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Since 1957 **A DEVELOPMENT MONTHLY**

Let noble thoughts come to us from all sides.
Rig Veda

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REGULARS

NEXT ISSUE - TRIBALS IN INDIA

The 'Techade'

The evolution of novel technologies is opening a doorway to a multitude of possibilities. The opportunities it offers is almost to the level of witnessing the Fourth Industrial Revolution. These technologies are turning out to be an indispensable part of our everyday lives. The use of AI, Cloud Computing, Blockchain, Quantum Computing, NFTs, and Metaverse are captivating us with their infinite scope and future. Conventional banking, medicine, agriculture, and other fields are witnessing a transformation with the advent of newer tech solutions.

Digital services are proving to be less complex and more effective along with ensuring transparency in the governance and service delivery. AI, Deep Machine Learning, Big Data, and Robotics are used in the banking and financial sectors to understand the needs of customers better. Digital technology eases our lives at every step. It is used by the government and the public sector to ensure transparency and accountability of governance, meet the increased demand for digital services among citizens, and to provide more simplified and high-quality services. Digital India Mission and digital transactions are at the foundation of India's digital economy. Aadhaar Enabled Payment System is playing a crucial role in the financial inclusion of people not enroled in formal banking. Another landmark change is brought out through the Direct Benefit Transfer System— it prevents financial leakage by directly transferring the benefits of the social security schemes to the beneficiary accounts. Aadhaar is ensuring 'Digital Inclusion', thus enabling social empowerment.

With the advent of AI/Machine Learning, IoT, 5G, Augmented Reality, Big Data, Nanotechnology, Robotics, and 3D printing— the society is altering en masse the functional, strategic, and operational landscape across various industries. Industry 4.0 is set to usher in an era of technologies that will completely alter how we interact with the world around us.

The US recently announced a new policy framework for quantum information sciences and to mitigate the risks of quantum computers to cyber, economic, and national security through quantum-resistant cryptography. El Salvador, where Bitcoin is a legal tender, is attempting to build the world's first "Bitcoin City." It is claimed that it would get geothermal power from a volcano. Various advanced technologies are capable of addressing and overcoming adversities worldwide in different sectors such as water, energy, waste management, infrastructure, transportation, real estate, and urban planning. Also, the professionals need to be up-skilled and re-skilled in the wake of concerns over unemployment or job displacement due to the deployment of New-age Technology.

India is establishing the quantum computing capability and chip-making prowess to integrate these systems on the front-end and back-end. It is one of the largest smartphone manufacturers in the world. It has impressive drone and robotics industries; along with a new semiconductor programme as a part of its economy. Blockchain, AI and machine learning, and other such technologies are the analytical softwares that complement the hardware. India is a world-leading destination for Software as a Service (SaaS) companies. Therefore, the growing demand of AI and associated technologies can only boost India's existing tech prowess. New-age tech including Artificial Intelligence (AI), Robotics, 3D printing, Data Science, etc., found its applicability in almost all the specialties of the medical field, not only in diagnostics and therapeutics but also in imparting medical education.

Technology is an asset for humanity as it enhances productivity, generates more wealth, and accelerates global economic growth when it is aptly combined with the appropriate public policy measures. In order to maximise the benefits of technological advancements in this 'Techade'– Decade of Technology, closing the digital divide is of paramount importance. ❑

Decoding Modern Tech Terms

Balendu Sharma Dadhich

This is the era of path-breaking innovation, invention, and products showcasing the use of technology. These products startle us with their capabilities and possibilities. While Artificial Intelligence, Quantum Computing, Cloud Computing, and Blockchain were making a mark till recently, NFTs and Metaverse are added to the list of these buzzwords.

With the new-age technology, we are in a world of infinite possibilities. A metaverse of myriad avenues is waiting to be explored to its full potential. Let us understand the scope and opportunities of some of these interesting technologies and disruptors.

Blockchain

Blockchain refers to a system whereby information about transactions is stored on countless computers spread across the globe. It is considered as an alternative to the conventional banking system. Notice what happens when you transfer money to someone through your bank account or apps like Paytm. That money is deducted from the amount kept in your account in that bank, and the same money is added to the account of the other person in another bank. Both the banks use a ledger that keeps the details of the money transactions between you two.

Along with banks, this also applies to mobile payment systems. The role of the bank in this process is to save money and keep details of the transactions. The bank certifies how much money is in your account and to whom you have given or taken the money from. What if the same thing is done without the bank? This is the vision behind Blockchain. Under this, transactions of a similar kind are recorded on computers worldwide, and this system has nothing to do with the banks. The information stored under the Blockchain is even more secure than our banking system because countless copies of that information are kept on computers around the world. No one can hack so many computers. The cryptocurrency, which is much talked about nowadays, has its transactions done through this blockchain system.

NFTs

The success of blockchain as an independent means of storing and authenticating information has created many more innovations. One of these is the Non-Fungible Token, or NFT. Here, the information is stored in the blockchain system itself, especially in a system called ethereum. We know about cryptocurrencies and know that if we have purchased cryptocurrencies, its account will be kept in the blockchain. But let's say you have not bought cryptocurrency, but an expensive original painting, something of historical importance, or memorabilia (such as a special attire worn by a celebrity). It is something which is unique in the entire world. How can you prove you are the owner of that item and it is the real thing and not a fake copy of it? Presently, there is no provision for this except that the organisation from where you have bought it can give you a certificate of ownership or get it stamped as an original by giving an affidavit in court. Imagine what it would be like if a technology platform could store and authenticate information about such unique things. This platform is NFT.

Under a Non-Fungible Token system, a kind of digital certificate is issued that such an original thing, unique in the world, is owned by you. This digital certificate cannot be tampered with. NFTs can be associated with physical assets and virtual or digital assets. Some time ago, you may have read the news that Jack Dorsey, Founder of Twitter, sold the first tweet he ever posted through NFT for USD 2.9 million. You may ask– how can one sell a post made on a digital platform? Anyone can copy it, take its screenshot or create a similar post. And how to prove that it is the same original note as it

The author is a technology expert. Email: balendu@gmail.com

Internet of Things

The Internet of Things or IoT simply means connecting various things of the world to the internet. IoT forms the network of physical objects i.e. things, enclosed with sensors, software, and other technologies for the purpose of connecting and exchanging data over the internet. These devices range from day-to-day objects to complex industrial tools. Everyday objects— household appliances, cars, etc., connected to the internet via embedded devices and seamless communication.

Minimal human intervention allows data to be shared and collected by means of low-cost computing, the cloud, big data, analytics, and mobile technologies. Digital systems can record, monitor, and adjust every interaction between connected things. IoT can be put into three categories where— 1) information is collected and sent. For example, sensors allow us to automatically collect information from the environment which, in turn, allows us to make more intelligent decisions; 2), information is received and acted upon, like printers, and 3) doing both simultaneously. For example, sensors can collect information about the soil moisture to tell the farmer and the irrigation system can automatically turn on as needed, based on how much moisture is in the soil.

has not been kept as a printout? So the NFT proves that Jack Dorsey has sold this comment and is now owned by the CEO of a Malaysian cryptocurrency company. The price is for the information and certificate only. Now, no one else can sell it except its new owner. Even though millions of people retweeted the original tweet, anyone can copy it, but the post owned by that person will be considered original. The rest of the millions of tweets around the world will be considered copies. This digital certificate is not in the form of writing but in the form of a digital image, video, etc. The same is called Non-Fungible Token (NFT). Non fungible means that it is the only one in the world, i.e., unique. This digital asset has been created so that it cannot be copied, and therefore it is safe. There is an immense need for such NFTs (images, videos, animations, illustrations, etc.) in the form of certifications associated with such digital assets. Hence, technically proficient people are engaged in the manufacturing and trading of NFTs.

Metaverse

Metaverse means a parallel universe present in the digital world that contains most of the things that exist in our physical world. Accessing this virtual world requires the Internet and digital devices, just like you would access a video game. You present yourself as a digital person in the game, competing with other players, making friends, and engaging in other activities. You participate in the game from your laptop while others take part through gaming devices or mobile phones. If the same video game is expanded widely and countless people could access it digitally, it would be the metaverse. However, it will not merely be a gaming activity. There

will be much more, such as various events, business, entertainment, meetings, etc. People like us will be there but in their virtual, digital avatars. Companies like Microsoft, Meta (Facebook), Decentraland, Nvidia, and Unity are engaged in making it a reality. Within the next five to ten years, such possibilities can open for all of us in the digital world that we can only imagine at the moment.

Quantum Computing

The Quantum computer is much talked about because of its infinite power. A quantum computer can perform calculations millions of times faster than a normal computer, and that is why it can prove to be a boon for humanity, but it can also give rise to new challenges.

Traditional computers work based on a fundamental unit of binary digits (0 and 1) called 'bit'. On the other hand, the Quantum computer adopts Qubit (Quantum Bit). While the bit value can be 0 or 1 only, the qubit value can be 0, 1, or both. Unlike traditional computers, quantum computers are not limited to just two states. Where transistors are used in normal computers— atoms, electrons, ions, photons, etc., are used in quantum computers which can be superimposed on each other. The working system of a quantum computer differs completely from the traditional computer, and its capacity is tens of millions of times more.

Let us understand it with an example. The information encrypted through an encryption system called RSA is so difficult to decode that if an attempt is made to crack this encryption with the help of ordinary computers, a very powerful computer

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capable of performing ten trillion calculations in a second, it will take three thousand trillion years. On the other hand, a quantum computer of ordinary capacity, capable of performing a million calculations per second, can do the same thing in just 10 seconds.

Presently, only a few quantum computers have been developed in the world. The world's first, very small quantum computer was built in 1997. In 2007, a company called D-Wave Systems of Canada introduced a powerful 28-qubit quantum computer. Today, Rigetti's quantum computer is considered the most powerful, with a capacity of 128 qubits. Except for small systems, even today, the number of quantum computers with good capacity will be less than two dozen in the world. They are being used at institutions like IBM, Intel, Google, Rigetti, Microsoft, NASA, D-Wave, Alibaba, IONQ, Oxford, Berkeley, Stanford universities, and the Massachusetts Institute of Technology (MIT). Here, Microsoft and IBM have given the facility to use quantum computers through the cloud.

Artificial Intelligence (AI)

Artificial intelligence (AI) is one of the most talked-about topic all over the world. In the future, it will become an important part of our lives and emerge as a huge technological force. It can bring about unprecedented changes in the world and has the potential to change the way we live, work, read and write, travel, do business, run industry, and get medical treatment. It is believed that AI will transform the world in a big way, similar to what electricity has done. How can one think of a working day in which electricity does not play a role in some form or the other?

Machines equipped with AI will become powerful and 'intelligent' and compete with human beings' capabilities.

AI refers to the ability of machines (or technology) to learn, analyse, think, understand, solve problems, make decisions, etc., similar to a human being. No other creature in the world has such abilities except human beings. Even if a creature possesses any of these abilities, it is at a minimal level. But now, technology has advanced so much that lifeless machines have similar capabilities. Now, machines have started doing many things that our senses do. They can see, hear, speak, move, and even feel touch. Apart from advanced research and development, many factors are creating this capability, such as the availability of large amounts of data, the ability to analyse it, the enormous

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increase in the capacity of computers, and the development of cloud computing, internet connectivity, etc. You must be using features like machine translation and voice-to-text conversion these days. All these have reached to you because of AI. But this is just the beginning.

Cloud Computing

Whatever enormous work has been accomplished through AI today, it would not have been possible without the help of cloud computing. Cloud computing has made vast computational power and storage space available to us, and technology like AI requires it for calculations.

Cloud computing implies using the resources available on the internet on your computers or devices. These resources are broadly of three types— the complete infrastructure of IT, i.e., hardware, software, etc. Suppose you need to work on a Mac computer for a few months. The cloud has a complete set of Mac computers. Why don't you use it virtually? For example, you are using many services on the Internet (such as email) when the software required for them is not present on the computer. If you want to use a Mac through the cloud, it is also possible in the same way that you would use Gmail or Dropbox through your browser. You will be connected to the internet from within your Windows computer, and from there, you will be able to access the Mac hardware and software. These are also called virtual machines, which you have in virtual form, but not in physical form. Interestingly, you have neither bought the Mac nor have it with you. Through virtualisation technology or any internet browser (Edge, Chrome, Safari, etc.), one can use it.

When you use any such infrastructure or infrastructural facilities remotely through the internet, it is called Infrastructure as a Service (IaaS). It is one of the three major categories of cloud computing. The word 'Cloud' refers to the infrastructure on the internet where various types of technical resources are present, such as hardware, software, and services. There are two more types of cloud– Software as a Service (SaaS) and Platform as a Service (PaaS). As the name suggests, SaaS is the service you can use through the cloud for some time without buying softwares like Photoshop, Microsoft Word, or AutoCAD. PaaS means technology platforms using which you can develop softwares and manage them, providing them to others for use. Everything is done remotely through the internet, without having to buy anything. ❑

Digital Disruptor

Dr Saurabh Garg

Digitisation, in this age, has to be the common link in all the sectors of any successful economy, as well as in all the aspects of a progressive society. The indispensability of going digital in any recent or future technological endeavour cannot be emphasised enough. In India, Aadhaar has played and continues to play an integral role in providing a unified national digital identity framework. The strength of this foundational infrastructure is now being increasingly felt in almost every sphere of life of residents of the country.

Regardless of the sector or vertical, new-age technologies are gradually ushering in the transformation of organisations and economies. The economic and financial landscapes are being revolutionised by rapid breakthroughs in technology, which more often than not, are disruptive with immense long-term potential to benefit society at large.

Some of the broad domain areas which are witnessing a lot of churning with respect to the introduction of technologies that have potentially far-reaching positive impact, especially on developing countries like ours, are as follows:

- **Artificial Intelligence (AI) and Machine Learning (ML):** AI technologies provide a plethora of opportunities to complement human intelligence and combat socio-economic issues.

- **Quantum Computing:** Applications in secure communication, disaster management through better prediction, computing, simulation, chemistry, healthcare, cryptography, imaging, etc.

- **Semiconductor Technologies including Semiconductor Nanotechnology:** Aim to give a major push to the hardware industry by eliminating boundaries between the digital and physical worlds.

- **Smart Manufacturing**: Use of Internet of Things (IoT), Blockchain, Big data Analytics, AI and Robotics as a part of Industry 4.0, more commercial use of additive manufacturing (i.e. 3D printing).

- **Smart Mobility:** Use of IoT and AI/ML in new-age transportation and logistics solutions, autonomous and remotely piloted vehicles**,** vehicles powered by renewable and clean fuels.

- **Advanced Communication Technologies and its Security**: Adoption of 5G, Cloud computing, penetration of broadband internet to remotest and least developed areas using satellite-based internet, optical fibre, etc., for use-cases such as Tele-health, remote learning and much more. Advancements in cyber security and the hardening of communication systems are also expected to stay apace with the communication and networked technologies. This includes building more secure cryptography solutions as well as the use of Homomorphic encryption technologies (computations performed on encryptic data).

The author is the CEO of the Unique Identification Authority of India (UIDAI). Email: ceo@uidai.gov.in

- **Space Technologies:** A plethora of futuristic technologies like Satellite-Based Quantum Communication, Quantum Radar, Self-Eating-Rocket, Self-Vanishing-Satellite, Self-Healing Materials, Humanoid Robotics, Space-Based-Solar Power, Intelligent Satellites and Space-vehicles, Make-in-Space concept, AI-based space applications, etc.

- **Blockchain-based technologies**: Development of solutions in areas such as Decentralised Financing (DeFi), sovereign digital currencies, and the possible creation of sovereign identities.

- **Biotechnology**: This includes advancements in areas such as Synthetic DNA, Development of Vaccines, 4D printing and Tissue Engineering, Gene Editing, Gene Sequencing, Quantum Microscope, Biosensors, etc.

- **Agri-food Technologies:** Sustainable and remunerative Agriculture (and its allied sectors) is the key to the food security of societies. Technologies related to climate-resilient farming, development of high-yielding seed varieties, resource-conscious and frugal irrigation, seeding, harvesting, and post-harvest technologies will define the future of agriculture, especially for developing countries that have large percentages of their population dependent on it.

- **Climate & Environmental Conservation**: Focus on green and sustainable technologies, renewable energy such as solar, Green Hydrogen, etc.

It is expected that a lot of these areas and technologies shall have synergy as well as interdependencies among them, so as to ensure a holistic technology framework. This shall possibly require close collaboration among sectors and industries and lead to an impact that is universally felt by all sections of society.

> 'Aadhaar' is held by almost one-sixth of the population of the world residing in India and is the foundation of India's digital democracy. This technology is for the 'Digital Inclusion' and India has always been advocating that a digital economy is an important tool for social inclusion for future cooperation towards digital inclusion and social empowerment.

In this context, it is also important to acknowledge the role and extent of the digital character of these technologies in their successful deployment and acceptance. Digitisation, in this age, has to be the common link in all the sectors of any successful economy as well as in all the aspects of a progressive society. The indispensability of going digital in any recent or future technological endeavour cannot be emphasised enough.

In India, Aadhaar has played and continues to play an integral role in providing a unified national digital identity framework. Aadhaar has become one of the most important pieces of public digital infrastructure ever to be built in the country. The strength of this foundational infrastructure is now being increasingly felt in almost every sphere of life of residents of the country.

Aadhaar is the world's largest Digital Identity Platform, which was planned and rolled out with a clear set of developmental objectives. The astounding success of Aadhaar and its Digital Identity Platform with billions of authentication transactions already being performed on it has proved its reliability, robustness, and security to the entire international community.

It is the most trusted ID held by almost one-sixth of the population of the world residing in India and is the foundation of India's digital democracy. It has reached the saturation point covering a large number of the population. Around 99.9% of the adult population of India is already enroled with it. Approximately 1.33 billion Aadhaar cards have been generated till date and over 600 million updates have been done by the residents. Over 70 billion Aadhaar authentications have been done till date.

Aadhaar was conceived as an online identity platform that used technology to deliver on its promises:

- Uniqueness– ensuring one person one ID

- Online verification and KYC to enable digital transactions

- Not requiring expensive credentials– such as smartcards, etc.

The above powerful features of the ID system delivered at a billion-population scale encouraged a plethora of useful applications through high assurance authentication and KYC facility, bringing speed and convenience to various transactions at a small fraction of the earlier cost. All this was possible due to the smart use

#AadhaarEssentials

UIDAI accepts

32 Documents as Proof of Identity,

45 Documents as Proof of Address

14 Documents as Proof of Relationship

15 Documents as Date of Birth Proof

Use any valid supporting document to update your details in Aadhaar | To see list SCAN

For any assistance/query: Call **1947** (Toll-free) or email at **help@uidai.gov.in**

of cutting-edge technology, be it multimodal biometrics, distributed computing, BI/Analytics, mobile apps, etc.

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Aadhaar and UIDAI have always been at the forefront of developing and/or using state-of-art technologies so as to ensure that they are successfully meeting their mandate of providing reliable, secure, resident and industry-friendly identity solutions and services.

In this context, some of the technologies that have been adopted or are in the process of being adopted at UIDAI include the following:

- Unified my-Aadhaar portal for a one-stop experience for users for all Aadhaar services in regional languages;

- Multiple services on mAadhaar mobile application;

- Use of secure QR code and offline e-KYC for offline verification of Aadhaar;

- Introduction of Virtual ID, Aadhaar Lock, Biometric Lock for securely using Aadhaar for various services;

- Integration with Digilocker for consent-based fetching of resident documents as well as for address update on other identity documents based on address on Aadhaar;

> The core strength of Aadhaar is its ability to be authenticated anytime and from anywhere. This completely digital and portable nature of Aadhaar makes it a ready candidate for an enormous number of applications and use-cases, for example, Aadhaar-authentication based digital payments such as those in the Direct Benefit Transfer (DBT) and last-mile branchless banking, social welfare benefit/service delivery such as PDS, etc.

- Extensive use of AI/ML for 'liveness check' of residents' biometrics and for document validation;

- State-of-the-art UIDAI's own Private Cloud Infrastructure;

- Indigenous development of Automatic Biometric Identification System (ABIS) to reduce dependencies on proprietary solutions;

- Integration with ISRO for location-based resident services;

- Inspection Portal for automating inspection of Aadhaar Centres by UIDAI;

- Research is underway in newer technologies like Blockchain-based Identity solutions, IoT, Confidential Computing, AI-based Fraud Analytics, quantum-resilient cryptographic solutions, etc.

Technology Innovation in Authentication

The core strength of Aadhaar is its ability to be authenticated anytime and from anywhere. This completely digital and portable nature of Aadhaar makes it a ready candidate for an enormous number of applications and use-cases, for example, Aadhaar-authentication based digital payments such as those in the Direct Benefit Transfer (DBT) and last-mile branchless banking, social welfare benefit/service delivery such as PDS, etc. Some of the innovations that Aadhaar has been able to bring to its Authentication landscape are as follows:

- **Face Authentication:** This is a recently-launched indigenous smartphone-based solution for Aadhaar Authentication using the 'Face' modality. It is contactless and has a 'liveness check' built into it. This makes it more secure and reliable. It extensively employs AI/ML for ensuring the 'liveness' of the modality captured as part of authentication.

- **Iris-based Aadhaar Authentication**: This has been in place for a long time and is being vigorously promoted now due to its inherent strengths which came to the fore, especially during Covid-19. Just as face-modality, it is contactless and more secure, and also more reliable than a fingerprint-based authentication, especially for people with worn-out fingerprints.

- **Fingerprint Image Record (based) authentication**: Fingerprint Image Record is being launched for ensuring the 'liveness' of the fingerprints captured and to check cases of possible frauds via fingerprint cloning, etc.

- **More secure registered devices for enrolment and authentication**: For added security, the new devices shall have encryption of Identity Information captured at the device chip/hardware level.

Security of UIDAI Infrastructure

UIDAI has conjured up state-of-the-art techniques and technological advancements in Information Security and conceptualised models and frameworks to explore some of the best ways to protect the integrity of the system from such actors and at the same time ensure its availability to legitimate users.

Aadhaar has a multilayered secure architecture. UIDAI-CIDR is ISO 27001 certified for Information Security. UIDAI is also certified for ISO 27701 for privacy protection as an extension to ISO 27001. Regular security feeds from government security agencies are assessed for security strengthening.

Face Authentication is a recently-launched indigenous smartphone-based solution for Aadhaar Authentication using the 'Face' modality. It is contactless and has a liveness check built into it. It extensively employs AI/ML for ensuring the liveness of the modality captured as part of authentication.

UIDAI also ensures continued adherence and compliance to the best practices in security by Aadhaar ecosystem partners through regular security audits of the partner infrastructure and processes.

Digital Technology is meant to be used by the government and the public sector to a) Ensure transparency and accountability of governance, and b) Meet the increased demand for digital services among citizens, to provide more simplified and high-quality services.

UIDAI has always been steadfastly aligned to this core objective. It has always remained abreast with the latest advancements in technologies that have a bearing in the Indian context and specifically in the context of providing digital-identity-led services to its people. Towards this, UIDAI plans to keep breaking newer grounds in its digital journey by making the right partnerships with industry, academia, and the residents who form the centre of its existence. ❑

DEVELOPMENT ROADMAP

Capacity Building Commission

The capacity of Civil Services plays a vital role in rendering a wide variety of services, implementing welfare programmes, and performing core governance functions. A transformational change in Civil Service Capacity is proposed to be affected by organically linking the transformation of work culture, strengthening public institutions, and adopting modern technology to build civil service capacity with the overall aim of ensuring efficient delivery of services to citizens.

Mission Karmayogi aims to prepare the Indian Civil Servants for the future by making them more creative, constructive, imaginative, innovative, proactive, professional, progressive, energetic, enabling, transparent, and technology-enabled. Empowered with specific role competencies, the civil servant will be able to ensure efficient service delivery of the highest quality standards.

Under the Mission, the Capacity Building Commission was constituted through the Gazette of India on 1 April 2021. As the custodian of the civil services capacity building ecosystem, the commission is mandated to perform the following functions:

1. Facilitate preparation of Annual Capacity Building Plans of departments, ministries, and agencies.

2. Make Policy recommendations to DoPT on personnel/HR and Capacity Building.

3. Evolve a harmonious de-siloed approach to improve civil service capacity.

4. Analyse learning/competency-related data from iGOT-Karmayogi, an online training platform.

5. Drive standardisation, harmonisation, and shared understanding of Capacity Building activities.

6. Create shared learning resources, including internal and external faculty and resource centers.

7. Exercise functional supervision over all Central Training Institutions.

8. Undertake an audit of Human Resources in the Government and outcomes of the Capacity Building efforts.

9. Approve Knowledge Partners and Content Validation mechanism for the training of civil servants.

10. Organise a global HR Summit to bring best practices of human resource management to the governance in India. ❑

Deep-Tech Startup Ecosystem

R Raghuttama Rao

Deep-tech startups arise from research-based, disruptive innovations from STEM labs of academic/research institutions and solve hard problems and challenges. India lacks deep-tech startups. Deep-tech startups constitute less than one per cent of the number of startups, far below what a fast-growing, complex, and large economy like India should have.

India has a vibrant startup ecosystem with supporting infrastructure– incubators, development grants, angel/venture investors, mentors– and a conducive policy environment. The Economic Survey of India 2021-22 says that there are 61,400 registered startups in India, making it the third-largest startup ecosystem in the world behind China and US. Around 14,000[1] new startups were registered in India during CY2021[2]. Over the past decade, Indian startups have created 6.6 lakh direct jobs and 34 lakh indirect jobs.

Indian startups raised USD 24 billion in CY21, compared to USD 10 billion in CY20. There has been a significant localisation and diversification in the investor pool for startups in India over the past decade. There were more than 750 institutional investors in India in CY21, 80% more than in CY20. The number of angel investors grew in CY21 by 20% to about 2,400. More than half the investment deals in CY21 had an India-based investor. Over 250 corporates have engaged with Indian startups in some way, including by running 80+ open innovation programmes for startups in CY21.

The Central and State governments in India have actively supported the startup sector over the past decade. The Startup India platform, which started in 2016, has been instrumental in encouraging startups and integrating them with the corporate and investment community. Over 26 States in India have a startup policy.

What is a Deep-Tech Startup?

Notwithstanding the healthy development of India's startup ecosystem, one weakness that keeps India behind the developed countries is that we lack deep-tech startups. "Deep-tech" startups constitute less than one per cent of the number of startups, far below what a fast-growing, complex, and large economy like India should have.

The absence of deep-tech startups harms India considerably by weakening her capability to meaningfully address complex socio-economic challenges that afflict our society in multiple sectors such as agriculture, healthcare, transportation, education, energy, etc. The solutions to such challenges that address the UN's Sustainable Development Goals would necessarily have to be radically new and disrupt existing industries and business processes.

In India's population of 130 crores, only the top 25%[3] (affluent and middle-class) benefit from the fruits of technological progress, be it healthcare, consumer goods, clean water, safe transportation, education, etc. In contrast, the remaining 100 crore people do not get enough or are substantially bypassed. This is because most of the hi-tech goods and services are designed in the developed world for rich people– the average per capita income in OECD countries is about USD 40,000, while the average per capita income of the bottom 100 crore people in India is around USD 1000[3]. They simply cannot afford modern innovations with an income of 2.5% of the people for whom such innovations are designed. So, how do 100 crore Indians move towards development?

The answer lies in becoming Atmanirbhar in commercialising domestic science and technology to solve our challenging problems.

India's development challenges are so unique and idiosyncratic that innovators from developed countries, not familiar with our context or cost structures, will not be able to provide solutions. The clarion call from the Prime Minister for 'Atmanirbhar' is apt here– we have to grow our own deep-tech ecosystem.

The author is the CEO, Gopalakrishnan-Deshpande Centre for Innovation & Entrepreneurship, IIT Madras. Email: enquiries@gdciitm.org

Need for Deep-Tech Startup Ecosystem

The phrase 'deep-tech startup' does not have a precise definition, but there is a broad consensus on what it is. Deep-tech startups arise from research-based, disruptive innovations from STEM labs of academic/research institutions and solve hard problems and challenges. Some examples are— (a) recycling sewage to get clean water at an affordable cost, (b) a low-cost solution at scale for curing blindness, (c) affordable solutions for treating diseases such as diabetes, dementia, cancer, etc., (d) creating an alternative to Lithium-ion batteries, and (e) low-cost satellite launching systems.

There are three major problems that deep-tech startups have vis-à-vis other startups (including those that are called tech-based startups).

1. Deep-tech startups need a longer gestation for development than other startups. The latter might need from 1-3 years to reach revenue, while deep-tech startups need 5-8 years.

2. Deep-tech startups require different types of inputs– they require more patient capital, specialised talent, and expert knowledge in more than one domain, to develop and validate a science-based innovation to the point where it is acceptable to commercial investors. For example, assume an invention involving creating a new substance (say a chemical that removes heavy metal from water). It takes time and resources to test and validate samples, obtain regulatory approvals, and set up a new manufacturing process to produce at scale. All these are capital-intensive, time-consuming, and have no assurance of success.

3. A deep-tech startup follows a different development path than other startups. A deep-tech startup derives its IP from the underlying science. The startup has to work backwards and find a real-life problem that is worth solving using its technology and validate the adequacy and nature of the market demand for the innovation.

Therefore, deep-tech startups take more time, talent, and capital to develop, upto when commercial investors find them acceptable. The risk of failure is high at every stage for a deep-tech startup, usually higher than in the case of other types of startups. But the payoffs of successful deep-tech startups are tremendous. Think of Microsoft, Google, Apple, Intel, Tesla, Moderna, SpaceX, etc. They are large corporations today, but they started as mere technology bets not very long ago.

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India has also created a few deep-tech startups over the past decade, whose impact has been overwhelmingly positive. It lends credence to the suggestion to step up policy and financial support to the deep-tech startup ecosystem.

Creating Ecosystem

India has produced about 94 unicorns so far, but barely any of them can claim to be a deep-tech startup. We have several venture funds in India, but most pursue relatively 'lower risk' investment opportunities that exploit India's growing consumption economy or those making cloned products. While India has a problem of inadequate R&D expenditure for an economy of her size, there is a sufficient amount of high-quality research in India's top STEM colleges to fuel a deep-tech startup revolution. Some key reasons why our academic researchers lag in their potential to convert research into deep-tech startups are:

1. There is inadequate appreciation amongst policymakers and university administrators for the need to build capacity amongst academic researchers, scientists, and STEM students in India to truly understand what entrepreneurship entails and what commercialisation of research means. Being formally trained in science and technology but not having adequate exposure to the real world of business/commerce, academic researchers conflate invention and innovation. There is a big difference between making a successful technological breakthrough in the lab and building a successful enterprise around it. Becoming entrepreneurial cannot be imbibed by reading or scholastic programmes but only through experiential learning and expert mentoring/coaching.

2. While Government has made good efforts to fund innovation in universities through programmes such as prototype development, filing for IPR, incubation, etc., few academics (<5%) commercialise their research by startups. A key point is that even if academics aspire to convert their inventions into enterprises, they do not have the mental make-up (the entrepreneur's mindset) or the knowledge of how to organise what they have and collaborate with others to get what they do not have/know. Many universities have set up incubators to help with this, but they are not adequately equipped or incentivised to commercialise research. Although they are not-for-profit entities, incubators look for startups that have a good chance to be commercially viable. With their limited budgets, incubators face a tough challenge to nurture startups to scale their revenues and become

attractive investment propositions. It is difficult (if not impossible) for incubators to engage more deeply with academics/researchers in labs and handhold them in crossing the early-stage valleys of death (e.g. finding proof of technology or proof of market). Incubators are vital for the ecosystem but their inbound supply chain needs to be strengthened.

3. Indian corporates and industries that are engaged with deep-tech startups do so only with those where technology is substantially developed or where revenues are visible. A majority of Indian corporates do not have knowledge or mechanisms for dealing with Open Innovation processes that our university/research institutions can potentially offer for creating deep-tech startups.

It is being proposed that policymakers should introduce Customer Discovery and Customer Development programmes to develop deep-tech startups from academic/research institutions in India.

In 2013, the US Government through the National Science Foundation[4] introduced the I-Corps programme[5] with great success to commercialise academic research in US universities. Quoting from NSF: "The I-Corps program uses experiential education to help researchers gain valuable insight into entrepreneurship, starting a business or industry requirements and challenges. I-Corps enables the transformation of invention to impact". The most significant risk for startups is not failure of technology but failing to get adequate customers. The I-Corps programme is mandatory in the US for startups to obtain federal funding for research/commercialisation.

Analogous to the I-Corps programme, the Government of India should consider making it mandatory for every translational research proposal at a university/research institution or a deep-tech startup seeking admission to a government incubator to undergo a rigorous Customer Discovery exercise. The learnings at such a programme can be truly transformative.

The Gopalakrishnan-Deshpande Centre for Innovation & Entrepreneurship (GDC) at IIT Madras has successfully run its I-NCUBATE programme for the past four years and trained over 170 deep-tech startups from over 50 colleges/incubators across India with excellent outcomes. The I-NCUBATE programme is inspired by the I-Corps programme. The empirical evidence of I-NCUBATE programme for success is described below:

1. Every participant startup in I-NCUBATE, without

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exception, found its innovation as not a good fit for the market. They would tweak their innovation or pivot it to become relevant. Two-thirds of startups found their early adopter customer segment in this manner. This puts them on a strong footing to build their prototype/MVP and provides insights into a good business model.

2. The remaining one-third of teams that do not find a "problem to solve" for their innovation have two outcomes post I-NCUBATE. Around 50% continue their Customer Discovery exercise and end up finding their early adopter customers. The residual 15% of teams conclude there is no problem to solve– i.e. their innovation is unlikely to succeed in the marketplace. This is not a failure (which is how incubators or investors would conclude) but actually a very good outcome for the researchers. Had they gone ahead with building their startup (without having done the I-NCUBATE programme), they would have spent 2-3 years on it, spent money and other inputs and then encountered failure.

3. The Customer Discovery exercise helps researchers know in 8 weeks (rather than learn it the hard way in 3 years) if their innovation has a market, or how they should shape their startup journey to maximise chances for success. A "No-Go" is one of the best outcomes a researcher can get from the I-NCUBATE programme.

Conclusion

Unfortunately, very few researchers and startup founders in India conduct a robust Customer Discovery exercise. This is more due to a lack of awareness and appreciation amongst policymakers of its transformational impact on the researchers/entrepreneurs. By linking development grants/seed investment programmes for deep-tech startups with a robust Customer Discovery exercise, we can create in India a significant amount of deal flow of robust and curated deep-tech startups into incubators and the ecosystem. More importantly, a fair share of deep-tech startups will help in solving India's hard challenges. ❑

(Views expressed in this article are personal.)

References

1. All data in this section (unless otherwise specified) is from NASSCOM Startup India Report – 2021.
2. CY – Calendar Year
3. Author's estimate
4. National Science Foundation: https://www.nsf.gov/
5. https://www.nsf.gov/news/special_reports/i-corps/

AI and Machine Learning

Hindol Sengupta
Bhavya Tyagi

Industry 4.0 is set to usher an era of technologies that will completely alter the way in which we interact with the world around us. Artificial Intelligence/Machine Learning, IoT, 5G, Augmented Reality, Big Data, Nanotechnology, Robotics, and 3D printing are transforming the operational, functional, and strategic landscape across various industries. In India, both private and public enterprises and the Central and State governments are investing in multiple AI use cases– from manufacturing to services. Most venture capital funding in India is now going to AI projects in Banking, Financial Services, and Insurance Sector (BFSI), e-commerce, healthcare, electronics and renewable energy startups.

India was ranked 8th in the top 10 countries by AI patent families[1], ahead of Russia and France, with AI-related patent applications growing tenfold from 2012 to 2018. A report titled 'AI Enabled SaaS: The Next Frontier for Global SaaS Start-ups from India' highlighted that AI could generate over 9,00,000 white-collar jobs and 3.6 million indirect jobs by 2030. Additionally, India has over 1,300 Global Capability Centres (GCCs), with one in every five GCCs using AI across key business functions such as cybersecurity, customer services, supply chain, and operations management.[2]

To support this thriving AI industry, India is one of the handful of countries that have developed a conceptual national framework for the use of artificial intelligence (AI) and its allied field, machine learning. The Government expenditure on AI and Machine Learning has also steadily increased with expected growth at a CAGR of 39 per cent over the period 2019-2025 to reach USD 11,781.9 million in 2025[3]. As per the government's think tank NITI Aayog, by 2035, AI has the potential to add USD 1 trillion to the Indian economy. However, successful adoption of AI will require strategy, implementation, risk management, and an AI-enabled workforce. Even to promote innovations in AI, a streamlined national policy framework is necessary.

In this regard, by recognising AI's potential to transform the Indian economy and the need for India to build a comprehensive strategic framework to harness it, NITI Aayog released a National Strategy for Artificial Intelligence #AIforAll in June 2018. The paper lays out the roadmap for India to leverage the coming-of-age technologies to ensure inclusive growth and social development. #AIforAll aims at enhancing and empowering human capabilities to address challenges of access, affordability, and efficiency in endeavouring to scale Made-

Hindol Sengupta is Vice President and Head of the Strategic Investment Research Unit at Invest India. Email: hindol.sengupta@investindia.org.in
Bhavya Tyagi is a researcher at the same organisation.

in-India artificial intelligence solutions for the benefit of the developing and emerging economies. Here, 'solve for India' means to 'solve for 40 per cent of the world.' In doing so, the paper identifies five priority sectors that are envisioned to gain the most incremental value from the adoption of these transformative technologies in solving societal needs: a) healthcare– increasing access to quality and affordable healthcare, b) agriculture– enhancing crop yield, ensuring food security, and increasing farmers' incomes, c) education– enhancing the quality of education and human resource productivity, d) smart cities and infrastructure– ensuring efficient connectivity and promoting intelligent urban planning, and e) smart mobility and transportation– enabling efficient and safe transportation. The National Strategy aims to support and enable India's AI ecosystem through grants, product and solution development, collaboration with the industry, and mentorship support to startups. Since the release of this report, NITI Aayog has launched several initiatives such as the Atal Innovation Mission, Empowered Group-6, RAISE 2020 summit, etc. The flagship AI initiative of NITI Aayog has been the Responsible AI Approach Documents published in collaboration with the World Economic Forum Centre for the next AI Industrial Revolution. The Documents seek to establish broad ethics and principles for the design, development, and deployment of AI in India.

AI ecosystem in the government currently comprises capacity building and reskilling, policies, innovation centres, and projects. However, given the agile nature of the technologies, several research reports have pressed for the development and deployment of an agile regulatory and infrastructural framework to remove bottlenecks and complexities in AI-driven processes and ensure standardization of AI. Keeping this in mind, India's AI Standardization Committee of the Department of Telecommunications (DoT) released a draft framework on the India Artificial Intelligence Stack to enable an environment to exploit AI productively across all sectors and bring interoperability, among other things. The Stack is divided into six layers– five main horizontal layers and one vertical layer— each catering to a specific purpose ranging from information gathering and storage to security and governance. The Report highlights numerous benefits of the AI Stack such as secure data storage and

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data privacy, easy interface, protection of digital rights, open API integration, trustworthiness, ethical standards, and usage of government Public Key Infrastructure (PKI). It further lays down the roadmap to increase public and private partnership in research, accelerating adoption of AI, skilling the workforce, and ensuring ethics and principle for a responsible AI. It also ensures the creation of a common Data controller, including multi-cloud scenarios. One of the major advantages of this proposed AI Stack is that it will facilitate open API integration and build AI architecture from square one. Through this, the Government aims to provide a balanced 'playground' for institutions to accelerate research and development in AI and ensure speedy adoption of AI across the value chain.

India is bringing in the use of AI in everything– from promoting digital health, and amplifying digital financial transactions to helping pensioners receive their payments with greater ease, and tracking down tigers to preserve them.

In Telangana, AI is helping authenticate pensioners and ensuring that payments go to pensioners who are alive (thus, removing chances of graft) and using basic images and information to help validate recipients.

The Ministry of Corporate Affairs is using AI to simplify corporate filings, while the Centre for Artificial Intelligence and Robotics (CAIR) has been built as a special hub for AI-related work of the DRDO (Defence Research and Development Organisation). AI is an area of special importance for the National Research Foundation, and it is being promoted at the school level to encourage new talent in this sphere.

India sees AI and machine learning as the next transformative process to reform its economy and give it greater depth, and weed out irregularities. This process has already started with the digitisation of citizen identity and financial transactions, but the use of AI would give it a whole new dimension and depth.

AI and machine learning are particularly suited for India because the country is the world's largest generator of democratic data or data which is being generated and analysed under the democratic rule of governance.

This wealth of data gives India an advantage in many fields– from

healthcare to manufacturing and consumer behaviour analysis. But the real value of this vast mine of data can only be extracted using effective AI and machine learning.

Therefore, the use of such technologies on Indian data would be priceless not just for decision making in India but around the world. As India has a great diversity of people and cultures, therefore its data can help determine many patterns that might be difficult in many other parts of the world.

The use of AI and machine learning, along with other technologies like blockchain, would enable solutions to longstanding policy challenges in issues like land transactions and medical record keeping.

India is building the world's largest citizen pool of data from citizens which is managed transparently, and upon such 'stacks', applications of various kinds can be built. Each such application, in turn, 'talks' to one another, thus providing the citizen with a seamless experience.

It is also building quantum computing capability and chip-making prowess to align and integrate these systems on the front-end and back-end. India is one of the largest smartphone manufacturers in the world, it has a new semiconductor programme, and its drone and robotics

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industries are some of the most exciting parts of its economy. AI and machine learning, and blockchain, along with other such technologies are the analytical softwares that complement the hardware. India is also a world-leading destination for Software as a Service (SaaS) companies, and the growing use of AI and associated technologies can only boost India's existing tech prowess.

In India, AI and machine learning are starting to be used in governance to give depth to the country's democratic processes. From education to defence, health to e-commerce, there is hardly any area where this impact isn't starting to become rapidly visible.	❑

References

1. https://cset.georgetown.edu/publication/mapping-indias-ai-potential/

2. NASSCOM Deloitte June 2021 Report

3. https://www.globenewswire.com/news-release/2020/01/09/1968230/0/en/India-Artificial-Intelligence-AI-Market-Size-2016-2025-and-Spending-Across-18-Sectors-140-Application-Segments-AI-Domains-and-Technology-Applications-Services-Hardware.html#:~:text=Artificial%20Intelligence%20(AI)%20spend%20in,US%24%2011%2C781.9%20million%20by%202025

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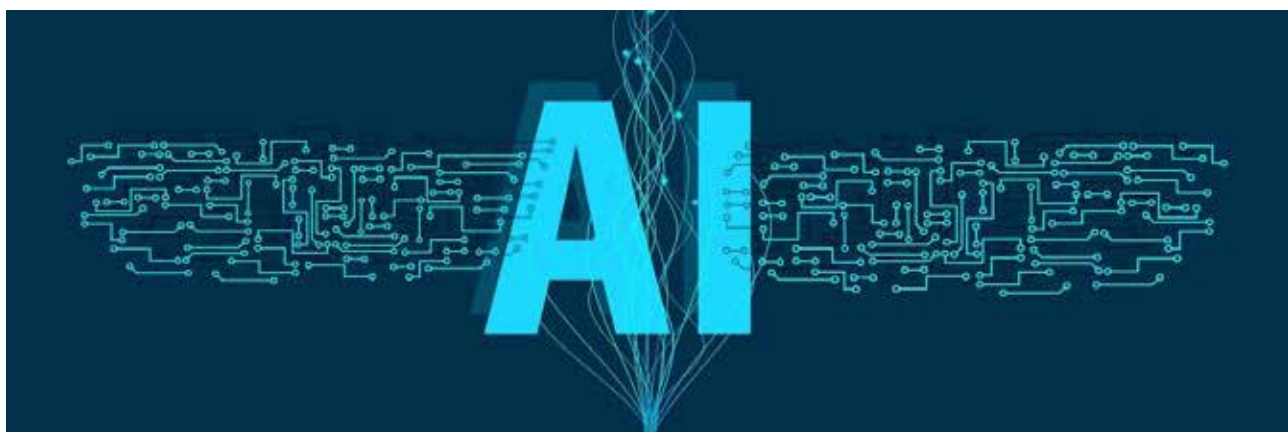
Dr G P Dang
Priyanka Sharma

The modern world is full of technology and new inventions, in which Artificial Intelligence (AI) is playing a major role in every sphere of life. Education sector is also not untouched with the application of AI, whether it is primary, secondary or higher education, including professional education. With the day-to-day growing influence of AI in education in India, the sector must adapt its plans to account for it and how it can assist today's young minds to become tomorrow's capable leaders and innovators. The use of AI applications in education field can assist our teachers in increasing their efficiency by sparing them to perform high-level intellectual tasks in teaching and delivering lectures to students, and making them free from performing monotonous and mundane tasks.

The pandemic has emphasised the importance and need for online education, due to which, a hybrid model of teaching, which involves offline as well as online classes, has now become a new trend in India. Considering the present scenario and the need for time, the University Grants Commission (UGC) has also recommended the application of modern teaching techniques, which include hybrid mode. Moreover, AI has also started playing an important role in the education system of India, the adoption of which needs to be further expanded. New Education Policy (NEP) has also been drafted and implemented incorporating all modes of teaching. It is realised that AI techniques can fill this quality gap in the education sector and hence should be given due importance.

Artificial intelligence uses the ability of the computer or computer-enabled system to process the information and produce outcomes similar to the human rational behaviour for solving the problem and for decision making. Machine learning is a subset of AI, which allows a machine to automatically learn from past data without programming explicitly. The goal of AI is to make smart computer system to solve complex problems. This technology can be applied in the education system.

Dr G P Dang is Professor, Department of Commerce, DAV (PG) College, Dehradun. Email: gpdang@gmail.com
Priyanka Sharma is a Research Scholar in the same institution. Email: pspriyanka.in@gmail.com

AI and machine learning are used to enhance the quality and speed of the work with a minimum requirement of human efforts. It is most suitable for performing repetitive and mundane tasks, which are also present in the education system. Nowadays, many queries relating to the academic field are answered by virtual assistance with AI capabilities like Google Assistant, Alexa, and Siri. Our education system desperately requires quality and wide geographical coverage, which can be made possible with the help of incorporating AI technologies.

Applications

1. Robot Teachers

AI can be used in education with the help of humanoid robot teachers that can assist human teachers in delivering their lectures to students. Robot teachers can make teaching more interesting for students using their AI capabilities. In various schools, Artificial Intelligence-enabled robot teachers assist teachers in the classroom and help in clearing the doubts of students. They complement human teachers in imparting lessons and replying to frequently asked questions (FAQs) of students.

2. Personalised Education

AI can help in personalising the teaching pattern for an individual student as per his/her potential in the learning. Various AI software-based programmes can analyse the knowledge gaps, preferences, and learning ability of each student. Accordingly, they can personalise the flexible teaching pattern for each student.

3. Tutoring

AI can play a great role in tutoring students and taking the doubts of students outside the classrooms. Chatbots and other AI-enabled tools can assist students in solving their additional problems or queries. Students even get the opportunity to ask their repetitive queries from these AI assistants, as they do in classrooms in the presence of their peers. It provides extra help to the students outside the classroom.

In addition, AI has also solved the issue of timely response. It can answer repetitive and commonly asked questions in seconds and overcome long delays. Issues of common interests and FAQs are now answered by AI tools, which help in minimising the waiting time for students and information seekers.

4. Automated Grading System

AI-powered grading software uses machine learning techniques by replicating human teachers' grading patterns with the help of past data to evaluate the answer papers of students. It helps in removing biased evaluating patterns of human teachers in subjective papers. The automated grading system is most popularly used in optical mark recognition (OMR) criteria for evaluating objective type or multiple-choice questions by reading the shaded areas in the examination papers. AI-enabled software is also used for checking plagiarism in various documents and reports, along with providing various suggestions as to the errors present in the document.

5. Natural Language Processing

In the educational context, the Natural Language Processing (NLP) can assist students in making necessary corrections and providing meaningful comments in relation to their documents or reports. Examples of NLP include softwares like Grammarly which make writings clear and error-free and QuillBot which helps people enhance their original content and paraphrase the sentences. Various NLP software tools that help in translating one language to another include Google Translate, Microsoft Translator, and Facebook Translation App.

There are other testing companies such as the Education Testing Service and Pearson that use NLP to score essays. Massive Open Online Courses (MOOCs) that are run by companies such as Coursera and Udacity, which allow unlimited participation through the web, have also included AI grading to examine essays within their courses.

6. Administrative Tasks

AI can help teachers in performing their repetitive and mundane administrative tasks, such as scheduling, rescheduling classes, curriculum and content development, marking attendance, grading papers, sharing report cards of students automatically to the parents, etc. This will allow teachers to concentrate on enhancing educational quality rather than spending time on manual

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paperwork, which would eventually decrease their work pressure. AI has made the performance of administrative tasks easier and improved teachers' or instructors' efficiency and effectiveness in providing instructions and guidance to students.

7. Creation of Smart Content

AI-based software tools help in the creation of smart content that can range from digital textbooks, study guides, videos, etc., that create customised environments for the students. AI can also help in generating and updating the contents of the lessons, keeping the information up to date, and customising it for different learning curves.

8. Multilingual Teaching

India is a country with varied regional languages where NLP tools having AI capability can break down the barriers of communication between the various regional areas by using deep learning networks to translate speech and text into different languages. In this way, access to quality education and sharing of knowledge can be processed at a wider level.

To summarise, the main roles of AI in education are the automation of both academic and administrative tasks, personalisation in learning, smart content, and day-night accessibility. With the help of AI techniques, a student can avail of educational services of interest, anytime from anywhere in any language. AI has resolved the issues related to accessibility, health, environment, etc., that were previously hindering the process of education.

> **AI-powered grading software uses machine learning techniques by replicating human teachers' grading patterns with the help of past data to evaluate the answer papers of students. It helps in removing biased evaluating patterns of human teachers in subjective papers.**

The potential growth of AI in India has made it inevitable for the country to incorporate AI in the education field to reap its benefits and prepare India's young population for the future. The most crucial segment of every country's population is its youth, and good education is essential to make them capable of leading the country towards a brighter future. With the influence of AI in education growing by the day, the education sector must adapt its plans to account for the impact of AI in education in India and how it can assist today's young minds to become tomorrow's capable leaders and innovators. The use of AI applications in the education field can assist our teachers in increasing their efficiency. These applications can let them perform high-level intellectual tasks in teaching and delivering lectures to students by making them free from performing monotonous and mundane tasks.

The use of AI in the education field can bring efficiency and accuracy to various educational activities that would eventually result in the improvement of the quality of the education system. Robot teachers can act as independent instructors with the help of any human operator having some knowledge to operate robots. These technical persons can be hired in educational institutions just to operate humanoid robot teachers. Teachers can focus on giving guidance to students on their critical issues relating to mentorship, moral education, and career opportunities.

Furthermore, AI can be used to provide training to teachers with the help of computerised tests, robot trainers, and other techniques in order to keep their knowledge up to date. ❑

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Jan Suraksha

Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY), Pradhan Mantri Suraksha Bima Yojana (PMSBY), and Atal Pension Yojana (APY) were launched in 2015.

These three social security schemes are dedicated to the welfare of the citizens, recognising the need for securing human life from unforeseen risks/losses and financial uncertainties. To ensure that the people from the unorganised section of the country are financially secure, the Government launched two insurance schemes– Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY)

and Pradhan Mantri Suraksha Bima Yojana (PMSBY); and introduced Atal Pension Yojana (APY) to cover the exigencies in the old age.

While the PMJJBY and PMSBY provide access to low-cost life/accidental insurance cover to the people, the APY provides an opportunity for saving in the present for getting a regular pension in old age.

As we celebrate the 7th anniversary of these three schemes, let us focus on how they have provided affordable insurance and security to people, their achievements, and salient features.

Atal Pension Yojana (APY)

Background: The Atal Pension Yojana (APY) was launched to create a universal social security system for all Indians, especially the poor, the under-privileged and the workers in the unorganised sector. It is an initiative of the Government to provide financial security and cover future exigencies for the people in the unorganised sector. APY is administered by Pension Fund Regulatory and Development Authority (PFRDA) under the overall administrative and institutional architecture of the National Pension System (NPS).

Eligibility: APY is open to all bank account holders in the age group of 18 to 40 years and the contributions differ, based on pension amount chosen.

Benefits: Subscribers would receive the guaranteed minimum monthly pension of Rs 1000 or Rs 2000 or Rs 3000 or Rs 4000 or Rs 5000 at the age of 60 years, based on the contributions made by the subscriber after joining the Scheme.

Disbursement of the Scheme Benefits: The monthly pension is available to the subscriber, and after him to his spouse and after their death, the pension corpus, as accumulated at age 60 of the subscriber, would be returned to the nominee of the subscriber.

In case of premature death of subscriber (death before 60 years of age), spouse of the subscriber can continue contributing to APY account of the subscriber, for the remaining vesting period, till the original subscriber would have attained the age of 60 years.

Contribution by Central Government: The minimum pension would be guaranteed by the Government, i.e., if the accumulated corpus based on contributions

earns a lower than estimated return on investment and is inadequate to provide the minimum guaranteed pension, the Central Government would fund such inadequacy. Alternatively, if the returns on investment are higher, the subscribers would get enhanced pensionary benefits.

Payment frequency: Subscribers can make contributions to APY on monthly/quarterly/half-yearly basis.

Withdrawal from the Scheme: Subscribers can voluntarily exit from APY subject to certain conditions, on deduction of Government co-contribution and return/ interest thereon.

Achievements: As on 27 April 2022, more than 4 crore individuals have subscribed to the Scheme.
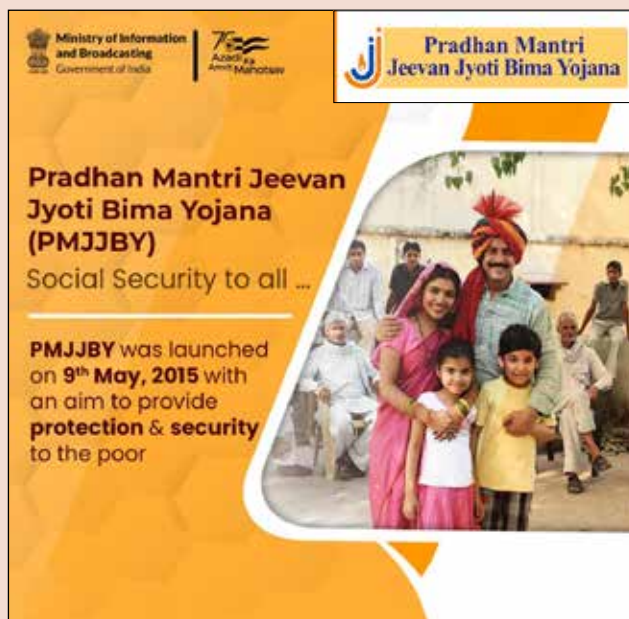
Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY)

Scheme: PMJJBY is a one-year life insurance Scheme renewable from year to year, offering coverage for death due to any reason.

Eligibility: Individuals in the age group of 18-50 years having a savings bank or a post office account are entitled to enrol under the Scheme. People who join the Scheme before completing 50 years of age can continue to have the risk of life covered up to age of 55 years upon payment of premium.

Benefits: Life cover of Rs 2 Lakh in case of death due to any reason against a premium of Rs 330 per annum.

Enrolment: Enrolments under the Scheme can be done by visiting the branch/BC point or website of the bank of the account holder or at the post office in case of post office savings bank account. The premium under the Scheme is auto debited every year from the subscriber's bank account, based on a one-time mandate from the account holder. Detailed information about the Scheme and the forms (in Hindi, English and Regional languages) are available on https://jansuraksha.gov.in.

Achievements: As on 27 April 2022, the cumulative enrolments under the Scheme have been more than 12.76 crore and an amount of Rs 11,522 crore has been paid for 5,76,121 claims.

Pradhan Mantri Suraksha Bima Yojana (PMSBY)

Scheme: PMSBY is a one-year accidental insurance Scheme renewable from year to year, offering coverage for death or disability due to accident.

Eligibility: Individuals in the age group of 18-70 years having a savings bank or a post office account are entitled to enrol under the Scheme.

Benefits: Accidental death and disability cover of Rs 2 lakh (Rs 1 lakh in case of partial disability) for death or disability due to an accident.

Enrolment: Enrolment under the Scheme can be done by visiting the branch/ BC point or website of the bank of the account holder or at the post office in case of post office savings bank account. The premium under the scheme is auto debited every year from the subscriber's bank account based on a one-time mandate from the account holder. Detailed information about the Scheme and the forms (in Hindi, English and Regional languages) are available on https://jansuraksha.gov.in.

Achievements: As on 27 April 2022, the cumulative enrolments under the Scheme have been more than 28.37 crore and an amount of Rs 1,930 crore has been paid for 97,227 claims.

Source : PIB

NFT Explained

Charmie Parekh

Artists need a platform to showcase their piece of art and to monetise it in order to earn a living, and to ensure the protection of the source, the ownership, the copyright, and its future value. With the invention of Non-Fungible Token (NFT), a technology that allows creators and artists to bypass the intermediary altogether, decentralisation allows artists and creators to gain control— not just over the financial value of their artworks but also over the ownership and copyright of the same. It all started with a set of 10,000 randomly generated pixelated images that proved the demand for digital ownership of non-physical objects and collectibles in 2017, and the market has been evolving rapidly ever since.

Great artists focus their energies on one thing: creating their next masterpieces. Musicians and composers spend months in search of the perfect lyrics or melodies. Architects ensure the minutest of details in their building plans. But the artists have to find a way— a platform to showcase their piece of art and to monetise it in order to earn a living, and to ensure the protection of the source, the ownership, the copyright, and its future value. This is where the intermediaries like art galleries, music labels, concert promoters, etc., come in, where on one hand they market the skills of the artists and on the other, help them monetise their artwork for a healthy cut of profits— sometimes even ownership of the artist's work.

Over a period of time, the intermediaries have become powerful, wealthy, and yet not very successful in protecting the provenance and copyright of the artworks that were the result of painstaking work of the artists.

With the invention of NFT, a technology that allows creators and artists to bypass the intermediary altogether, decentralisation has taken place and has allowed artists and creators to gain control— not just over the financial value of their artworks but also over the ownership and copyright of the same.

As the NFTs are dealt with in cryptocurrency jargons, scaring off non-techies, they are not understood properly and still not talked about or considered mainstream, due to, first, the fear of the unknown— popular publications' inability to accept an ever-evolving technology as an important one, lack of knowledge thereof, mainly due to the jargons associated with the technology, second, the fear of failure— as the NFTs are based on the decentralised cryptocurrencies where the control does not remain with any financial institution constituted by Government but is purely driven by market forces and volition of the 'people' (or computers connected in a Blockchain Network) and the last bubble burst of Bitcoin witnessed in the years 2017-18, the scepticism prevails in accepting any technology or platform dealing entirely in cryptocurrencies.

What is an NFT?

At a first glance, NFT does sound complex and difficult to comprehend, but it is relatively simple. The NFT stands for Non Fungible Token, and to understand it better, let us quickly break down these words.

First of all, Token: Here, Token can be anything— a piece of art, a musical melody, a video, a game, or even a physical object. There are many things which can be and have been converted into Tokens, e.g. Concert Tickets. These tokens are mostly PNG images, animated images (GIF), MP4 Audio tracks, or videos. So a question naturally

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The author is CEO, Silvassa Smart City, UT Administration of Dadra and Nagar Haveli and Daman and Diu.
Email: charmie.k.parekh@gmail.com

arises is, how is an image on the internet different from an NFT? And the answer is that, an image becomes an NFT when it is stored on an online network of computers called Blockchain, and a unique serial number is assigned each time a Token is placed on the Blockchain Network. Each NFT has its unique serial number and that also makes the Token Non-Fungible.

The next word, Fungible means that in simple language, if an object can be replaced by another object, it is called Fungible. E.g. one Rs 500 note can be replaced by another Rs 500 note. Its value is not going to change even after the replacement. Therefore, it is a Fungible object. On the other hand, something having a value of personalised or unique nature that cannot be replaced by another object makes it a Non-Fungible object. Imagine your cellphone having scratches on the front screen, when sold online will be unique and will have a completely different value than any other cellphone of the same model being sold by another person. A celebrity's laptop will probably have more worth than someone else's, even if it's the same model and brand. Similarly, one NFT cannot be replaced by another NFT, because even if it is the same image, each copy of this image has its unique serial number and therefore, has its own value, making it unique.

Combining these words, a Non-Fungible Token can therefore be described as an object having a unique serial number, stored on the Blockchain Network.

Why choose NFTs?

The question that naturally arises is, why buy/sell NFT when you already have these objects like image artworks, music tracks, MP4 videos existing on the internet and/or with the intermediaries like art galleries, music labels, streaming platforms? To answer this: All artists and creators can now easily display and monetise their work. Artists can sell their work directly as an NFT to a consumer and make a profit, this leads to less dependence on traditional art galleries and auctions. Royalties can be included, which means that each time their NFT is sold, the artist can receive a certain percentage of the price at which the consumer decides to resell it. Royalties are paid to the original artist each time the NFT moves from consumer to consumer. If their art were sold in the traditional way, the revenue from secondary sales would not occur, making NFTs particularly beneficial to creators. NFTs ensure ownership of a digital object, thanks to the Blockchain.

There are more benefits of NFTs. To name a few important ones: Firstly, each NFT is unique, the only one of its kind. It is impossible to create another NFT with the same serial number. Everything is verified by the blockchain and can be seen by everyone. Not only that, but the owner of that Token on the

Blockchain will have full commercial copyright to use that image and asset. Secondly, because they are unique and cannot be copied, they are scarce. Most of the time, there are very few NFTs from an artist or seller. Therefore, you can safely assume that you will be one of the few people in the world to own a collectible that can then be resold. Thirdly, no one can change the metadata of the token, no one can delete your image or the name of the token. This means that it will never change, it will never be deleted, it cannot be removed from the blockchain, hence making it immutable. Apart from these benefits, NFTs are collectible, downloadable, permeant, and resalable. In short, NFTs certainly have more value than one would assume at first glance.

How do NFTs Work?

These NFTs are bought and sold using cryptocurrencies like Bitcoin, Ethereum, XRP, Dogecoin, Apecoin, Binance coin, WRX, etc. The first digital cryptocurrency that tops the list is certainly Bitcoin. The second most popular cryptocurrency is Ethereum and it has its own Blockchain Network, enabling the NFT sale and purchase. Opensea is the first, largest, and internationally popular platform for selling crypto goods including NFTs. In India, WazirX is a popular cryptocurrency exchange which also has its own cryptocurrency called WRX.

But one might ask if NFT itself is a unique token, why is there a requirement of cryptocurrency for buying an NFT? Isn't NFT one kind of cryptocurrency? The answer is No, and here's why. Cryptocurrencies are fungible. One Bitcoin can be replaced by another Bitcoin and the value will be the same. Just the way one Rs 500 can be replaced by another Rs 500 note. On the other hand, each NFT is different from another NFT because it is unique, having a unique serial number on the Blockchain Network. Therefore, each NFT is one of a kind and can have a completely different value.

NFTs and its Categories

The most popular category in the present day is the category of visual art as NFTs: The community of creators, developers, artists, and merchants have started pushing their art into the new territory of NFTs. As discussed earlier, each NFT has a unique serial number as an identifier and this allows the visual art to be recognisable in its uniqueness, cannot be copied, and therefore, the creators have control over their artworks saving them from plagiarism. It all started with CryptoPunks, a set of 10,000 randomly generated pixelated images that proved the demand for digital ownership of non-physical objects and collectibles in 2017, and the market has been evolving rapidly ever since.

> **NFTs are based on the decentralised cryptocurrencies where the control does not remain with any financial institution constituted by Government but is purely driven by market forces and volition of the 'people' (or computers connected in a Blockchain Network).**

Music as a category of NFTs is steadily evolving. Many artists are taking advantage of the NFT opportunity by offering their audiences limited edition unreleased tracks. The benefit of offering Music as NFTs is that the intermediaries like Music Label companies have been removed from the equation, offering the chance for the artist to sell their products directly to the audience, while getting closer to their community.

NFTs are becoming increasingly popular in the Domain Name business also. Crypto domains are Blockchain addresses that allow, among other things, to receive payments in cryptocurrencies. It is similar to the late 1990s' '.com' web craze. Buyers have started purchasing Blockchain Domain names which are being sold as NFTs which typically end with '.eth' or '.crypto'. Blockchain developers, speculators, and NFT traders have already purchased Blockchain Domain names of important global brands. It remains to be seen how much such brands are willing to pay to buy back their domain name.

Another popular category of NFTs is Metaverse. It is a virtual world powered by the Blockchain where users can create and trade digital assets, play games, buy plots of land, display art in galleries, etc. Metaverse has as many utilities as far as the imagination can reach. Recently, Facebook has renamed the company name to 'Meta' to affirm its ambitions to become a major player in this category by presenting its Metaverse project. Popular singer Daler Mehndi made headlines when he bought land in the metaverse and named it 'Balle Balle Land'.

When all categories of entertainment and utility are entering into NFT space, Sports cannot be left behind. Sports brands have some of the most valuable intellectual property in the world. Sports teams and related companies have made headway into the NFT world and have started selling items to their millions of fans. The Lille Football Club has released an NFT collection that represents their four French Championship titles. On the NBA Top Shot platform, video excerpts of basketball games, although accessible to all on YouTube, are traded at a premium. The secret is that they are sold with a certificate of authenticity, thanks to NFTs.

A similar category to Sports is the Events, as with the adoption of NFTs in the Event industry like Concerts, Cinema, Theatre, museums, etc., it is only a logical step that the tickets to access stadiums would be sold via NFTs in the near future.

Collectibles can be described as yet another category of NFTs. Some of the popular examples include the Bored Ape Yacht Club, Cool Cats and CryptoPunks collections. Recently, the Prime Minister of India gave away Blockchain-based digital degrees at IIT, Kanpur. They are

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nothing but NFTs, which are unique and hence, unforgeable.

Building a Community around NFTs is yet another category. Tourism-related brands like Zostel have launched their NFTs in order to have a close community of travellers and backpackers being provided exclusive benefits upon purchase of their NFTs.

One might ask that all the benefits and features of NFTs are fine and NFTs might benefit artists and creators, but how does it affect a layman in day-to-day life? To elaborate on this, let's go back to the times when Twitter was put in the public domain. Twitter founder and CEO Jack Dorsey tweeted the first tweet on the microblogging platform in 2006, a short text that said "just setting up my twttr." While the tweet will continue to exist on Twitter, it has been sold as an NFT to Sina Estavi, CEO of Bridge Oracle, for USD 2.9 million. Estavi would get the NFT as "signed and verified by the creator." The USD 2.9 million raised was then donated to charity which specialises in providing financial resources to the poor and its Covid relief programmes in Africa. To sum it up, people have always been collecting different objects in various formats, from World War weapons to sneakers to 1st generation iPhones. So, it should come as no surprise that there is a market for collectibles in digital form. Not only that, this digital form not only provides and ensures uniqueness, authenticity, and immutability, but it also benefits the creators (the seller) and the collectors (the buyers) in numerous ways.

Way Forward

While the benefits of using NFTs are ample and the real-life use-cases are on the rise day by day, understanding the jargons around this technology would only benefit one to adapt to the remarkable shift that is taking place all over the world in terms of how existing currency and financial systems are looked at, how art is perceived and how parallel universes are being set up where people buy and sell pieces of land.

However, if we have to talk about its future, the beauty of the NFTs is that their future isn't chiseled in stone. Nobody knows what will become the most prominent use of NFTs. The risk-takers are writing the future of NFTs—trying radical applications and taking NFTs to places we hadn't thought of. But one can safely say that the sky is the only limit for NFTs, or the sky exists in the Metaverse. The NFT-fication of everything will take place in the years to come and anyone can participate. The future of NFTs is being written as we speak. ❑

Endnotes

1. The Ultimate Guide: All there is to know about NFTs
2. The NFTs handbook by Matt Fortnow, QuHarrison Terry
3. Newspaper Articles

Tech-Innovation in Banking

Manjula Wadhwa

The banking sector is rapidly adopting new emerging technologies to draw the customers to park their wealth in attractive bank products and schemes. Latest technologies like Artificial Intelligence, Big Data, Deep Machine Learning, and Robotics are being used to understand the customers and their needs better. Established 252 years ago, banking system in India has left its traditional way of functioning far behind and has emerged in a new avatar with the advent of new technologies.

A decade ago, Indian banks mostly followed global banks in terms of innovation, but today the whole scenario has changed. Nowadays, in the Indian banking sector, one agenda which is regularly discussed in the meetings of the 'State Level Bankers' Committee' (SLBC) of all the States is how to provide banking services to the general public in a time-bound, coordinated and efficient manner, and through the latest technologies. Due to these coordinated efforts, digitisation in the Indian banking sector has started taking place at a faster pace. The UPI-based remittance and Aadhaar Enabled Payment System (AEPS) in India are far ahead of the technologies adopted in many western countries. Taking a step further, banks in India today are actively engaged in finding blockchain-based solutions for international remittances, syndicated loans, KYC, etc.

Digital Transformation: Key Milestones

Banking system in India, established 252 years ago, has left its traditional way of functioning far behind and emerged in a new avatar with the advent of new technologies. Long queues at the bank are a thing of the past; people carry their banks in their pockets and can electronically transfer the money in minutes. Overall, technology in the banking sector has made citizens self-reliant.

After the nationalisation of banks in 1969 and particularly after the liberalisation in 1991, the era of competition and providing the best facilities to the customers started in the banking sector. Along with this, the journey of the internet began. Although it was being used less frequently, the possibility of using the internet on a global scale was seen to be of great help in advancing the banking sector. Even though the first business ATM in the world began operational in 1969 in the US; HSBC, the first private sector foreign bank in India, opened the first ATM in Mumbai in 1987. While ICICI became the first bank to introduce internet banking in India, the public sector bank, the Central Bank of India, was the first to offer a credit card facility in India.

DIGITAL BANKS

The author is Deputy General Manager, NABARD. Email: manjula.jaipur@gmail.com

Ease of Transactions

Earlier, a lot of time used to be wasted on withdrawal and sending money. ATMs, Internet Banking, and Credit Cards have made it so easy now. There was a time when bank unions used to go on strike on the pretext of using computers in the banking system, while today, most of the Indian banks provide all banking facilities to their customers on mobile phones. When technology breezed in, paperless banking caught on, and today the situation is that Electronic Funds Transfer (EFT) has overtaken paper-based fund transfer. Data available from the Ministry of Electronics and IT shows that in comparison to digital transactions of Rs 5554 crore in 2020-21, banking transactions worth Rs 7422 crore were done through digital mediums during 2021-22.

In recent years, several steps have been taken by the Government of India to use banking technology to simplify the banking system. The Government's ambitious Digital India Mission and Payment System laid the digital economy's foundation. While Rupay, Kisan Credit Card enabled farmers to engage in cashless transactions, General Credit Card enabled people involved in occupations other than farming. Since its inception, NABARD, the country's apex agriculture and rural development bank, has provided financial support to enable cooperative and regional rural banks to issue EVM chip-based Kisan cards. There is a need to establish a system in rural India so that farmers can use these cards not only for cash withdrawal but for most digital transactions; hence NABARD is regularly giving grants to the regional rural banks and cooperative banks to make available Point of Sale Terminals (PoS) in villages across India.

AEPS is crucial in the financial inclusion of people not covered by formal banking. A financial incentive of 0.5% of the transaction amount and a maximum of Rs 10 per transaction to promote Aadhaar enabled PoS transactions upto Rs 2000 is also provided to encourage digital transactions. The Direct Benefit Transfer System (DBT), introduced in January 2013 to directly transfer the benefits of the social security schemes to the accounts of the general public without any financial leakage, is also

> The Direct Benefit Transfer System (DBT), introduced in January 2013 to directly transfer the benefits of the social security schemes to the accounts of the general public without any financial leakage, is also proving to be very effective. Another significant step was the establishment of a Payments Bank by the Reserve Bank of India, which aimed to increase the access of small traders, low-income families, migrant workers, etc., to payments, remittances and other financial services through secure methods using technology.

proving to be very effective. Another significant step was the establishment of a Payments Bank by the Reserve Bank of India, which aimed to increase the access of small traders, low-income families, migrant workers, etc., to payments, remittances and other financial services through secure methods using technology. In Green Channel Banking, you only have to enter the account number where you want to transfer money, and the amount in the swipe machine. At your end, you deposit cash in the bank, and the money gets deposited in the particular account there.

ATMs: In the beginning, only money could be withdrawn from ATM, but now money can also be sent to anyone's account through ATM. Also, many banks have started the facility of deposit through ATMs; only the account of the sender and the receiver should be in the same bank.

From Banking Correspondent to Mobile Banking: Banking Correspondents are important for unskilled workers, labourers, and less educated people in rural and urban areas. They help people in several ways, including depositing or remitting money and opening an account. A banking correspondent can also be a grocery store or other retail outlet in the neighbourhood. With new technology and increasing competition, tech-savvy people have easily shifted to their mobile phones for banking purposes, and banks are constantly upgrading their technology to make it more convenient.

New Mobile Banking Apps: Banks have launched different iOS and Android phone Apps. Using Mobile Banking, one can do everything– funds transfer, getting the bank statements, mobile recharge, and train or hotel booking directly through the bank's App.

NEFT-RTGS: National Electronic Funds Transfer (NEFT) and Real Time Gross Settlement (RTGS) are the facilities with the help of which individuals, companies, and firms can easily transfer money from one bank to another. Many banks in India operate as banking agents for international money transfers that can now also be transferred on mobile.

National Automated Clearing House (NACH): Launched in December 2012, the National Payments Corporation of India (NPCI) runs this service. This

service also plays an important role in data management, along with transparency and security.

Core Banking Solution (CBS): Today, the facility of Core Banking Solution is being provided all over the country by commercial banks and cooperative banks. As a result, anytime, anywhere, banking has made life easier. This trend points towards the fact that these digital solutions are gaining momentum as mobile banking customers increase.

Though the cutting-edge and innovative banking, technologies are still in experimental stages, customers over the next five years, will be able to get new banking experiences through voice, gesture, virtual reality, augmented reality, movement of the eyeball, finger-based payment, interactive holographic mannequins, etc.

New-Age Innovation

Robotic Process Automation: With the rapid growth of the digital economy, the amount of unstructured data processed by banks is increasing. It is not just banking transaction data but also behavioural data which banks can adopt to guide their customers to a new world of innovation. By combining various technologies that enable cognitive and robotic processes, bankers can make quick, large-scale, and quality decisions by predicting customers' actions. Smart Virtual Assistants are helping customers by handling banking transactions and providing relevant information. Robotic process automation uses bots to do repetitive tasks without human intervention in a more efficient manner.

Data Analytics: Today, banks are meeting customers' needs faster by analysing their business data. Technology and digitisation have enabled the banking sector to make informed decisions with actionable insights in real time, face market competition, understand future launchable products and ensure customers' satisfaction.

API Platform: Today, through the API Platform, banks are engaging with Fintech, which allows them to become a platform on which customers and third-party service providers can connect to deliver a flexible and personalised experience to the end-user. API Banking Platform is designed to work through Application Programming Interface, which is a software intermediary that allows two applications to talk to each other. They allow banks to adopt entirely new business models and use new technologies such as blockchain at a lower cost. APIs also help banks to make their systems future-proof.

Cyber Security: The banking industry deals with sensitive and personal information, so cybercriminals are in ambush for such information. With the increasing use of technology in banking, cyber risks are also rising. Banks are becoming more alert concerning cyber security. They are gradually implementing advanced, analytical, real-time monitoring and biometrics, and behaviour analysis software to detect threats and prevent them from disrupting systems. They are also using anti-hacking tools that provide network-level security.

Cloud Computing: Cloud Computing is another technological advancement revolutionising the banking sector. Cloud is an important tool of the service delivery model and enables banks to find new business opportunities and access new distribution channels. By leveraging cloud-based services, banks, while ensuring the security of customer data, can reduce data storage costs by saving on capital and operating expenses. Cloud computing also promotes secure online payments, digital money transfers, wallet payments, etc.

Biometrics: Companies are inventing new payment systems due to a gradual decline in dependence on cash. Customers can pay within seconds by simply verifying their identity through their fingers or face.

Chatbots: As voice-based interactions with customers continue to grow, banks are rolling out new financial chatbots that save up to 4 minutes per transaction. Banks are also getting feedback from customers immediately and at a nominal cost.

Wearable Smartwatch: These give customers a unique digital payment experience. A rapid rise in their usage amongst the Millennial and Gen-Z generation will surely revolutionise the digital payments arena.

Zero-Trust Security Model: Banks and customers are losing their trust in the old IT models. The zero-trust security model is the way to deal with the growing cyber risk. It ensures strict adherence to the user and device authentication across the network without relying on implied trust.

The Way Forward

Considering the importance of digitisation as the need of the hour, especially in the pandemic era, all Indian banks, government or private, are now focusing on the digitisation of loan products after the digitisation of payments systems. The country's Central Bank, RBI, has also set up a Fintech Department with effect from 4 January 2022, which along with promoting innovation in our banking sector, will focus on the challenges and opportunities which keep coming in the banking sector through technology every now and then, and this department will continue to engage in research to find their solutions. ❑

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Accessible Healthcare to All

Dr R S Sharma

Conceived with the idea of making quality healthcare accessible to the most deprived and vulnerable sections of India's population, Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY) is a bold and transformative resolve to change the healthcare paradigm of India. The Scheme promises its beneficiaries an equitable and affordable access to quality healthcare services without the need to worry about the financial implications arising out of it. The idea was not a new one. However, what is different this time is that the Scheme rests upon evidence-based policy making, agile scheme implementation and harnesses technology to drive innovation in healthcare service delivery.

Ayushman Bharat Pradhan Mantri Jan Arogya Yojana enshrines to accelerate India's march toward achieving Universal Health Coverage (UHC) as listed in The National Health Policy (NHP) of 2017.

AB PM-JAY is not India's first tryst with healthcare insurance. Due credit must be given to predecessor schemes such as Rashtriya Swasthya Bima Yojana (RSBY), States schemes like Aarogyasri in Andhra Pradesh, Rajiv Gandhi Jeevandayee Arogya Yojana (RGJAY) in Maharashtra. However, in terms of scope and scale, AB PM-JAY simply dwarfed all existing healthcare insurance interventions. It is for the first time that we now have a health insurance scheme with a pan-India presence being implemented almost everywhere in the country.

As of 1 April 2022, Ayushman Bharat PM-JAY in alliance with State health schemes covers a beneficiary base of more than 14 crore families (70 crore individuals). Almost 18 crore individuals have been identified under the Scheme and been provided with an Ayushman card. AB PM-JAY has facilitated almost 3.28 crore hospitalisations, providing treatment worth over Rs 37,600 crores. All this has been achieved in a little over 3.5 years and amidst the greatest global pandemic in recent times.

As I reflect on the trajectory of Ayushman Bharat PM-JAY, the Scheme's success is mounted on the vision of the Prime Minister of India and the versatile policy framework conceptualised by the Cabinet. This policy framework crystallised the guiding principles behind Ayushman Bharat PM-JAY which are as follows:

Comprehensive Healthcare Benefits

AB PM-JAY was launched with 1,393 treatment packages covering treatment for various medical specialties like oncology, neurosurgery, cardiovascular surgery, etc., upto Rs 5 Lakhs per beneficiary family. Over multiple package revisions, this was subsequently increased to 1,670 treatment packages. The benefits package under AB PM-JAY was comprehensive, covering pre and post hospitalisation expenses. Additionally, all pre-existing
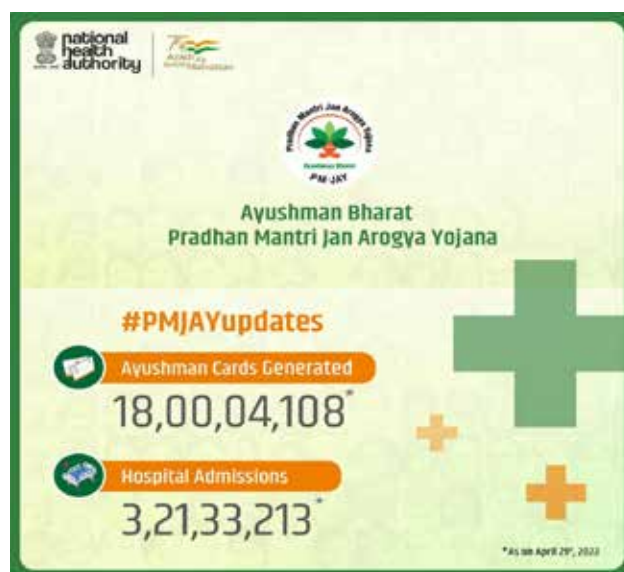
The author is the CEO, National Health Authority (NHA). Email: rssharma3@gov.in

conditions were covered from the first day of the policy period. This ensured that beneficiaries could avail treatment under AB PM-JAY without worrying about co-payments or exclusions. The health benefits package was also made portable across the country, empowering beneficiaries from the remotest villages in India to seek treatment at the most advanced healthcare facilities in cities such as New Delhi, Mumbai, Chennai, and Bengaluru.

Convergence & Integration

AB PM-JAY was never about reinventing the wheel. It was about learning from past experiences and making well-adjusted changes to the current scheme construct. One of the key insights that emerged from stakeholder consultations was about forging stronger partnerships with the States.

Accordingly, under AB PM-JAY, considerable flexibility was provided to the States and Union Territories in choosing their mode of implementation, beneficiary database, and creating the network of hospitals. Further, National Health Authority (NHA) diligently pursued convergence with the existing State-based schemes. Currently, AB PM-JAY is implemented in alliance with more than 25 State-specific health schemes. This has ensured that the Scheme is operationalised in a manner best suited to the local context.

State Governments were encouraged to set up State Health Agencies (SHAs) for better oversight of the Scheme at the State level. Additionally, District Implementation Units (DIUs) were set up in over 600 districts across the country. This ensured that the administrative reach of AB PM-JAY extended to the beneficiary's doorstep.

Ensuring Equity in Access to Healthcare Services

Under AB PM-JAY, the renewed impetus has been given to extending the Scheme benefits to the marginalised sections of society covered under the Socio-Economic Caste Census database. Likewise, the Scheme has adopted an enlightened approach towards ensuring gender-specific equity. The erstwhile RSBY Scheme had mandated a limit

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of adding up to 5 family members. Unfortunately, this led to the exclusion of female members of the household, especially the girl child. However, under AB PM-JAY, this capping was done away with. It's a matter of great pride for me to say that gender parity has been achieved under AB PM-JAY. Women account for approximately 50% of Ayushman cards generated using the NHA IT platform and 47% of authorised hospital admissions.

Robust, Scalable, and Inter-operable Technology Platforms

One of the problems that afflicted in the past was fragmented IT systems for the schemes like AB PM-JAY. This led to a lack of visibility into the last-mile implementation of the Scheme and created fertile ground for irregularities and fraud. Therefore, under AB PM-JAY, a highly versatile technology platform was developed to aid in beneficiary identification, transaction management, and hospital empanelment. This award-winning IT platform is now active across 26 States and UTs. As a result, SHAs and NHA have gained granular insights into the Scheme to aid in evidence-based policymaking and necessary course correction, where required.

Furthermore, NHA also leveraged technology to institute robust anti-fraud protocols. A National Anti-Fraud Unit (NAFU) was set up with institutional support from the multi-lateral development community. This enabled NHA and the SHAs to address fraud and address beneficiary grievances.

Public and Private Partnership

Under AB PM-JAY, both public and private hospitals have been empanelled for providing healthcare services to the Scheme beneficiaries. The participation of the private sector has increased avenues for the Scheme's beneficiaries to seek treatment and concurrently reduced the burden on tertiary care facilities in the public sector. At the same time, public sector hospitals also stood to benefit from the Scheme. Under AB PM-JAY, it was ensured that public hospitals would be equally reimbursed for their services and at the same rates as that of private hospitals. This delineation of the Government's role as provider and purchaser of healthcare services has allowed for the monetisation of healthcare services that were hitherto provided free-of-cost. This has supported public sector hospitals to create a pool of untied funds that could be sustainably invested in infrastructure and human resources. The complementary role of the public and private sector hospitals has been vital in ensuring that the Scheme implementation proceeds seamlessly.

In order to make AB PM-JAY more accommodative for different types of stakeholders, the following policy adoptions are being processed for implementing radical policy changes:

Health Benefit Packages 2022

Since the inception of the AB PM-JAY Scheme, NHA has made several changes in the constituents and prices of its Health Benefit Packages (HBP). There has been a transition from HBP 1.0 (September 2018) to HBP 2.0 (November 2019), HBP 2.1 (November 2020), and HBP 2.2 (November 2021). Recently, the HBP master has been reviewed and revised and therefore, HBP 2022 was launched.

The rationalisation exercise for revision to 'HBP 2022' comprised of an extensive review of current Scheme performance in terms of its utilisation and related issues, consideration of cost evidence to determine the variation in cost and price, an exhaustive consultation with expert committees in different specialties, inputs from State Health Agencies, hospital associations, and other stakeholders.

The new version has added 365 new procedures taking the total package count to 1949 and also has included high-end procedures like Bone marrow transplant, Cochlear implant surgery, and several Interventional Radiology procedures. The revised package has a new specialty of Palliative care also added in addition to rationalising the existing procedure rates. With HBP 2022, differential pricing is being introduced for the first time under the Scheme, based upon the type of city and level of care.

International Classification of Diseases (ICD-11)

AB PM-JAY has recently completed three years, and NHA as part of a new initiative has taken steps to strengthen patient classification and provider payment systems through ICD-11 (International Classification of Diseases)/ICHI (International Classification of Health Intervention) for AB PM-JAY Scheme using DRG (Diagnosis Related Groups).

A lot of work has already been initiated and a detailed plan has been developed. Experiences from other countries and health systems will always help us shorten our learning curve.

The ICD-11 costing tool is easy to use. The smart search option of ICD tooling with phonetic or spelling errors, unspecified and other specified diagnosis

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is an incredibly helpful endeavour. ICD-11 & ICHI tooling infrastructure along with the three specific modules have been prepared for each cluster to do the coding exercises, which include the first two modules for easy and straightforward coding exercises and module#3 for more typical and multiple diagnosis-based problems to solve. The coding platform provides more options for post-coordination and laterality.

This IT integration will have the standardisation of Scheme nomenclature as per international standards. AB PM-JAY Scheme has the country's largest data on health insurance/assurance sector, hence this will help in rich data mining and useful policy insights, which lead to evidence-based decision making. Key challenges will also include coding accuracy and compliance.

Diagnostic Related Groups (DRGs)

AB PM-JAY is the first insurance Scheme in India and amongst the first few in the world to implement a provider payment mechanism through Diagnosis Related Grouping (DRG). The DRG system entails that the hospital gets paid based on the admitted patient's diagnosis and prognosis, rather than paying on the basis of booked HBP. This will address today's hospital concerns that package costs do not address/incorporate complications and co-morbidities. For example, if a hospital can treat a patient while spending less money than the DRG payment for that illness, the hospital makes a profit. If, while treating the hospitalised patient, the hospital spends more money than the DRG payment, the hospital will lose money on that patient's hospitalisation. This is meant to control healthcare costs by encouraging the efficient care of hospitalised patients.

With DRG implementation, packages would not be selected by hospitals but instead assigned by a grouping algorithm using patients' underlying diagnosis and procedures which will be beneficial in many ways like increased objectivity, greater transparency, and workload reduction for pre-authorisations. It may create more incentives for increasing quality by providing the 'right' care in terms of length of stay, consumables, and number of tests/procedures. DRG can thus contribute to the empanelment of certain specialties like burns, trauma, etc., which at present, hospitals do not want to cater to, due to low payments or multiple specialty approaches.

Adoption of Diagnostic Related Groups under AB PM-JAY will reduce
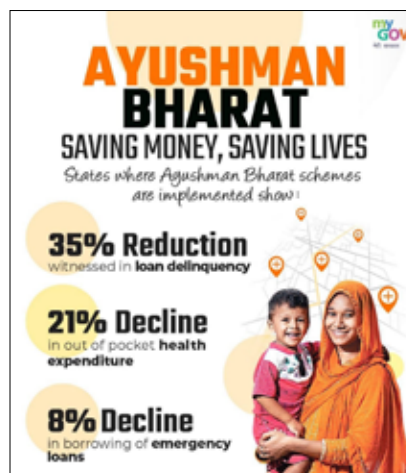
the abuse of certain specialties and packages based on high volume, high costs, and large variation by making hospital-friendly grouping. DRG will also reflect various nuances related to the patient's healthcare needs, including the severity of the condition, the prognosis, how difficult or intensive the treatment is, and the resources necessary to treat the patient.

The most important part of assigning a DRG is getting the correct primary diagnosis and this is where implementation of ICD/ICHI will play a pivotal role. DRGs support the rational use of hospital care as an effective way to achieve a balanced health service system and will be associated with quality assurance mechanisms.

Aapke Dwar Ayushman

Sustained beneficiary identification drives are necessary to improve the saturation of Ayushman cards and thereby increase awareness of the Scheme. Furthermore, there is a positive correlation between Ayushman cards generated and the demand for healthcare services under the Scheme. As a result, one of the key activities that I green-lighted upon assuming charge of NHA was the 'Aapke Dwar Ayushman'.

Under Aapke Dwar Ayushman, a grassroots network of frontline healthcare workers, Gram Panchayat officials, and village-based digital entrepreneurs were used to undertake door-to-door mobilisation of beneficiaries across communities. Special night camps were set up for daily wagers. These efforts translated into the creation of more than 4.7 crores Ayushman Cards since January 2021, an increase of 55% in the Ayushman cards generated by the NHA IT system. Aapke Dwar Ayushman, therefore, gave a big fillip to beneficiary identification activities under AB PM-JAY. NHA is launching Aapke Dwar Ayushman with renewed vigour. This time, we are focusing on States such as Assam, Bihar, Gujarat, and Uttar Pradesh.

Besides, credit goes to the entire Ayushman Bharat PM-JAY ecosystem consisting of NHA, SHAs, DIUs, Implementation support agencies, Pradhan Mantri Arogya Mitras, frontline healthcare workers, Ayushman Card creators from partner agencies such as CSC/UTIITSL for their tireless support in making AB PM-JAY such a grand success. However, moving forward much more needs to be done to help the Scheme realise its full potential.

To conclude, AB PM-JAY is a path-breaking intervention to address healthcare delivery holistically. I believe it has the potential to catapult India into the top countries of the world in terms of healthcare that's built on the 3As of Accessibility, Affordability, and Availability. The road ahead perhaps may seem long and not easy. But I believe that difficult roads often lead to beautiful destinations and with our collective efforts and hard work, we can help Ayushman Bharat Scheme touch and save more lives and ensure that no one's health is disregarded. ❑

DO YOU KNOW?　　　　　　**INTERNATIONAL DAY OF YOGA 2022** 🧘

Moorhen Yoga Mats

Handwoven Moorhen Yoga Mats is an initiative by the Indigenous Fishing Community using Natural Materials from Deepor Beel Wetland. The Moorhen Yoga Mat is named after Kam Sorai (Purple moorhen, a resident bird of Deepor Beel Wildlife Sanctuary). These mats are produced led by women from the fishing community, living on the fringe of the Sanctuary, whose families are directly dependent on the wetland for their survival. They have trained themselves in fibre processing and making products out of the natural materials like water hyacinth present within their ecosystem.

During the pandemic, a few women shared their learnings through 'free to all' training programme with other women in their community, so that livelihood is made possible for others. North East Centre for Technology Application and Reach (NECTAR), an autonomous body under the Department of Science & Technology (DST), Govt. of India took an innovative initiative to involve the entire women community associated with the Project to create wealth from water hyacinth plants, which are generally considered as a nuisance to the ecosystem and waste, therefore unwanted.

Their idea is based on 3 Rs: Right, Revolution and Relationship. Today, 38 women from 3 fringe villages work six days a week to produce Yoga Mats.

Considering all aspects of water hyacinth's behavioural properties and the functional requirements of a product like a mat, a hand-woven, 100% biodegradable, and 100% compostable mat to be used for doing Yoga was ideated as a means of providing multiple ecological and social benefits such as improvement of the aquatic ecosystem of the wetland through the removal of water hyacinth, sustainable production of utility products with community engagement and generation of livelihood for indigenous communities to become completely 'Atmanirbhar'. These Yoga Mats have been developed with technological support, under the theme 'Waste to Wealth'. ❑

Advancements in Medicine

Jayanthi Rangarajan

'Medicine is not merely a science but an art too'. This is a famous adage we owe to Paracelsus, a 16th century Alchemist turned Physician. Technology, the third dimension, has steadily been incorporated and has fortified medicine as it is practised today. Health or medical technology is defined by the WHO as the 'application of organised knowledge and skills in the form of devices, medicines, vaccines, procedures, and systems developed to solve a health problem and improve quality of lives.'

Medical technology can save lives, improve the health conditions of individuals and communities and contribute to sustainable healthcare. 'It is said that the best way to predict the future is to invent it.' The past has invented the present, the present is endeavouring to invent the future. Any futuristic technology should be people-centric, for the sake of humanity and its well-being.

Medical technology has grown by galactic leaps ever since the first invention of a wooden tube by René Laennec, which is the primitive form of the now-familiar stethoscope to amazing adoptions of high-end technology such as Artificial Intelligence (AI), Robotics, 3D printing, Data Science, etc., in almost all the specialties of the medical field.

Augmented, Virtual and Mixed reality are all technologies which find application in not only diagnostics and therapeutics but also in imparting medical education, thereby making the learning of medicine— fascinating and lively. While AR helps the end-user to have augmented visualisation of the real world, VR shuts out reality and provides wholesome simulation. AR finds its application in operation theatres and helps the surgeons to get better visual projections of vital life-saving operating fields. VR can be applied to create simulated environments in treatment protocols in specialties like Psychiatry. Mixed reality on the other hand offers cutting-edge technology in medical education tools. Most of the modern education facilities are equipped with 3D image learning.

An exciting development of New Age Medical technology is the brain implants which create a brain-computer interface wherein 'a smart chip' implanted in the human body can provide a nearly total functional replacement of any lost brain function. (e.g. Retinal and Cochlear implants are already in the market). The futuristic models are brain implant therapies for patients paralysed by spinal cord injury or stroke.

Cybernetic organisms (Cyborgs) are the leap forward in medical technology, not only in repairing and replacing the lost function but also in enhancing the existing ones. It will create Mini Super Human Powers in selective sensory functions like vision, and hearing (hearing aids powered with AI). Memory chips with astronomical memory capacity can revolutionise human cognitive abilities. 3D prints applied in medicine can be used to design anything from a tablet or a capsule in desired shape and size to implants, stents, and prosthetics. The 3D-printed forms ensure superior quality, functionality, and aesthetics.

These give a wider viewpoint of futuristic technology in medicine. Let us look at certain specialised fields of medicine with a focused perspective.

Nuclear Medicine

India is a global leader in the medical field— as a knowledge and technological hub in recent times. Dedicated scientists from institutions like the Bhabha Atomic Research Centre (BARC) and the Institute of Nuclear Medicine and Allied Sciences (INMAS) etc., are actively inventing novel radioactive medications that can

The author is the Dean, Technology and Medicine, Tamil Nadu Government Super Speciality Hospital, Chennai.
Email: rjayanthi363@gmail.com

become a game-changer in the future practice of clinical medicine.

The human body contains about 20,000 molecules only. Diseases happen whenever there is a random discord amongst them. In Nuclear Medicine, we directly visualise, measure, and modify these by administering tracer quantities of medications that emit electromagnetic or particulate radiations, long before they can get clinically manifested as physical disabilities and diseases. We can save considerable time and resources involved in diagnosing and treating several dreadful diseases.

In addition to the conventional radioligands, we now make novel tracers tagged with 225Actinium, 177Lutetium, 131Iodine, 106Ruthenium, 99mTechnetium, 90Yttrium and 68Gallium for diagnosis and treatment in our country. AI enables us to reach large volumes of the population with greater precision, handle large volumes of data and deliver personalised medicine.

Although enormous efforts are being made by these scientific institutions to reach the primary care physicians and the patients, much needs to be done by decision-makers to translate the real benefits from bench to bedside.

Orthopedics and Physical Medicine

New-age technologies have the potential to find solutions for complicated scenarios faced by surgeons. 3D printing has revolutionised treatment in patients with bone loss due to severe trauma, tumours, infections, etc., by producing porous-coated customised implants that help in limb salvage, thereby preventing amputations in several such cases. 3D printing can also produce specialised polymer wears to aid people with neurologic illness. Bionic limbs, developed with cutting-edge technologies could give a new lease of life to patients with amputations by giving them functional limbs.

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Genomic sequencing can lead to early tumour detection, identifying implant-associated infections, and specific targeted treatment. AI/Machine Learning has given a deep insight into predicting success/major complications with mathematical models. These can predict the patients who are at risk for further revisions and help in patient counselling. Robotic surgery has induced perfection in the positioning of implants in complex arthroplasties that has largely helped in longevity. Advanced antimicrobial nanotechnologies are poised to treat resistant orthopedic infections more effectively.

Critical Care Medicine

Critical care medicine is one of the dynamic fields with rapid advances, constant transformation by novel technologies, integration of AI support systems with algorithms to detect patient symptoms, and guide treatment with excellent operationalisation across diverse healthcare systems within federated datasets.

These pandemic years have directed us towards wireless support systems including monitors and wearable devices which help the multidisciplinary team to give inputs without being actually present at the bedside.

Critical care teaching has shifted to adopt a virtual reality form of teaching where the simulated scenarios create realism, hence enhancing learner competence without compromising patient safety. Simulation is widely being incorporated into the curriculum of teaching institutions, and simulation laboratories have made learning more interesting than the usual classrooms.

Catering Public Health

Public Health's adoption of new-age technologies like AI, High-performance computing (HPC), IoT sensors, and 5G, and ever-increasing ownership of smartphones will result in accurate population data explosion and analysis, transforming public health interventions into more effective, actionable, real-time, personalised and precise 'Health for All' actions.

New-Age Technologies like Geospatial Technology, Wearable Technology, Microblogging monitoring, 3D Printing, Telehealth, cloud-based Electronic Health infrastructure, Transportation (drone) Technology, and Internet of Medical Things (IoMT) will work with Public Health by profiling disease and demographic variables, health information pooling, predicting disease severity, public health facilities and services mapping, printing public health supplies to name a few, and this results in decisive and decentralised

health intelligence, informed health governance, Intelligent Transportation Systems, streamlining the overall healthcare and ultimately reducing healthcare costs.

Diagnotic Radiology

Radiology is a medical specialty that is greatly impacted by the fast-paced technological advancements which include: AI and machine learning algorithms are used to flag abnormal images to expedite the reporting for critical patients. Some AI softwares are trained to diagnose common abnormalities. They help to improve the image quality with low radiation dosage, provide diagnostic accuracy, enhance workforce efficiency, alleviate Radiologist burnout, reduce turnaround time, handle large patient volumes, and provide alerts to the doctor on their mobile phones. Radio Genomics is an interpolation of imaging details and genomic data of patients which will help to individualise treatment. Dimensional Printing, Cinematic Rendering, Virtual Reality (VR) & Augmented Reality (AR)— provide accurate anatomic and functional detail that guide complex cardiac procedures and serve as an educational tool. Wearables in Radiology— the Microsoft HoloLens and Google Glass, provide holograms for Interventional Radiology procedures.

Radiology in Developing Nations

It is imperative that imaging services reach the large rural population. Mobile imaging units, handheld ultrasound devices, mobile phone-based scanners, and radiology robotic devices will help achieve these Teleradiology Services, and enable radiologists in providing expertise to different geographical locations simultaneously. Cyber security helps safeguard the

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privacy of patient data in conformance with regulatory and medicolegal statutories.

Endovascular Surgery

Vascular surgery is an exciting, innovative, and vibrant specialty in today's medical era. The 20th century witnessed a tremendous explosion in the application of minimally invasive, catheter-based interventions in virtually all vascular bed territories. Novel devices such as drug-eluting stents, drug-coated balloons, cryoplasty balloons, cutting balloons, and focal pressure balloons have improved patency, and reduced or modified the anatomy of the plaque. The advent of IVUS (Intravascular Ultrasound)— the best technology to demonstrate the anatomy of the artery wall, and plaque morphology tailors the treatment of vascular diseases and assesses the completeness of treatment. Miniaturised in Vivo Robotic Assistant help to perform minimally invasive surgeries in the abdomen. Exciting development in vascular surgery is the implementation of Electronic Blood Vessels— flexible, biodegradable, and durable. Therefore, the new technologies will be relevant only if the focus is to emphasise, enhance and improve the 'human touch' in Healthcare.
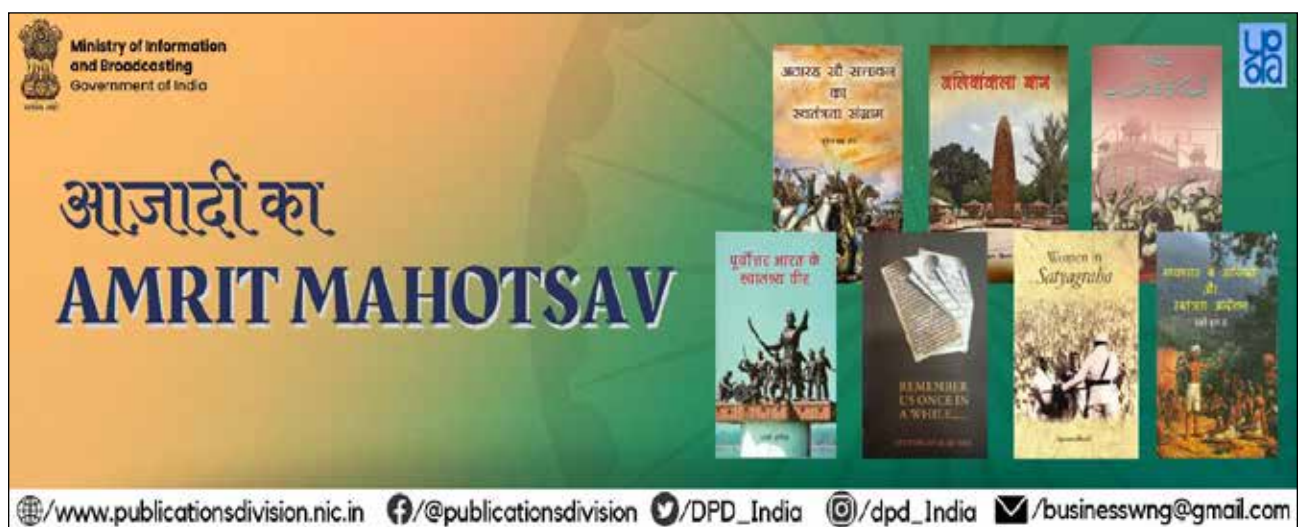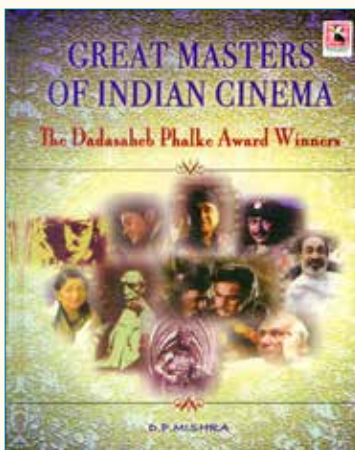
Great Masters of Indian Cinema
The Dadasaheb Phalke Award Winners
Author : D P Mishra
Price: Rs 180

One man who probably understood the art and technique of filmmaking better than most of his contemporaries, was Dadasaheb Phalke. His landmark film 'Raja Harishchandra' is considered as India's first feature film. Dadasaheb Phalke Awards, instituted in the memory of this icon of Indian Cinema, are given away every year since 1969 to those film personalities who have made outstanding contribution to the growth and development of Indian Cinema. From Devika Rani in 1969 to Adoor Gopalakrishnan in 2004, the awardees include actors, directors, producers, singers and music directors, a wide canvas of creativity and ingenuity which constitutes the Indian film industry. The author has made a sincere attempt to portray the profile and contributions of these personalities in the book. A short description of the awardee, the films they were associated with, and illustrations make this book informative and interesting. ❑