाने योग्य बनाने के लिए ब्लॉकचेन, एआई, आईओटी के उपयोग की खोज की गई है। यह प्रौद्योगिकी और बाजार तक पहुंच प्रदान करके अगले 5 वर्षों में किसानों की आय को दोगुना करने के प्रधान मंत्री के दृष्टिकोण के अनुरूप है। फसल संबंधी मामलों के लिए मकिसान पोर्टल के विकास के साथ एक किसान सुविधा ऐप भी मौजूद है।

● मोदी सरकार ने मौसम की भविष्यवाणी, कृषि उत्पादन का पूर्वानुमान, भू-स्थानिक मानचित्रण, मसौदा मूल्यांकन, मानचित्रण के लिए जियोटैगिंग और बाढ़, सूखा और फसल बीमा में स्थिति की निगरानी के लिए ड्रोन के अनुप्रयोग के लिए अंतरिक्ष प्रौद्योगिकियों को भी सक्षम किया है।

इस प्रकार, पिछले 9 वर्षों में प्रधान मंत्री मोदी और भाजपा के नेतृत्व वाली एनडीए सरकार के सक्रिय प्रयासों ने भारत में प्रौद्योगिकी और वैज्ञानिक अनुसंधान को बढ़ावा देने में बहुत रुचि दिखाई है। मोदी सरकार ने एआई, आईओटी, ब्लॉकचेन, मशीन लर्निंग और स्पेस टेक्नोलॉजीज में डीप-टेक जैसे क्षेत्रों में निजी-इक्विटी निवेश के लिए नवाचार और उद्यमशीलता पारिस्थितिकी तंत्र के निर्माण में भी मदद की है। इसने भारत को अगली पीढ़ी की औद्योगिक क्रांति के लिए भी तैयार किया है। एवम प्रतिभा को निखारने के लिए भी काफी प्रयास किए गए हैं। निश्चित रूप से विज्ञान और प्रौद्योगिकी के क्षेत्र में प्रधानमन्त्री नरेन्द्र मोदी के ऐतिहासिक निर्णयों व दृष्टिकोण ने विश्व में भारत की धाक जमाई है व भारत के पुनः विश्व गुरु बनने का मार्ग प्रशस्त किया है।

Navigating the Ecosystem: Science Policy, Start-ups, and the Modi Era

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The dawn of independent India brought about the implementation of the first Science Policy Resolution (SPR) in 1958. This policy recognised the importance of education in nurturing a cadre of talented scientists. However, as the wheels of progress turned, we again found ourselves at crossroads. Though well intended in its focus on poverty eradication and urban development, the first policy inadvertently sidelined the rural areas and gave the potential technological advancements a backseat. It took nearly 25 years before introducing the second Technology Policy Statement (TPS) in 1983, which aimed to rekindle the spirit of technological self-reliance and nurture indigenous innovation. This policy recognised the need to strike a balance between adopting imported technologies efficiently while providing a nurturing environment for indigenous innovation. However, our closed economy at the

time, high fiscal deficits, etc., led our country into a severe economic crisis.

The revolutionary economic liberalisation in 1991 opened doors for foreign investments and globalisation. But over the years, as we marvelled at the allure of foreign technologies and products, we unknowingly fell prey to a neo-colonial mentality, overlooking the immense potential of our home-grown innovations. Even simple pleasures like imported chocolates, such as Toblerone, overshadowed the charm of our beloved local candies like Kismi and Poppins. The possession of foreign products and Western technologies became a status symbol, an indicator of being ahead of our peers. Our infatuation with foreign technologies hindered our progress and perpetuated the perception of our inferiority. It took us another two decades after this to recognise the dire need for a paradigm shift in the momentum for scientific progress in India, and the Science and Technology Policy of 2003 (STP 2003) came into effect. This policy acknowledged the

changing landscape of science and technology and the imperative to integrate them seamlessly.

Yet, the journey toward scientific excellence is not without its challenges. The top-down and centralised approach of the past, combined with the lack of support for indigenous technologies, meant continued dependency on foreign innovations, which we can now infer as the beginnings of mass talent drain from India, which is very clearly noticeable today. It became increasingly apparent that a transformative shift was imminent - one that would empower our scientists and technologists, involve the grassroots and foster collaboration across sectors.

Against this backdrop of past limitations and collective experiences, the Science, Technology, and Innovation Policy of 2013 (STIP 2013) was announced. It included "Innovation" as a game changer and a way towards a knowledge-driven economy. Compared to previous policies, the 2013





STIP demonstrated a more inclusive approach, addressing the complexities of societal issues, socio-economic challenges, and gender parity. It acknowledges the significance of the informal sector, which contributes significantly to the country's GDP. It introduces schemes encouraging research and innovation in the Micro, Small, and Medium Enterprise (MSME) sector. The policy also facilitated India's participation in global mega-science initiatives such as the Laser Interferometer Gravitational-Wave Observatory (LIGO), the Large Hadron Collider (LHC-CERN), the International Thermonuclear Experimental Reactor (ITER), and the Square Kilometre Array (SKA), among others.

After 2014, alongside implementing policies, what changed in India was how we saw our government strengthening our global position. We were no longer at the disposition of the Western world, but our confidence increased in our country, and we started to see ourselves as proud Indians. Visible developmental changes and showcases of our culture on the global stage made us feel more connected to the government, and it's not a surprise that India started to witness a surge in people going to give votes. It is a remarkable feat. People are now involved in what's happening in the country, and the long-awaited push came from our Prime Minister, Shri Narendra Modi.

Be it "Man ki Baat", his speeches to people on the ground, or constant interaction with students and the scientific community, people feel they have someone they can depend on. In the last 9 years, we have seen a dramatic shift in the mindset and development of our nation.

In recent years, the COVID-19 pandemic has cast a spotlight on the importance of self-reliance, igniting a renewed focus on innovation and technological advancements. Embracing the spirit of Atmanirbhar Bharat (Self-Reliant India), the government revised STIP 2013 and introduced STIP 2020, building upon the strengths of its previous iterations. This transformative policy strongly emphasises indigenous innovation, collaboration, and harnessing our capabilities to drive research, development, and entrepreneurship. It seeks to position India among the top three global scientific powers and unlock our nation's full potential.

What sets these policies apart is the personal connection we have with them. They reflect our aspirations, determination to overcome obstacles, and unwavering belief in our capabilities. The bottom-up approach adopted in their formation, with extensive consultations involving the public and stakeholders from all walks of life, signifies a shift towards a more inclusive and participatory system. We are no longer content with looking outward

for solutions; we have embraced the message of "Atmanirbhar Bharat" with pride. When the 'Make in India' initiative was announced by PM Modi in 2014, it set the stage for India's transformation into a global manufacturing hub. The government's emphasis on enhancing domestic production and reducing reliance on imports strengthened India's economy. It also infused a sense of collective national pride in our products, which was lacking previously. We started to become more aware of our own country's potential.

2021-22 witnessed a record-breaking FDI inflow of \$83.6 billion, demonstrating its growing appeal as a global manufacturing destination. Under the 'Make in India' initiative, The Production Linked Incentive (PLI) scheme, implemented across 14 sectors, has incentivised domestic production, strengthened manufacturing capabilities, and boosted export potential. Reforms in laws, guidelines, and compliance processes have reduced the burden of doing business. At the same time, the Public Procurement (Preference to Make in India) Order 2017 provides preference to domestic manufacturers in government procurement activities.

We have witnessed many milestones in the last 9 years. For instance, the production of supercomputers has surged, with the National Supercomputing Mission (NSM) establishing

over 70 high-performance computing facilities nationwide. Notably, electronics production has experienced remarkable growth, with the sector's production value increasing from ₹1,90,366 crore in 2014-15 to ₹4,58,006 crore in 2019-20. Additionally, India has emerged as a hub for mobile phone manufacturing, producing over 300 million smartphones annually. Make in India has propelled India's manufacturing capabilities and positioned the nation as a global manufacturing destination, making India a key player in the world economy. Establishing the National Medical Devices Promotion Council (NMDPC) in the medical device sector has stimulated indigenous manufacturing, reduced dependence on imports, and fostered innovation. Developing industrial corridors, with six corridors spanning the country, has also helped foster industrial growth and generate employment opportunities. Moreover, India has become a net exporter of electricity, with 7,203 million units exported to neighbouring countries during the 2017-18 period, showcasing the country's robust power sector.

Furthermore, digitisation has paved the way for financial inclusion, mainly through the widespread adoption of mobile banking and digital payment platforms. Initiatives such as Jan Dhan Yojana and the Unified Payments Interface (UPI) have empowered millions of previously unbanked individuals to access financial benefits that are available to them, make digital transactions, and participate in the organised economy. With the ease of internet access and digital advancements, Indians have seen a significant boost in entrepreneurship and ease of doing business. However, this sudden surge in development and manufacturing abilities is not just attributable to circumstances and policies. It is also because of changing mindset, where people are confident in the "Made in India" label, have contributed to buying indigenous products, and have actively promoted the "Vocal for Local" motto. Such a sense of national support has been instrumental in India's success.

Parallel to the Make in India initiative, the Modi government launched Startup India in 2016, aiming to foster a conducive environment for startups to thrive and innovate. The expansion of digital infrastructure, ease of internet connectivity, and the adoption of digital technologies have propelled the growth of digital services, e-governance, and technology-driven businesses. Since its inception, the startup ecosystem in India has witnessed exponential growth. The number of startups has surged from 452 in 2016 to a staggering 84,012 as of November 2022, highlighting the remarkable expansion of the start-up landscape. The multitude of benefits provided to startups is nothing short of a game-changer. These advantages are not merely superficial gestures but a testament to the government's unwavering commitment to nurturing innovation and empowering entrepreneurs. From fast-tracking intellectual property applications to making available substantial funds (Rs 10,000 crores Funds of Funds scheme) for equity funding, the opportunities for startups are immense in India and have also resulted in the beginning of a reverse brain drain. Startups can register as sellers on the Government e-Marketplace (GeM), the largest e-procurement platform in India. It opens new market opportunities and gives startups access to government contracts, boosting their visibility and credibility. The accelerated exit process offers flexibility and ease of closure when required, reflecting the understanding that not all entrepreneurial endeavours follow a linear path.

Make in India has propelled India's manufacturing capabilities and positioned the nation as a global manufacturing destination, making India a key player in the world economy.

Furthermore, schemes like the CHUNAUTI Challenge encouraged startups to develop solutions for pandemic-related issues. The SAMRIDH Scheme provides funding and incentives to startups with proof of concept. The MSME Market Development Assistance Scheme supports MSMEs in international trade events. The NIDHI Scheme offers funding and resources

to nurture startup ideas. The Credit Linked Subsidy Scheme aids MSMEs in upgrading technology. MSME Sustainable (ZED) Certification promotes quality and sustainability in manufacturing. The Multiplier Grants Scheme encourages industry-academia partnerships. The Startup Leadership Program trains aspiring startup CEOs. ASPIRE focuses on agro-industry entrepreneurship. These are just a few examples of schemes, alongside recognised startup benefits, that have helped create an ecosystem that fosters innovation and entrepreneurship, driving India's growth as a global innovation hub. Furthermore, the government has established a network of incubation centres and mentorship programs to nurture and support startups. These centres provide startups with access to infrastructure, mentorship, networking opportunities, and technical expertise, fuelling their growth and success.

Modi government understands the importance of digital innovation and connecting India to global platforms. Digital initiatives like 'Digital India Bhashini,' 'Digital India GENESIS,' and 'Indiastack. Global' are focused on promoting digital transformation and enabling startups to leverage the digital ecosystem. The SETU (Supporting Entrepreneurs in Transformation and Upskilling) programme aims to connect Indian startups with investors in the United States of America. This initiative creates opportunities for startups to access global markets, gain exposure to international investors, and foster collaborations and partnerships. With the support of these programs, Indian startups are well-armed to make significant strides in various sectors and drive the country's entrepreneurial ecosystem forward. The fundamentals of this ecosystem are robust.

From developing our testing kits and personal protective equipment (PPE) and manufacturing generic medicines to our vaccine during the COVID-19 crisis, we are paving the way for a self-reliant future.

The impact of these initiatives and schemes has been emphatic, and our people are significant contributors



too. In less than a decade, India has secured the third spot globally, following China and the United States, regarding the number of startups. The remarkable growth of India's startup ecosystem is evident in the unicorn club, which now boasts 108 unicorns. In 2022 alone, India added 21 new unicorns, raising a combined funding of \$6.2 billion. This achievement is exceptionally noteworthy, considering the economic slowdown and funding challenges faced during the year.

Startups have emerged as key players in various sectors, leveraging technology to develop innovative solutions and address social challenges. Healthcare startups like Practo, Portea, and Cure.fit has revolutionised the healthcare industry by providing affordable and accessible services through online platforms. Education startups like BYJU'S, Vedantu, and Unacademy have transformed the learning landscape by providing quality education to students nationwide through online platforms. Agricultural startups like Agrostar and Ninjacart have connected farmers with buyers, streamlined the supply chain, and empowered the agricultural sector. E-commerce startups like Flipkart and Myntra have revolutionised online shopping experiences, providing a wide selection of products and personalised recommendations.

In addition to this, one of the most stellar achievements under the Modi government's guidance is the evolution of the Indian Space Research

Organisation (ISRO) and the introduction of the booming startup culture in the space sector, which was never done earlier. The country has witnessed a quantum jump and is now on par with countries like the USA, which began their space journey many years or decades earlier than India. This government's unwavering support and involvement, as demonstrated by the continued increase in funding to ISRO, shows the commitment to India's position as a pioneering force in space research.

Budgetary allocations to ISRO have witnessed a substantial increase under the Modi government, rising from ₹5,615 crore to ₹13,949 crore between 2014 and 2021, representing a growth of over 148%. This surge in funding has provided ISRO with the necessary resources to undertake ambitious missions and develop advanced technologies. India asserts its technological prowess with ground-breaking missions such as the Mars Orbiter Mission (Mangalyaan), Chandrayaan-2 lunar mission, and the recent Chandrayaan-3 lunar mission. It marks its entry into an elite group of nations.

What sets the Modi government's initiatives apart is promoting private sector participation in the space sector. The number of space startups in India has soared from 21 in 2014 to over 120 active startups in 2021, attracting substantial investments. In 2020 alone, Indian space startups secured a record-breaking \$1.4 billion funding, underscoring investor confidence in

the sector's potential. Initiatives like In-SPACE have opened ISRO's satellite data and testing facilities to private players, fostering collaboration and innovation. This collaborative approach has paved the way for India's space startups to offer cost-effective alternatives to European launchers. It has positioned India as a significant player in the global space industry. The Indian Space Research Organisation (ISRO) is transforming from solely an end-to-service provider for India's space program to a facilitator.

Today, ISRO is working with nearly 150 private startups, a significant development compared to the sporadic launches undertaken by ISRO before 2014. Skyroot Aerospace, an Indian startup founded in 2018, successfully launched its Vikram-S rocket from the Satish Dhawan Space Centre, marking a significant milestone in the country's private space exploration endeavours. Other space tech startups like Pixxel and Dhruva Space have also made remarkable contributions, sending their payloads on Indian Space Research Organisation's (ISRO) satellite launch vehicles.

Due to the visionary policies of Prime Minister Shri Narendra Modi, the future of technology-driven economic transformation in India looks more promising than ever before. Adopting emerging technologies and promoting a robust link between research and industry will prepare India to navigate the 21st century successfully.

A New Space Odyssey

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O

n 4th October 1957, the USSR launched Sputnik towards the unlimited sky, the first man-made object in space. A new era of human exploration beyond earth originated. Sputnik was followed a month later by Sputnik-II, carrying a living dog called Laika, the first living creature in space. In May 1959, the USA launched two monkeys into space, and both returned alive. Since childhood, we have studied that Russian cosmonaut

Uri Gagarin became the first human to journey into outer space. An American astronaut, Neil Armstrong, became the first human to land on the Moon through Apollo-11. These two countries kept making a beeline for space in the 60s and 70s, leading to space exploration by other countries as well. 15th August 1969 was that auspicious day when Indian Space Research Organisation (ISRO) was established, and since then, it has never looked back but breaking its records to reach higher and higher, year by year.

At 75, India can be proud of its achievements in various facets of science and technology, especially in communication, space, defence and much more. We have successfully marked “Azadi ka Amrit Mahotsav” and have entered “Amrit Kaal”, the 25-year-long leadup to “India@100”. Under the leadership of visionary Indian Prime Minister Shri Narendra Modi, the Indian Space Research Organisation (ISRO) has witnessed a phenomenal surge in its launch capabilities, with a remarkable total of 47 launches to date. This achievement represents a significant leap from 24 launches during Dr Manmohan Singh-led government. The Modi government's support and focus on space exploration have steadily propelled India's space program to newer heights.

India has made significant achievements in space technology in recent decades. The launch of the first Indian satellite, Aryabhata (1975), led to the very birth of Indian space technology and space programs, which has put our country on the map as a spacefaring nation. The first Polar Satellite Launch Vehicle (PSLV) was launched in 1993, and then the launch of the Geosynchronous Satellite Launch Vehicle (GSLV) was accomplished in 2001. The ISRO has facilitated the launch of dozens of polar satellites to our country and several other developed and developing nations. The successful launch of the Chandrayaan-1 mission was done in 2008, and the orbiter of this mission led to the first clue of the presence of water in the moon's south polar region. The discovery of such precious lunar

water made history and is considered one of the most important discoveries in space exploration.

The very first attempt of ISRO's Mangalyaan mission (MOM-1) was successful in 2013 with a low cost of 450 crores, which is cheaper than many Hollywood movies. The development of the indigenous cryogenic engine was accomplished in 2014. The cryogenic engine is a powerful and efficient engine compared to the liquid fuel engines India previously used. It has allowed India to launch heavier satellites and spacecraft into outer space orbits. Since assuming office in 2014, Prime Minister Modi has strongly emphasised advancing India's space capabilities. The government's vision and commitment to scientific progress

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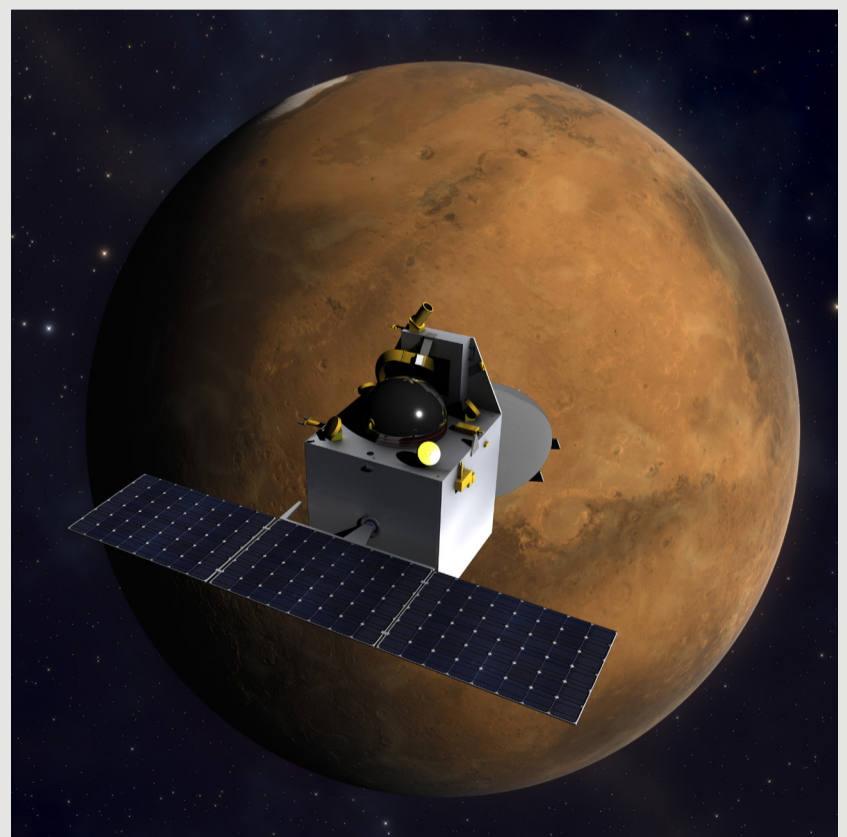
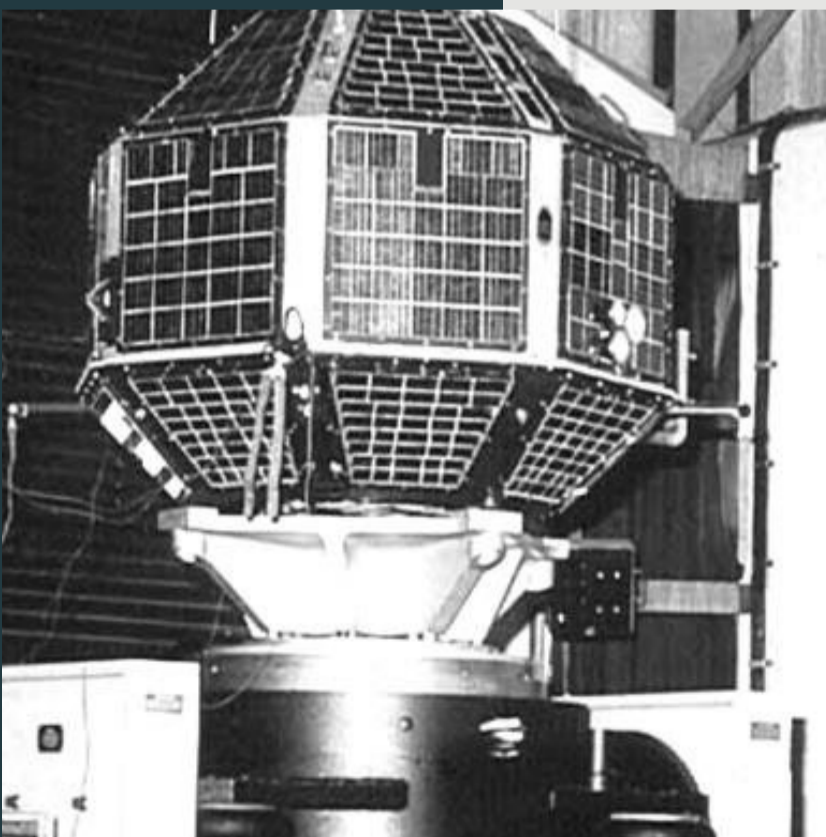
have resulted in a remarkable increase in ISRO launches, enabling the nation to contribute to space research and space exploration actively.

The recent launch of the Chandrayaan-3 mission consists of an indigenous propulsion module (PM), Vikram lander and Pragyan rover to develop and demonstrate new vistas of space technology and innovations. Chandrayaan-3 mission will raise the level of India's International collaborations, particularly in Science, Technology, Innovation and Startups. This lunar mission is a significant improvement over ISRO's second lunar mission, trying to safely touch the moon's surface and be able to look at the earth from the moon to study habitable planet-like features and explore the possibility of exploring exoplanets in the near future. Also, the Chandrayaan-3 will study the environment, soil composition and structure. The world eagerly awaits learning how much lunar water is present on the moon from the Chandrayaan-3 mission.

The control over Space science and technology has enormous potential to improve the navigation system, disaster relief, urban planning and technological innovations. The advances in Space science will lead to avenues in the space economy by allowing private players to allow space



tourism, where extra-rich people may surf the space for their leisure. The ISRO may have orders to launch communication satellites in various African and Latin American countries. Due to “Atmanirbhar Bharat” and “Make In India,” the cost of a satellite launch is far cheaper than any other space agency in the world. The success ratio of our indigenous heavy-duty LVM-III (GSLV) rocket is marvellous. There was only one startup in space science till 2014, but in the recent period, it has increased to 140 innovation startups in space science in our country. Our nation is developing a space economy whose size will soon touch four lakh crores from the present 60,000 Crore value. The good thing is that our space programs have a great emphasis on indigenous innovations and not a copycat of the Western world. Our country's fast-growing space research shall lead to new educational modules and research. Under the leadership of PM Modi, the country's reputation has changed to “space charmer,” which was once ridiculed as a “snake charmer's nation” by the West. The most recent Chandrayaan-3 launch can discover unexplored information about the lunar environment, soil, water, rare moon elements, etc. The discovery of the presence of crystallised water on the moon shall be a boon to further human exploration to Mars by the moon acting as a stopover for refuelling etc. There are many promising space programs on the anvil for the upcoming year by ISRO, including Gaganyaan, Aditya L-1, Mangalyaan-2, AstroSat, Shukrayaan (Venus mission) and Lunar Polar Exploration Mission and so on. The upcoming years shall be golden and sparkling in space science with a futuristic vision of our nation.



Digital Transformation under Modi's Leadership: How Technology is Shaping India

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The BJP government at the centre has been a boon for the country, particularly in the area of science and technology. What comes first to mind is Digital India. Launched in 2015, the Digital India campaign aimed to transform India into a digitally empowered society and knowledge economy. It encompassed various initiatives such as promoting digital infrastructure, e-governance, digital literacy, and digital services to citizens. Digital India, an ambitious initiative launched by the Government of India, has transformed the country in several ways. Digital India has played a significant role in expanding internet connectivity across the country, especially in rural areas. Through initiatives like BharatNet, which aims to connect all villages with broadband connectivity, and the provision of affordable smartphones, more people now have access to the internet. This connectivity has opened up opportunities for education, information access, and e-commerce, bridging the digital divide.

Digital India has streamlined and improved government services through various e-governance initiatives. Online platforms like Aadhaar (unique identification system), Digital Locker, and e-Office have made it easier for citizens to access government services, reducing bureaucratic hurdles and enabling efficient delivery of public services. Digi-

tal India has accelerated financial inclusion by promoting digital payment systems, such as Unified Payments Interface (UPI), mobile wallets, and the Aadhaar-enabled Payment System (AePS). These initiatives have made it easier for individuals, including those in remote areas, to access financial services, transfer money, and make digital transactions, fostering a cashless economy.

Digital India has had a significant impact on education and skill development. Initiatives like SWAYAM (online learning platform), ePathshala (e-learning resources), and National Scholarship Portal have expanded

access to quality education, particularly in rural and underprivileged areas. Additionally, skill development programs like Skill India and online platforms like NPTEL (National Programme on Technology Enhanced Learning) have helped individuals acquire new skills, enhancing their employability.

Digital India has fostered an environment conducive to startups and innovation. Programs like Startup India and Stand-up India have provided support, funding, and mentorship to aspiring entrepreneurs, facilitating the growth of the startup ecosystem in India. Digital platforms and initiatives like Make in India, Tinkering Labs, and Atal Innovation Mission have encouraged innovation, research, and development across various sectors. Digital India has catalyzed the growth of digital services and infrastructure. E-commerce platforms, ride-sharing apps, food delivery services, and digital entertainment platforms have witnessed significant growth, creating employment opportunities and enhancing convenience for consumers. Additionally, initiatives like the National Optical Fiber Network (NOFN) and the push for 5G connectivity have laid the foundation for a robust digital infrastructure. Digital India has empowered citizens by providing access to information, enabling them to exercise their rights and participate in democratic processes. Social media platforms, digital news portals, and online citizen engagement platforms have



facilitated increased citizen participation, activism, and awareness.

The second major development has to do with the UIDAI Aadhaar initiative. The Aadhaar program, launched in 2009, gained significant traction during the Modi government's tenure. Aadhaar is a unique biometric identification system that assigns a 12-digit number to Indian residents. It has been integrated with various government services, facilitating better targeting of welfare schemes and reducing fraud. The use of the Aadhaar card by the Indian government, under the leadership of Prime Minister Narendra Modi, has been aimed at enhancing transparency and promoting efficient service delivery. The government has linked Aadhaar to welfare schemes and subsidies such as Direct Benefit Transfer (DBT). By mandating Aadhaar for beneficiaries, the government aims to eliminate intermediaries and ensure that the

benefits reach the intended recipients directly, reducing corruption and leakages in the system. The Public Distribution System (PDS) is a vital mechanism for distributing essential commodities to the poor. Aadhaar has been linked to the PDS system to authenticate beneficiaries and prevent identity fraud.

It has helped reduce pilferage and ensure that subsidized food grains and other items reach the intended beneficiaries. Aadhaar has been integrated with the banking system to enable Direct Benefit Transfers and financial inclusion. It has facilitated the opening bank accounts through the Aadhaar-based e-KYC (Know Your Customer) process, making it easier for people, especially those from marginalized sections, to access formal banking services. The government has undertaken an exercise to weed out duplicate and ghost entries from various databases by linking them

with Aadhaar. It has helped identify and eliminate fraudulent beneficiaries, reduce wastage of resources, and ensure that benefits reach genuine beneficiaries. The government has also addressed data security and privacy concerns by implementing strict security measures and ensuring that Aadhaar data is protected.

Thirdly, we have the path-breaking Make-in-India programme. Launched in 2014, Make in India aimed to boost domestic manufacturing and attract foreign investment. The initiative focused on electronics, IT, pharmaceuticals, automobiles, and defence sectors. It aimed to foster innovation, improve technology infrastructure, and create employment opportunities. Make in India” is an initiative launched by the Indian government in 2014 to transform India into a global manufacturing hub and promote economic growth. The initiative focuses on attracting domestic and foreign investments, fostering innovation, and improving the ease of business in India.

The Make in India initiative recognizes the importance of a skilled workforce. It focuses on enhancing the quality and availability of skilled labour by promoting vocational training programs, skill development initiatives, and collaboration between industries and educational institutions. A skilled workforce boosts productivity and competitiveness. Make in India encourages innovation and research by promoting “Startup India” and “Digital India.” These initiatives support entrepreneurs, facilitate access to capital, and encourage the development of cutting-edge technologies.

Innovation-led growth can help India gain a competitive advantage in global markets. The Make in India initiative aims to increase India's export potential by facilitating trade agreements, improving logistics infrastructure, and promoting quality manufacturing. Make in India emphasizes sustainable manufacturing practices and clean tech-



nologies. By promoting renewable energy, waste management, and environmentally friendly production processes, the initiative contributes to reducing carbon emissions and creating a greener and more sustainable industrial ecosystem.

Another major initiative by the government is BharatNet. The BharatNet project aimed to connect over 250,000 village panchayats (local administrative units) in India with high-speed broadband internet connectivity. It aims to bridge the digital divide in rural areas of India by extending high-speed internet connectivity. It seeks to empower rural communities by providing access to information, online services, e-governance, digital education, healthcare, and entrepreneurship opportunities. Farmers can access weather forecasts, market prices, and agricultural techniques, helping them make informed decisions about crop selection, farming practices, and selling their produce. Rural residents can also access educational resources, healthcare information, government schemes, and other previously difficult-to-access services.

Rural areas often lack access to quality healthcare services. The internet has enabled telemedicine, where rural patients can consult doctors remotely through video calls, receive medical advice, and access specialist care without travelling long distances. It has also facilitated the

dissemination of health-related information and awareness campaigns, improving healthcare outcomes in rural communities.

The internet has been crucial in promoting financial inclusion in rural areas. India has also built a robust digital financial ecosystem with the UPI and BHIM initiatives. At the end of the calendar year 2022, UPI's total transaction value stood at INR 125.95 trillion, up 1.75 X year-on-year (YoY), as per the NPCI. The Unified Payments Interface (UPI) and Bharat Interface for Money (BHIM) are digital payment systems that gained popularity during the Modi's government's tenure. UPI enabled easy and instant money transfers between bank accounts, while BHIM provided a simplified interface for UPI transactions.

The ease of transaction has made digital payments accessible to a large segment of the Indian population, even those who are unbanked or have limited access to traditional banking services. UPI's interoperability allows users to send and receive money seamlessly between banks and payment service providers. It eliminates the need for multiple payment apps and provides a unified transaction platform. The interoperability of UPI has significantly enhanced the adoption of digital payments across the country. UPI and BHIM have been vital in driving India towards a cashless economy. The widespread adoption of these

platforms has led to a reduction in cash transactions and increased digital transactions. This shift towards a cashless economy has several benefits, including increased transparency, reduced instances of black money, and enhanced financial inclusion.

UPI and BHIM have facilitated digital payments for merchants, tiny and micro-businesses. UPI has also fostered innovation in the fintech sector in India. Numerous startups and technology companies have built innovative products and services on top of the UPI infrastructure, from peer-to-peer lending platforms to bill payments and investment apps. It has led to the growth of a vibrant digital ecosystem, further strengthening India's position as a leading country in digital payments.

All in all, the Modi government has laid the building blocks for an Amrita Kaal, of which a key pillar is implanting solutions based on advances in science and technology. And on this front, the proactive actions by the regime have propelled us in ways hitherto unexplored and, some, even unconceptualized! We must keep moving ahead in service to our nation and behind one of the greatest leaders this country has ever seen. After all, as Swami Vivekananda ji said

“It is the duty of every person to contribute in the development and progress of India.”



Indian Science Flourishes Under Swadeshi Approach

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Uith the advent of affordable internet services and artificial intelligence, the ability to access knowledge and information has become easier than ever before. Suppose it took a school student to write an assignment in one week in the 1990s by referring dozens of books from the school library or public reading room. In that case, it takes less than a minute for the present school student to download a well-edited document and submit it in his/her name, as has been evidenced through the reports on plagiarism even at the university level. Moreover, the information availed by students from the internet results from implanted motives behind the search engines and hence their algorithms propagate information deemed suitable for Western narratives. It is quite definite that the Western perspectives have greatly influenced the modern global knowledge systems and have been well reflected in science, technology, engineering, history and philosophy of science.

The students of India of the present and near past generations have been made to imbibe non-native perspectives of science into their consciousness rather than in understanding and reciprocating 'Swadeshi Sciences and Swatantra' that are rich in multidisciplinary, logical and scientific approaches as India celebrates 'Azadi Ka Amrut Mahotsav'. Not only this, but the history of Indian sciences has an expanse of thousands of years and has seen the contribution of several stalwart scientists, philosophers, mathematicians, engineers and thinkers who have been groomed at the various ancient and medieval era universities of the Indian subcontinent. Science historiography has historically been influenced by colonial and Marxist ideologies, which tried to dissociate the Indian civilizational heritage from its robust scientific aspect. This article aims to explore the advancements and transformations in science historiography, the study of the history of science, during the tenure of the Modi government. It is important to note that while the government plays a crucial role in setting the agenda for scientific research and innovation, historiography is an academic pursuit influenced by multiple factors beyond political governance.

Under the Modi government, there has been a visible emphasis on promoting a scientific temper among the general public. Initiatives like the "Make in India" campaign

and "Digital India" have aimed to foster a culture of scientific inquiry and innovation. These initiatives have inspired a renewed interest in studying the history of science as scholars and researchers seek to understand India's scientific contributions in a global context. The government has prioritized the revitalization of scientific institutions across the country. Projects such as the "Atal Innovation Mission" and "National Mission on Interdisciplinary Cyber-Physical Systems" have been launched to encourage collaborative research and development. The renewed focus on these institutions has increased the demand for historical studies to document their evolution and contributions.

The Modi government has recognized the importance of preserving scientific archives and making them accessible to researchers. Efforts have been made to digitize historical, scientific documents and manuscripts, enabling scholars to explore and analyze primary sources with greater ease. The digitization of archives has opened up new avenues for studying the history of Indian science and has facilitated interdisciplinary research collaborations. The government has made notable efforts to revive and promote indigenous knowledge systems and traditional sciences. Initiatives like the "Traditional Knowledge Digital Library" and the establishment of the "Council for Scientific and Industrial Research" (CSIR) have helped to bridge the gap between traditional knowledge and modern scientific practices. It has created opportunities for historians of science to explore the historical roots of indigenous knowledge and its relevance in contemporary society.

The Modi government has actively sought international collaborations in the field of science and technology. Collaborative projects with countries like the United States, Israel,

The students of India of the present and near past generations have been made to imbibe non-native perspectives of science into their consciousness rather than in understanding and reciprocating 'Swadeshi Sciences and Swatantra' that are rich in multidisciplinary, logical and scientific approaches as India celebrates 'Azadi Ka Amrut Mahotsav'.

and Japan have accelerated scientific research and facilitated knowledge exchange. Such collaborations have encouraged historians of science to study the cross-cultural interactions and historical underpinnings of these partnerships, contributing to a more comprehensive understanding of the global scientific landscape.

As education takes multidisciplinary perspectives, it is crucial to imbibe in the students the knowledge related to scientific knowledge generation by inter-relatively teaching them the science-society interface to understand better how science evolved in India over time. It would make their education more meaningful and prepare them for a period involving qualitative higher education. Such an enriched syllabus of science could be ensured through selected scientific scenarios or case studies and examples from the history of Indian sciences, Indian scientific personalities, scientific inventions and discoveries of India that were truly marvelous and defining moments in the history of science in India and the world.

As the concept of education has changed, the process and intention of educating our future citizens should also change. India was the epicentre of wealth and knowledge systems at the multi-level aspects of science, culture, spirituality, architecture, arts, etc., built on scientific thinking and logical reasoning and evolved into a household knowledge system. Just like the unique geographical and topographical landscape of the Indian sub-continent, the knowledge culture and its inhabitants' history were also distinct, deep-rooted and infinitesimally inter-

twined enough to survive civilizational backlashes for centuries together. Bharat's journey to the 'pinnacle of glory' and its crowning as the Vishwaguru is possible only if we understand its splendid past, including science with a Swadeshi spirit. Today's global development has been constructed on the foundations of science, technology and innovation, and the resulting revolution has pushed us towards modernity. However, a deeper understanding of Bharat's scientific past reveals that the foundations of global philosophical and scientific magnanimity were laid on the soil of Bharat.



Tech-Powered Crisis Management

- Rajarshi Roychowdhury, BJYM West Bengal

Un early 2020 just when the debilitating pandemic hit India, the average citizen had no clue as to what the future held in store for them, but they were assured that if things went south, Prime Minister Modi & his government would stand behind every individual. Touching individual lives has been the hallmark of the BJP-led NDA government under the able leadership of PM Modi. The digital delivery mechanism that has been perfected to become a fusion of fine art & dynamic science; enabled the government to touch individual lives. Digital payments to vegetable vendors & zero balance bank accounts for the poor once sounded amusing to those born with a golden spoon and who lived in ivory towers. The poor, the weaker sections & the backward classes were mocked with glee, contempt & derision. However, when one of their own occupies the nation's highest political office, the weaker sections move forward in faith & not in fear.

This journey started with making the UID or Aadhar the basis of creating a digital identity for every resident of India. The zero-balance bank accounts through the Jan Dhan Yojana made financial inclusion possible for the poor. The ushering in of the cheapest mobile data rates worldwide made digital inclusion a reality. The JAM trinity was the most significant revolution ever to have taken place in India's governance history. It ensured that all benefits reached the poor during the peak of covid & that no Indian had to sleep with an empty stomach. When vaccinating over 100 crore Indians, the digital public infrastructure stood us in good stead by ensuring the entire process was paperless thanks to the COWIN app based on an open platform that enabled other nations to replicate it.

Drones became our foot soldiers by delivering much-needed vaccines to the remotest corners of India. Till 2014 it was always the private sector that took the lead in ushering in new technologies but post covid we saw the government take the lead in digitally transforming lives, which forced the private sector to follow suit. Several game-changing initiatives by the government, like the DigiYatra portal, made air travel paperless & the Digi locker made storing individual documents paperless as well. With a paperless parliament on the way, India will leverage technology by simplifying individual lives while also making our nation greener & cleaner.

As India marches forward confidently towards Amrit Kaal, there is much interest in both the government & citizens on the next big things in the world of science & technology, like

artificial Intelligence or Quantum Computing. What India has achieved in these nascent fields of human endeavour is nothing short of phenomenal however, India's real achievements lie in the realm of digital public infrastructure & the digital backbone of public services that has been created in the last nine years. Science & its applications in the form of technology are meaningless if they don't touch & transform the lives of the last person in the last line in line with our vision of Antodaya.

We as a nation are on the cusp of indigenously landing an Indian on the Moon & at the same time, we are digitally delivering government subsidies at the click of a button to millions of our eligible citizens via DBT(Direct Benefits Transfer). Just as India is building its indigenous aircraft carrier INS Vikrant, it is also digitally validating land records & creating an accurate chart of land holding with the help of Swamitva Yojana. India is all set to become the next big hub for semiconductor manufacturing. At the same time, it has also formed one of the most comprehensive digital payments infrastructure by connecting those on the last rung of society.

The government has adopted a bricks & mortar approach to technology by making it one of the building blocks of a future-ready society. It has leveraged its tremendous power by making it transform individual lives on a massive scale. The true technological prowess lies not just in our made-in-India satellites, submarines & semiconductors but in our digital delivery system & digital public infrastructure. To the poor & the downtrodden, technology makes sense when it can bring observable changes in her life. Phenomenal reforms have reached a fever pitch & it is rising fast enough to reach a crescendo. Digital banking has today reached such a scale that brick-mortar branches will soon be a relic of the past. Digital delivery is similarly reaching a point of saturation that no matter where an Indian resides, she will be an integral part of the digital net woven by the government of India. As Prime Minister Modi says, "Mind is never a problem, mindset is", & India now has the mindset to be the next tech superpower.



Technological Collaboration: A New Chariot of India-U.S. Diplomacy

- Rahul Singh, Department of Buddhist Studies, University of Calcutta

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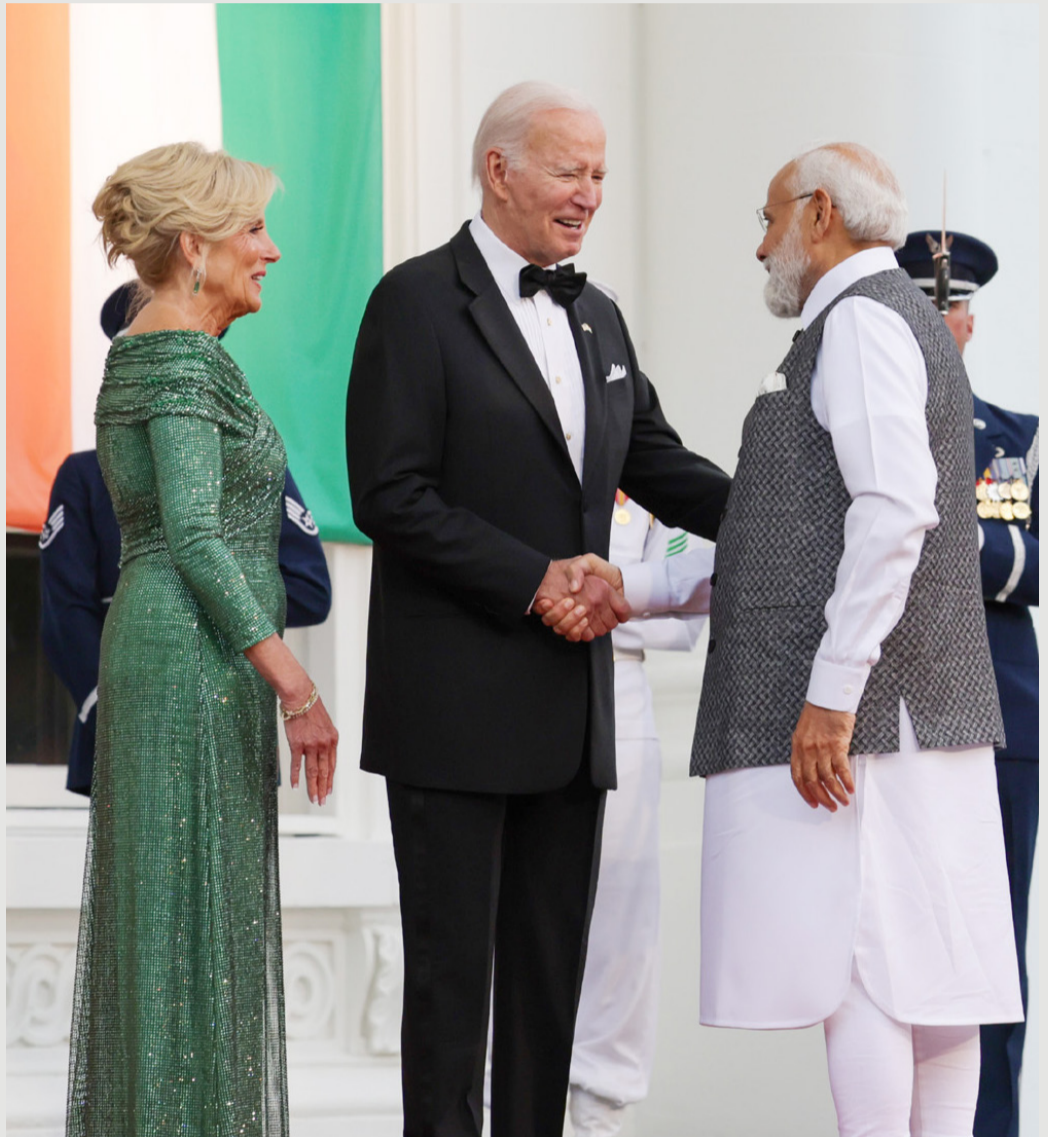
ssues on “Technology Transfer” and “Restrictive Domestic Laws” of both the United States and India have always hindered the realization of the full potential of their military ties. However, the situation is drastically changing in the current era. Defence and technology cooperation has emerged as the most significant dimension of the India-US strategic partnership,

and it has become a key driver of the bilateral relationship over the recent years, especially after Prime Minister Narendra Modi's significant state visit to the United States.

U.S secretary of Defense Lloyd Austin gave some remarkable comments during his visit to India wherein he spoke about a new roadmap for U.S.-India Defense Industrial Cooperation which will fast-track technology cooperation and co-production in areas such as air combat and land mobility systems, intelligence, surveillance, and reconnaissance, munitions, and the underseas domain.

The United States is known for manufacturing some of the best jet engines in the world. Manufacturers such as Pratt & Whitney and General Electric are known to produce incredibly efficient engines for commercial and military aircraft. Their power and reliability remain a step ahead of engines produced by any other nation. Historically, the U.S. government has only offered technology used in its engines to its most trusted allies as it is among the country's most valuable and sensitive technologies. The F414 engine is already being integrated into aircraft being built in South Korea, Sweden, and Turkiye, Although South Korea is the only other Nation currently assembling or co-producing this engine with the U.S.

The United States - Indian defence relationship has rapidly accelerated in recent years in scope and depth. Successive U.S. governments of both parties have identified India as a major defence partner, a pillar of the Quad (Australia, India, Japan, and the U.S.), and as a cornerstone of America's Indo-Pacific strategy. India and the U.S. have almost finalized the deal, and the White House is set to sign off on it, which would allow American manufacturing company General Electric (G.E.) Aerospace to share critical technol-



ogy with Hindustan Aeronautics Limited (HAL) for the joint production of GE-F414 jet engines that will power indigenous Light Combat Aircraft (LCA) like Tejas Mk-2.

What is G.E.'s F414 engine?

G.E.'s F414 engine is a turbofan engine that the U.S. Navy has used for over 30 years, and it is equipped with a dual-channel full authority digital engine control (FADEC), a six-stage high-pressure compressor, an advanced high-pressure turbine along with a “fuelraulic” system for nozzle area control. It offers exceptional throttle response, excellent afterburner light, stability, and unrestricted engine performance when required. The F414 engine has powered military aircraft in eight nations, making it a trusted choice for modern fighter jets.

India's Engine Requirements:

For India, the F414 engine holds great significance, particularly in the context of the LCA Tejas Mk-2. The Aero-

nautical Development Agency (ADA) of the DRDO has selected the India-specific version of the engine, known as F414-INS6, for the LCA Tejas Mk-2. This strategic decision reflects India's aim to bolster its indigenous defence capabilities and reduce dependence on foreign suppliers. Furthermore, there are prospects of utilizing F414 engines for the Advanced Medium Combat Aircraft (AMCA), India's ambitious fifth-generation fighter aircraft.

What is LCA Tejas Mk-2?

The LCA Tejas Mk-2 is an upgraded version of the indigenous fighter aircraft developed in India. It can simultaneously carry eight Beyond-Visual-Range (BVR) missiles and integrate native and advanced weapons from other countries.

The LCA Mk-2 offers Improved range and mission endurance compared to its predecessor, with a mission endurance of 120 minutes, as opposed to 57 minutes for the LCA Tejas Mk1. It is intended to replace the Jaguars, MiG-29s, and Mirage 2000s as they retire in the coming decade. Manufacturing has already begun, and the aircraft is expected to be rolled out by 2024.

Significance of the India-US Jet Engine Deal:

1. Self-reliance in Critical Technologies:

Manufacturing engines for combat aircraft requires advanced technology and metallurgy, and this sector is currently dominated by the U.S., Russia, the U.K., and France have mastered. However, India is pushing for self-reliance in critical technologies, including cryogenic rocket engines, and is making significant leaps to join this league with its



foreign counterparts.

The countries with the technology to manufacture advanced fighter aircraft engines have traditionally been unwilling to share them, which is also why the deal is path-breaking.

2. A Significant Component of ICET:

The agreement for the transfer of technology was discussed earlier in the talks between India's Defense Minister and the U.S. Secretary of Defense in June 2023. It was a key highlight of India's National Security Advisor's meeting with his U.S. counterpart, during which the US-India ICET was operationalized.

3. Development Efforts by DRDO:

The DRDO's Gas Turbine Research Establishment (GTRE) initiated the development of the GTX-37 engine for the LCA, followed by the ambitious Kaveri engine project in 1989.

Despite the development of 9 full prototype engines and 4 core engines and extensive testing, the engines did not meet the requirements for fighter aircraft making this deal crucial for its defence capabilities.

4. End of Technology Denial Regime:

This pact finally lays to rest what the former PM of India (in 2008) had described as the "technology denial regime" imposed on India by the West, led by the U.S.

The Nuclear Suppliers Group's waiver of the Indo-US nuclear deal marked the end of India's decades-long isolation from nuclear technology.

This jet engine technology transfer agreement is another one of the important milestones in this journey.

India's Recent Developments in its Defense Sector:

India's Indigenous Developments:

Successful testing of indigenous weapons and systems, including:

1. Rustom-2 drone
2. Light Combat Helicopter
3. Man Portable Anti-Tank Guided Missile
4. Agni-5 intercontinental ballistic missile
5. Advanced Medium Combat Aircraft.
6. Launch and commissioning of indigenous naval vessels, including:
 - INS Karanj submarine
 - OPV Vijaya patrol vessel
 - INS Dhruv nuclear missile tracking ship
 - INS Himgiri stealth frigate.

Conclusion:

An engine technology deal would be a significant and mutually beneficial opportunity for both New Delhi and Washington, one that bolsters collective security in the Indo-Pacific and elevates the defence partnership to new levels. But to sustain momentum in defence ties, it is incumbent on both Sides to prove to each other and their respective constituencies at home, Why these transactions are in the long-term interests of both countries.

Towards Becoming Vishwaguru of The Digital Age

- Saumitr Shikhar Srivastava has worked at the Delhi High Court and did his LLB at the Campus Law Centre, Faculty of Law, University of Delhi. He is associated with the BJYM outreach to young professionals in the science and technology sector.

“He who controls the sea controls everything”

Declared the Athenian statesman Themistocles. He gave this maxim in the context of the tussle between the Greek city-states over the control of the Aegean Sea, the main trade and commerce channel connecting ancient Greece with the rest of the world. About 2000 years later, the rising colonial powers of Europe adopted the same maxim and went on to colonise most of the world by controlling the global sea routes and the spice trade. In the 20th CE, the doctrine of sea control remained the same, but the paramount trade commodity changed from spices to oil. Most of the wars in the post-Cold War era have been fought for the control of the seas and oil trade, and this geo-political reality is here to stay for at least a few more decades.

But a 'new sea' and a 'new paramount trade commodity' is on the horizon, which has its genesis in the dot-com revolution of the late 20th CE. This new sea is the 'Sea of the Internet', and the new paramount trade commodity of the world is data. Data is the spice and oil of Industry 4.0. And therefore, he who shall control the Sea of the Internet and the trade routes of data will control the global digital economy of the 21st CE.

Thus, India must move towards Digital Aatmanirbharta and safeguard its Digital Sovereignty. While simultaneously envisaging a roadmap for tapping into the nation's digital-economic

potential so that India can emerge as the Vishwaguru of the Digital Age.

The Digital Personal Data Protection Bill (DPDPB)

To achieve the double goal of accelerating India's digital economy without compromising on India's digital sovereignty, the Modi Government will introduce the Digital Personal Data Protection Bill in the upcoming monsoon session of the Parliament. The Bill is part of the Modi Government's larger vision of a Digital Economy. This vision includes a comprehensive “Digital India Act” that would, in time, replace the existing Information Technology Act 2000 and give India an updated and robust digital regulatory framework.

Background

Despite the tremendous rise in India's IT sector over the past three decades, there is no separate legislation dealing with data protection. Guidelines on data protection were inferred from the Information Technology Act 2000 and the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011. In 2017, the government established the Justice BN Srikrishna Committee to promote the growth of the digital economy while safeguarding citizens' data. Additionally, the Supreme Court's momentous ruling in Justice K.S. Puttaswamy v. Union of India recognised the right to privacy as a fundamental right under Article 21 of the Constitution. The court further declared that 'informational privacy' is an integral aspect of the right to privacy and urged the government to implement a robust data protection regime.

In 2018, subsequent to the submis-

sion of the Srikrishna Committee Report, the Modi Government proposed separate legislation for a robust data protection framework. The primary goals of this legislation were to safeguard the citizens' right to privacy, encourage greater investments, and enhance the ease of doing business. The Draft Data Protection Bill 2021 was conceived after extensive public consultation.

Balancing Rights and Responsibilities

Establishing a data protection and regulation regime is akin to walking on a tightrope for most governments around the world. But the DPDPB strikes the right balance between rights and duties. The DPDPB sets forth the rights and responsibilities of Digital Nagriks (citizens) and the obligations of Data Fiduciaries regarding the lawful and transparent use of collected data. This Bill is guided by seven fundamental principles that govern the Data Economy:

- 1. Lawful use:** It obligates organisations to handle personal data in a legal and fair manner while ensuring transparency to the individuals involved.
- 2. Purpose limitation:** mandates that personal data should only be used for the specific purposes for which it was originally collected.
- 3. Data minimisation:** It emphasises the importance of collecting only the necessary personal data directly relevant to achieving a specific purpose.
- 4. Data accuracy:** To ensure that at the point of collection. There should not be any duplication.
- 5. Storage limitation** entails that personal data is not stored indefinitely by default. Instead, the duration of storage should be restricted to the extent

necessary for the specific purpose for which the personal data was initially collected.

6. Authorised collection and processing: There should be reasonable safeguards to ensure “no unauthorised collection or processing of personal data.”

7. Accountability of users: The person who decides the purpose and means of processing personal data should be accountable for such processing. These seven guiding principles of DPDPB ensure that a healthy balance is achieved between the interests of Fiduciaries and the protection of per-

event of a data breach and will be responsible for addressing grievances raised by affected individuals.

(2) Data Principal and Data Fiduciary

The Bill introduces the terms “Data Principal” and “Data Fiduciary” to define the individual whose data is being collected and the entity responsible for determining the purpose and methods of processing personal data, respectively. The Bill also recognises that parents or lawful guardians act as Data Principal for children under the age of 18.

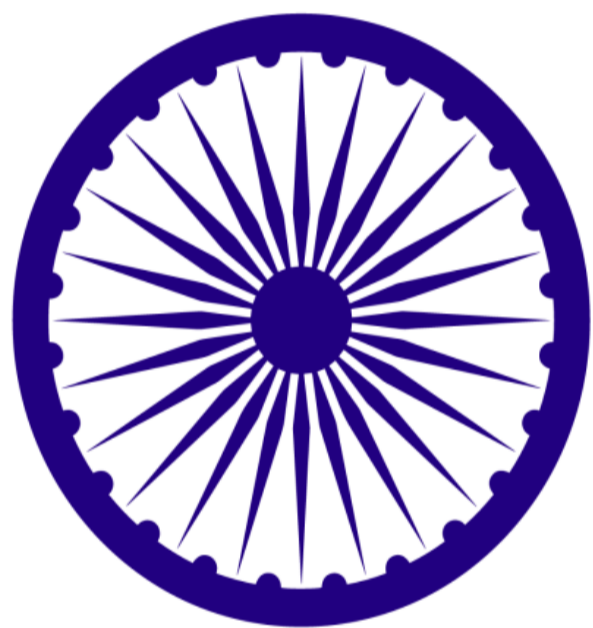
Board if unsatisfied with a Data Fiduciary's response.

(5) Language of information

The Bill ensures that individuals can access basic information in languages specified in the eighth schedule of the Indian Constitution. Data collection notices must be written in clear and understandable language.

(6) Significant Data Fiduciaries

The Bill addresses “Significant Data Fiduciaries” who handle large volumes of personal data. The Central government will determine the crite-



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sonal data. The seven guiding principles are translated and expanded into the various sections of the DPDPB, which form the core of the regulatory framework.

Key Features of the Bill:

(1) Data Protection Board

The central government will establish the Data Protection Board of India, which will undertake several key responsibilities, including monitoring compliance with data protection regulations and enforcing penalties for non-compliance. It will also have the authority to instruct data fiduciaries on taking appropriate actions in the

(3) Defining personal data and its processing

According to the Bill, personal data refers to any information that can identify an individual. Processing of personal data includes all stages, from data collection to storage.

(4) Individual's informed consent

The Bill emphasises the need for individuals to provide informed consent before their data is processed. Data Fiduciaries must clearly communicate the items of personal data they intend to collect and the purpose of such collection. Individuals also have the right to withdraw consent and file a complaint with the Data Protection

ria for identifying such entities based on factors like data volume, potential harm, and impact on India's sovereignty and integrity.

(7) Data protection officer & Data auditor

Entities covered by the Bill must appoint a Data Protection Officer as a point of contact for grievance redressal. They are also required to engage an independent Data Auditor to assess their compliance with the act.

(8) Right to erase data, right to nominate

Data Principals have the right to request the erasure and correction of

their collected data. They can also nominate an individual to exercise these rights in case of their incapacity or demise.

(9) Cross-border data transfer

The Bill permits cross-border storage and transfer of data to specific countries and territories following an assessment by the Central Government.

(10) Financial penalties

The Bill proposes substantial penalties for businesses involved in data breaches or failing to notify users about such breaches. Entities that do not implement reasonable security measures may face fines of up to Rs. 250 crore. The Data Protection Board can impose penalties of up to Rs. 500 crore for significant non-compliance.

Balancing Digital Sovereignty with Digital Economy

Digital sovereignty in the Indian context is not merely the right and ability to control digital and technological data but to ensure the privacy and consent of Indian citizens over their personal information. Since data is the new oil and the internet is the new sea, there are bound to be 'pirates' who could steal and misuse this data. The Article 21 of the Indian constitution casts the obligation on the state to preserve the life and personal liberty of all citizens. Today, data is intrinsic to the whole being of a person, it is a part and parcel of everyday life. Therefore, data protection comes within the scope and ambit of the state's duty to protect life and personal liberty.

But certain apprehensions have been raised by some sections regarding Bill. One of the main concerns being raised is that the Bill may enable unchecked data processing by the state, which may violate the right to privacy. These apprehensions are unfounded, as the government has been granted certain exemptions in the provisions of the Bill for the following interests - the sovereignty and integrity of India, the security of the state, maintaining friendly relations with foreign countries, preserving public order, or preventing the incitement of any cognisable offence. Similar exemptions can be observed in the digital data regulatory frameworks of other countries, such as the United States

(United States Privacy Act, 1974), Australia (Privacy Act, 1988), Singapore (Personal Data Protection Act, 2012), and the most recent European Union (General Data Protection Regulation).

On a comparative analysis, the DPDPB is at par with the global standards of a digital regulatory framework, especially with the Western nations. Therefore, the singling out of DPDPB for unsubstantiated criticism smacks of double standards. The Bill has gone through thorough vetting by parliamentary committees and extensive public consultations with various stakeholders. Further, it will go through the parliamentary procedure of debate and discussions, where necessary changes, if any, will be considered and incorporated. The

India must move towards Digital Aatmanirbharta and safeguard its Digital Sovereignty. While simultaneously envisaging a roadmap for tapping into the nation's digital-economic potential so that India can emerge as the Vishwaguru of the Digital Age.

Bill will smoothen the data protection regime, enhancing the trust of global investors in India's digital economy. Therefore, a balance will be found between safeguarding digital sovereignty and enhancing digital India's growth story.

Navigating the Sea of Internet

India is on the cusp of emerging as a \$5 trillion economy and the technological centre of the world, and the driving force behind it is India's digital revolution. PM Shri Narendra Modi laid the foundations for this digital revolution with the Digital India Mission in 2015, with the vision of transforming India into a digitally empowered society and a knowledge-based economy. It will be achieved by ensuring digital access, inclusion, empowerment, and bridging the digital divide. The push towards a Digital India has ensured that the internet penetration in the country has increased by 200% between 2015-2021, and almost 76 crore Indians are active internet users. This number of internet users is predicted to rise to 120 crores over

the coming years. India ranked one in the world in digital payments, with 89.5 million digital transactions in 2022. As of May 2023, India is home to 108 unicorns with a total valuation of \$340.80 billion,

These facts and success stories are a testimony to the digital revolution that is taking place in PM Modi's India. The DPDPB is a much-awaited and significant step toward the larger vision of making India the Vishwaguru of the Digital Age. But the voyage towards becoming the Digital Vishwaguru goes through the Sea of the Internet and requires eternal vigilance to protect our data resources. The DPDPB will be the flagship to help India sail through the stormy waters and ward off the digital pirates.



Technological Renaissance: Science and Technology in Public Policy

- Pranjal Chaturvedi and Aishwarya Pranjal are Law Graduates from Sharda University

In an era where scientific and technological advancements drive progress and innovation, the Modi government has laid a solid foundation for transforming India into a knowledge-based, tech-oriented economy. With a focus on empowering the youth and harnessing the potential of science and technology, several initiatives have been implemented by the government, resulting in significant progress across various sectors. This article highlights key developments in science and technology under the leadership of Prime Minister Narendra Modi.

The Modi government has played a pivotal role in driving India's technological advancement through visionary policies and initiatives. Under the Modi government, India has made Irreversible Non-Linear Technological advancement and combinatorial innovation. The government has successfully launched the Digital India campaign by prioritising digital empowerment and strengthening digital infrastructure, expanding internet connectivity and promoting digital literacy nationwide. It has improved access to information, government services, and opportunities, effectively bridging the digital divide and empowering citizens to the root level. Furthermore, the government's focus on fostering innovation and entrepreneurship through programs like Start-up India and Make in India has cultivated a thriving ecosystem of technological advancements and domestic production. The government has also invested significantly in space research and exploration, leading to noteworthy accomplishments such as

the Mars Orbiter Mission and Chandrayaan-2. Additionally, efforts to promote clean energy, enhance infrastructure via the Smart Cities Mission, and prioritize research and development across various sectors have all contributed to India's technological progress. Through these concerted endeavours, the Modi government has established a robust foundation for India to emerge as a global leader in science, technology, and innovation.



Digital India: Digital India, one of the flagship programs initiated by the Modi government, aims to digitally empower citizens, bridge the digital divide, and create a digitally empowered society. Through initiatives like expanding broadband connectivity, promoting digital literacy, and providing digital services, Digital India has revolutionized how people access information, government services and participates in the digital economy.

As of February 28, 2022, the Digital India Mission has had a significant impact. A total of 567,941 kilometres of Optical Fibre Cable (OFC) has been laid, establishing a robust telecommunications infrastructure. Additionally, 172,361 Gram

Panchayats (GPs) have been made Service Ready, with 168,010 GPs connected via OFC and 4,351 GPs connected via satellite. These efforts have enhanced connectivity and access to digital services across the country. Under the National e-Governance Project, the Indian government has established Common Service Centers (CSCs) to provide access to information and communication technology (ICT). CSCs offer multimedia content encompassing e-governance, education, healthcare, telemedicine, recreation, services from other states, and private services through

computer and Internet access. This initiative aims to bridge the digital divide and ensure that citizens, particularly those in rural areas, have access to a range of essential services and information.

Overall, the Digital India Mission has made significant progress in expanding digital infrastructure, connecting Gram Panchayats, and establishing Common Service Centers to deliver various services and information to citizens. These efforts have improved access to technology, connectivity, and digital services throughout the country.

Smart Cities Mission: The Smart Cities Mission integrates technology and urban planning to create sustainable and citizen-centric cities. Under this mission, 100 smart cities are being developed, utilizing digital technologies and data-driven solutions to enhance infrastructure, utilities, and quality of life. These cities aim to become innovation and technological excellence centres, incorporating smart transportation systems and intelligent waste management.

Start-up India: The post-2016 period has witnessed a remarkable surge in the number of start-ups in India, driven by the policies and initiatives introduced by the Modi government. The launch of the Start-up India campaign in 2016 has played a pivotal role in fostering entrepreneurship and creating a favourable environment for start-ups to flourish. Consequently, India has experienced a significant proliferation of start-ups across diverse sectors, including technology, e-commerce, healthcare, and finance. Access to funding has improved by establishing various funding schemes, angel investor networks, and venture capital funds. Government-supported incubators and accelerators have provided aspiring entrepreneurs invaluable mentorship, guidance, and infrastructure support. Furthermore, regulatory reforms such as simplifying business registration processes and relaxing foreign direct investment norms have further bolstered the start-up ecosystem. The growth of start-ups in India has stimulated economic expansion and job creation and positioned the country as a global hub for innovation and entrepreneurial talent.

Make in India and Atma-nirbhar Bharat: The Make in India and Atmanirbhar Bharat initiatives aim to make India a global manufacturing hub and reduce dependence on imports. These initiatives emphasize indigenous production, research and development, and innovation in various sectors, including science and technology. Encouraging domestic manufacturing and innovation has boosted economic growth and led to advancements in electronics, biotechnology, defence, and space technology.

Advancements in Space Technology: Under the Modi government, India's space program has achieved significant milestones and gained global recognition. The Indian Space Research Organisation (ISRO) successfully launched the Mars Orbiter Mission (Mangalyaan) in 2014, making India the first Asian country to reach Mars. Subsequently, ISRO has achieved successful satellite launches, the Chandrayaan-2 mission to the moon, and is developing the ambitious Gaganyaan project to send Indian astronauts to space.

Clean Energy Initiatives: To promote sustainable devel-

opment and reduce India's carbon footprint, the Modi government in India has implemented several clean energy initiatives to promote renewable energy sources and reduce the country's reliance on fossil fuels. These initiatives include the ambitious target of achieving 450 gigawatts of renewable energy capacity by 2030, specifically focusing on solar power generation through the "National Solar Mission." Additionally, the government has launched the "Saubhagya" scheme to provide electricity to every household, emphasising connecting rural areas through renewable energy sources. The "Ujala" program promotes using energy-efficient LED bulbs, while the "KUSUM" initiative supports farmers in adopting solar-powered irrigation systems. The government has also encouraged the adoption of electric vehicles through various policies and incentives, including the "FAME India" scheme. Efforts have also been made to promote electric vehicles, energy-efficient technologies, and research and development in clean energy sources, positioning India as a global leader in the transition to a greener future. These initiatives demonstrate the Modi government's commitment to transitioning towards a cleaner and more sustainable energy future for the country.

According to NPCI data, India had approximately 74 billion transactions worth Rs 125.94 trillion using UPI in the calendar year 2022, turning India from an offline, informal low productivity economy into an online, cashless, formal, high-productivity economy. With the help of tech infrastruc-

The Modi government has played a pivotal role in driving India's technological advancement through visionary policies and initiatives.

ture, the 'CoWIN' application operated by the Ministry of Health and Family Infrastructure, India vaccinated 69.84% of its population with double doses and 75.38% of its population with a single dose. Every Text Book printed by state governments have approximately 20 QR codes for digital learning, and what not.

The Modi government's focus on science and technology has propelled India toward becoming a global leader in innovation, research, and technological advancements. Initiatives such as Digital India, Smart Cities Mission, Start-up India, and Make in India have transformed various sectors, fostering entrepreneurship, digitization, and self-reliance. Achievements in space technology and clean energy initiatives have instilled national pride and positioned India as a global force to be reckoned with. As India progresses, the government's commitment to science and technology will play a crucial role in shaping a prosperous and technologically advanced future. By nurturing innovation, investing in research and development, and leveraging emerging technologies, the Modi government has paved the way for India's journey toward scientific and technological excellence. The progress made under these initiatives demonstrates the transformative power of science, technology, and innovation.

From Vision to Reality: The Technological Revolution in Governance

- Akanksha Singh is engaged in Public Policy & Research and has completed MA & LLB.

"वि ज्ञानेन योजि ता राष्ट्रं, नव्यंप्रगति गच्छति ।"

"Through the fusion of knowledge and innovation, a nation progresses towards new horizons."

Under the leadership of Prime Minister Narendra Modi, several initiatives have been launched to leverage technology for development and empowerment. The Digital India campaign, launched in 2015, aims to provide government services electronically, improve digital infrastructure, and promote digital literacy among citizens. India today is home to more than 75 crore smartphones, 133 crore Aadhaar cards, and more than 80 crore internet users. It has 4G and is now accelerating towards 5G. Above all, it has among the lowest data tariffs in the world. Innovation, driven by technology, has become a crucial differentiator across various sectors, transforming how we live, work, and govern. It explores the significant role of innovation in governance, with a specific focus on the initiatives led by Prime Minister Narendra Modi in India over the past nine years. These initiatives have brought about breakthroughs in digital governance and E-Gov, establishing global benchmarks for transparency and efficiency. Transparency and efficiency are key pillars of Prime Minister Modi's commitment to digital governance. By leveraging technology, he has implemented initiatives and policies prioritising transparency and governance efficiency.

The implementation of the Aadhaar system, a biometric identification program, has enabled the government to provide direct benefits to citizens, including subsidies and welfare payments. Digital payment systems such as Unified Payments Interface (UPI) have gained popularity, facilitating convenient and secure transactions. Technology has been harnessed to drive entrepreneurship and innovation. Initiatives like Startup India and Atal Innovation Mission have been launched to foster a culture of innovation and support startups across the country. The focus on digital technologies, such as artificial intelligence (AI), blockchain, and the Internet of Things (IoT), has encouraged the development of cutting-edge solutions and the growth of the digital economy. The digital transformation in India has been

aimed at leveraging technology as a tool for socioeconomic development, empowering citizens, and bridging the digital divide. The government's efforts have focused on expanding digital infrastructure, promoting digital literacy, and encouraging the adoption of digital technologies across sectors to drive inclusive growth and improve the quality of life for citizens.

Breakthrough Initiatives in Digital Governance and E-Gov:

1. Digital India Campaign:

The Digital India Campaign, launched in 2015, is one of the flagship initiatives of Prime Minister Narendra Modi. It aims to transform India into a digitally empowered society and knowledge economy. The campaign focuses on three core areas: digital infrastructure, digital empowerment of citizens, and delivering government services digitally. Under the Digital India Campaign, various initiatives have been implemented, including the National Optical Fiber Network (NOFN) to connect rural areas with high-speed broadband, the BharatNet project to connect all gram panchayats with broadband connectivity, and the Common Service Centers (CSCs) to provide e-services to citizens in rural and remote areas. The campaign also emphasises e-governance, promoting digital literacy, and leveraging technology for better service delivery.

2. Aadhaar: Unique Identification System:

Aadhaar is a biometric identification system introduced by the Government of India. It provides a unique 12-digit identification number to residents, based on their demographic and biometric information. The Aadhaar system aims to establish a robust and inclusive identity infrastructure, enabling efficient delivery of government services and benefits. Aadhaar has revolutionised various aspects of governance, including targeted welfare programs, financial inclusion, and eliminating duplicate and ghost beneficiaries. It has enabled direct benefit transfers (DBTs) to bank accounts, ensuring transparency and reducing leakages in social welfare schemes. Aadhaar authentication is now

widely used across sectors, such as banking, telecom, and public distribution systems, to streamline processes and enhance efficiency.

3. Goods and Services Tax Network (GSTN):

The Goods and Services Tax (GST) is a comprehensive indirect tax reform introduced in India in 2017. The Goods and Services Tax Network (GSTN) was established as a non-profit organisation to support the implementation of GST. It serves as the IT backbone for the GST system, facilitating registration, filing of returns, and processing of payments. GSTN has enabled seamless online compliance for businesses, simplifying tax administration and reducing the paperwork burden. It provides a common platform for taxpayers, tax authorities, and other stakeholders to interact, improving transparency and efficiency in the tax system.

4. Direct Benefit Transfer (DBT):

The Direct Benefit Transfer (DBT) scheme aims to transfer government subsidies and benefits directly to the bank accounts of eligible beneficiaries, eliminating intermediaries and ensuring transparent and efficient delivery of welfare schemes. The DBT system leverages the Aadhaar-based authentication process to verify the identity of beneficiaries and prevent leakages and diversions. Under the DBT scheme, several government programs, such as scholarships, pensions, LPG subsidies, and food and fertiliser

subsidies, have been linked to beneficiaries' Aadhaar and bank accounts. It has resulted in significant cost savings, reduction in leakages, and improved targeting of subsidies. DBT has also facilitated financial inclusion by encouraging beneficiaries to open bank accounts and access formal financial services.

5. e-National Agriculture Market (e-NAM):

e-National Agriculture Market (e-NAM) is an online trading platform for agricultural commodities introduced by the Government of India. It aims to create a unified national market for agricultural produce by connecting farmers, traders, and buyers through a common electronic platform. e-NAM enables farmers to sell their produce directly to buyers, eliminating intermediaries and ensuring fair prices. The platform provides transparent and competitive bidding, access to market information, and digital payment options. It facilitates seamless trade across states, encourages fair competition, and promotes efficient price discovery. e-NAM has been instrumental in reducing market inefficiencies, minimising post-harvest losses, and empowering farmers through enhanced market access.

6. GeM: Government e-Marketplace:

The Government e-Marketplace (GeM) is an online platform established by the Government of India to procure goods and services by government departments, organisations, and public sector undertakings. GeM aims to stream-



line the procurement process, enhance transparency, and promote ease of doing business with the government. GeM provides a dynamic and user-friendly portal for sellers to showcase their products and services and for government buyers to procure them. The platform offers a wide range of products, including office supplies, IT equipment, vehicles, and services, along with features such as e-bidding, e-auction, and online payment. GeM has significantly reduced procurement time, increased competition, and brought cost savings to the government.

7. MyGov: Citizen Engagement Platform:

MyGov is an innovative citizen engagement platform launched by the Government of India. It enables direct interaction between the government and citizens, allowing them to participate in policy formulation, governance, and social development initiatives. Through the MyGov platform, citizens can share their ideas, suggestions, and feedback on various government programs and policies. It serves as a channel for disseminating information, conducting surveys, and organising competitions to engage citizens actively. MyGov has helped bridge the gap between the government and the people, fostering a participatory approach to governance and ensuring citizens' voices are heard.

These breakthrough initiatives in digital governance and E-Gov, including the Digital India Campaign, Aadhaar, GSTN, DBT, e-NAM, GeM, and MyGov, have played a significant role in transforming governance in India. They have set global benchmarks by harnessing technology to enhance transparency, efficiency, and citizen engagement, and their impact continues to shape the future of digital governance in the country. The campaign has facilitated the growth of the telecommunications sector, attracting investments in network infrastructure development and the deployment of advanced technologies. The increased availability of affordable smartphones and data plans has further contributed to improved digital connectivity and access to online services.

The Digital India Campaign has also encouraged public and private sector collaboration in expanding digital infrastructure. Partnerships with telecommunications companies, technology providers, and industry stakeholders have played a crucial role in enhancing digital connectivity and expanding the reach of digital services to citizens across the country. Digital India Campaign has laid the foundation for a robust digital infrastructure and improved connectivity, enabling citizens to access government services, participate in the digital economy, and benefit from the advantages of a digitally empowered society.

The government's efforts have focused on expanding digital infrastructure, promoting digital literacy, and encouraging the adoption of digital technologies across sectors to drive inclusive growth and improve the quality of life for citizens..





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