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YOJANA

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Let noble thoughts come to us from all sides
Rig Veda

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YE-961/2018

Innovation: Making a Difference

When Archimedes cried 'Eureka' ! it was not just an expression of excitement on a new discovery, but a statement on the entire experience of innovation and discovery.

Innovation has been at the heart of all progress of mankind – be it the discovery of fire, the wheel, weapons for hunting, the idea of agriculture – each one developed from an idea or observation. In recent times also, innovations have taken place in almost every sphere touching mankind. Agriculture, space science, bio-technology, health care, education etc. – every sector has benefitted by innovation.

Obviously, the lead in innovations has been taken in the field of science and technology. Many of these innovations are deeply connected with the lives of the common man. Innovations in health, like discovery of DNA profiling, stem cell research, organ donations, heart transplants etc. have actually been life saving.

The Green Revolution was an innovation that helped convert India into a food sufficient nation from a food scarce nation which had to depend on supplies from abroad to feed its hungry population during the initial years after gaining independence. Other innovations in agriculture over the years have promoted farmers' welfare and ensured increased productivity.

Space science is another area which has seen a number of innovations. Innovations in satellites and launch vehicles have further boosted India's efforts to earn its rightful place in the comity of nations. These innovations have secured benefits in various fields such as telecommunications and rural connectivity.

The thrust of the Government on promoting innovation can be seen in many policies and programmes covering various sectors. The Ministry of HRD's initiatives like MHRD Innovation Cell (MIC), Atal Ranking of Institutions of Innovation Achievements (ARIIA), GIAN and SPARC are all aimed at promoting innovation in young minds. Similarly, programmes like MUDRA and ASPIRE have tried to create a spirit of entrepreneurship through innovative ideas among entrepreneurs. Financial inclusion initiatives like Jan Dhan Yojana and various innovative pension schemes are aimed at benefitting the common man.

Specific innovative programmes like the Atal Innovation Mission and innovations in public systems like the BHIM App, e-Nam etc have also contributed to the innovative spirit in India. The Metro Rail is one of most innovative modern transport systems and has made a huge difference to the public transport system .

There is no doubt that innovations have made a difference to society from times immemorial. But they should not be restricted to individual efforts of scientists and researchers alone. The innovative spirit in each one of us has to be nurtured from the very beginning and young minds taught to think out of the box rather than just get through with rote learning. This calls for a reformation in the education system as also changing the mind set of parents and the society at large. Collective efforts by all relevant stakeholders can make all the difference.

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YE-963/2018

Scientific Innovations in the Service of Society

Ajey Lele

Innovation mostly indicates advancements, however, it is important that such advancements should be novel too. This is because, at times, the advancement is more about the progression for the existing technology than having discovered something new or original. Say in case of developments being witnessed over the years in the domain of computers: a 32-bit microprocessor introduced in 1985, the Intel 80386, which was known as 386 was replaced by a 486 microprocessor after a few years, which was a higher performance unit. Here the nature of technology almost remained the same, but the upgradation of technology was witnessed. However, if the present conventional (known as classical) system in future gets replaced by a quantum computing system, then it could be correct to conclude that a new innovation in the computing technology has occurred. This is because the processes of undertaking computations are different in classical format and quantum format and quantum computing has been projected to bring in major change to the existing structures of computing processes. At present, quantum computing is at an experimental stage and it is expected that in a few years this technology could become a reality bringing in major disruption in the IT (Information Technology) sector in particular and ICT (Information and Communication Technology) sector, in general.

Technology forms the subtext of human development. History is replete with instances of technology serving as catalyst in the grand narrative of human development. From basic necessities like food, air, water, clothing and shelter, to structural requirements like security, technology has played a tremendous role in every field of human growth and survival. Over the years, the world has witnessed various innovations happening in the field of science and technology (S & T) which have made significant difference to the lives of the common man. Such innovations have been happening in various fields of science from Physics to Biology. Some of the innovations which have been predicated to change

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human lifestyle in the near future, are presently at various levels of their technology development life cycles.

Around the year 1948 the invention of the transistor, a device with potential to have numerous applications in radio technology by replacing the vacuum tube, took place. This electronic component demonstrated its capability to have instantaneous action. This was possible because there was no workup delay that used to take place in the vacuum tube, since no heat was getting developed. The innovation of the transistor could be viewed as one of the most significant innovations of the modern era. The transistor is a resister or semi-conductor device which helps amplify electoral signals as they get transferred through it. The presence of the transistor enables all kinds of binary logic operations and has brought a revolution to the field of electronics and computing.

Historical Perspective

Actually, manifestation of various technological developments have resulted in various industrial revolutions since 17th/18th century onwards. The beginning of the industrial revolution had British industry at the centre. Slowly, industrialization spread from Britain to other European countries like Belgium, France and Germany, and then to the United States. By the mid-19th century, industrial progress had happened mainly in Western Europe and the North and Northeast of the United States. It was the period when the United State was emerging as a major global industrial centre. In Asia, countries like Japan, and in the later part of 20thcentury, South Korea contributed much towards the industrial revolution. However, during the last few decades, one country that has shown remarkable progress towards industrialisation is China. Countries like Israel and India are known to have made some contributions too, with Israel playing a major role in the realm of technology development. The main features of these industrial revolutions are as follows:

Biology, Biotechnology, Pharmacy and Medicine are the areas which have witnessed various important innovations over the years. Particularly, all these innovations matter much to humanity because they have helped to increase the life expectancy of humans, have also found cures to various diseases and have overall assisted to make humans healthier.

- The First Industrial Revolution: 1760 – 1840. It was a period which witnessed the emergence of steam engine, textile industry and mechanical engineering
- The Second Industrial Revolution: 1870 – 1914. The revolution was about emergence of railways and steel industry.
- The Third Industrial Revolution: 1969 – 2000. Electric engine, heavy chemicals, automobiles and consumer durables made their presence felt during this period.

- The Fourth Industrial Revolution: the digital revolution, since 2000 or a few decades prior. This is an ongoing phase of this industrial revolution which has also been called as Industry 4.0. Developments in the oil industry and the IT industry have led the initial phase of Industry 4.0. At the same time there are various other S & T innovations which are leading the progression of this Industrial Revolution.

Innovation in Various Sectors

Biology, Biotechnology, Pharmacy and Medicine are the areas which have witnessed various important innovations over the years. Particularly, all these innovations matter much to humanity because they have helped to increase the life expectancy of humans, have also found cures to various diseases and have overall assisted to make humans healthier. Invention of Penicillin during 1928 by the Scottish scientist Alexander Fleming could be considered as the beginning of the modern era of medicine. It transformed the field of medicine by its ability to cure infectious bacterial diseases. Almost seven decades later during 2001, the secret behind the complete sequence of all three billion base pairs in the human genome was discovered. The discovery of DNA (deoxyribonucleic acid) has totally revolutionized the

....technology could said to have evolved as a response to the various requirements of society and it is expected that the S & T innovations happening in the future too would help humans to live more peacefully and happily

Another interesting technology/method for energy generation is by using nuclear fusion reactors. Presently, much work is happening in the arena of development of nuclear fusion reactors. In southern France, International Thermonuclear Experimental Reactor (ITER) is getting developed. This technology, when fully operationalised, is expected to change the global energy habits.

field of biology and demonstrated that this discovery would help humans to resolve various challenges beyond medicine. Today, DNA profiling has major utility for confirming if people are related to each other (parenthood testing). It also helps the law enforcement agencies towards solving crimes. Apart from these important discoveries, the research on the stem cell is also an important innovation. Such cells have the unique ability to develop into specialised cell types in the body which could be used to replace cells and tissues that have been damaged or lost due to disease. In addition, various innovations in the organ donation field which assist to replace (repair) eyes, lung, heart, kidney, liver, pancreas or intestine have helped human race immensely.

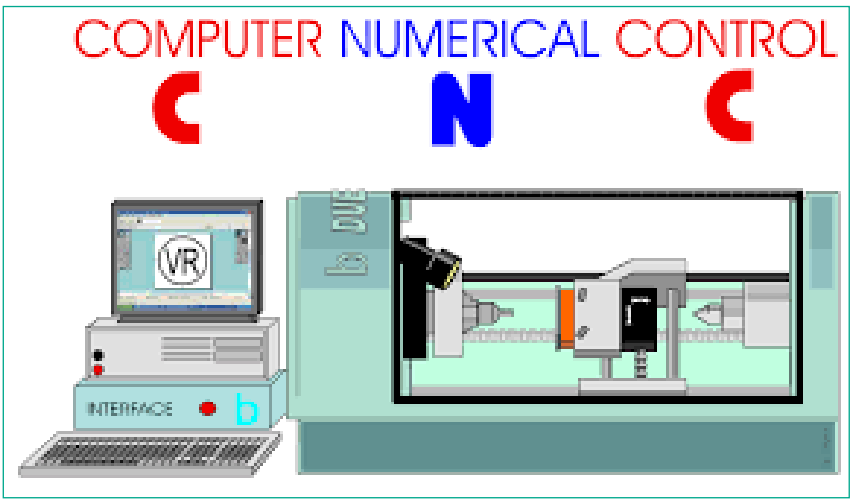
In the power sector, from nuclear power to solar power to space based solar power to biofuels, various clean options have been made available. A major innovation with regard to wind turbines is getting discussed where a start-up is working on an environmentally friendly aero-generator which needs no blades. This is expected to be a more cost-effective option. Another interesting technology/method for energy generation is by using nuclear fusion reactors. Presently, much work is happening in the arena of development of nuclear fusion reactors. In southern France, International Thermonuclear Experimental Reactor (ITER) is getting developed. This technology, when fully operationalised, is expected to change the global energy habits. A major innovation could happen when the current nuclear fusion reactors where the hydrogen isotopes tritium and deuterium are used as the fuel would be replaced by other technology. If helium-3 and deuterium could be used as fuels, then a major revolution in the energy sector is expected. The helium-3 is not available on the earth's surface hence, at present few states are undertaking missions to Moon where helium-3 is available in abundance. However, this entire process of getting helium-3 down could take few more decades.

Innovation in Modern Technology

For many years one of the best approaches to industrial production was considered as CNC (Computer Numerical Control) machine. This milling technology has existed since 1950s and is being used to produce significant quantities of large, heavy, precision-crafted products having applicability for commercial and industrial equipment, machines, and engines. Today, with the developments taking place in the additive manufacturing (AM) sector it is expected that a major change is at the doorstep of global manufacturing processes. This technology which is commonly known as 3D printing is a mechanism of direct digital manufacturing. This would allow object creation by simply using a digital file which is having the design of the product. This file would send a signal to a printer, which would be constituting the required material (say powder) and 'print' the product as per the requirement.

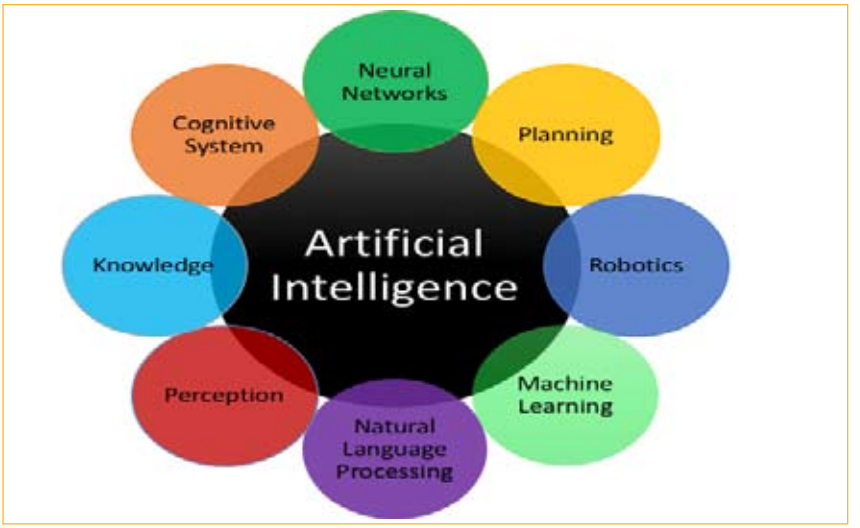
Internet of Things

At the heart of various technological innovations over the years, lies the Internet. This is the single most technology which has helped to change the face of the world within a few years. This one innovation has actually led to various other



innovations. Internet could be branded as one technology which connected the world and has changed various practices of human survival from education to healthcare to nature of doing business including financial transactions. Today, this Internet is being viewed as a first setup towards a major disruption in IT and ICT. Internet 2.0 is expected to bring in major changes in the present-day setup of doing various things. Development in multiple fields of science and engineering like nanoscience, electronics, and sensor technologies are offering new opportunities to relate with internet differently. The idea of using internet differently and by using diverse effects (normally "thing" or "object" are viewed as any possible items in the real world that could join the communication chain) is expected to upswing to the model of Internet of Things (IoT). Generally, IoT is considered to be simply a means of connecting different sensors to a network. It is important to look at IoT over a broader canvass of numerous IT related and futuristic IT technologies. Ambient Intelligence and Cognitive Technologies are anticipated to have a major impact on the future of IT. Technologies like Fog computing, Distributed computing, Cloud computing, Big Data and Block-chain are expected to impact the future of IoT.

Artificial Intelligence (AI) is another technology which has been there for many years and is presently found making a lot of impact on the developmental cycle in various disciplines. However, even today, AI is still an evolving technology and the scope for AI is varied. There are various viewpoints about the exact applicability of AI. No final verdict has yet been announced whether AI is a saviour or destroyer. Issues of ethics do get raised in regard to the applicability of AI. However, globally it has been observed that AI could bring in various advantages in very many fields associated with human growth and progress. Robotics is one area, which is associated both directly and indirectly with the AI and has already made many inroads in various human activities over the years. Broadly, it could be argued that AI and Internet 2.0 could decide on the future of the world.



The most fascinating aspect of modern S&T innovations has been its evolutionary and adaptable nature. It is important to appreciate the fact that despite being developed for a specific purpose, some technologies have witnessed modifications and have provided innovation for altogether different purposes. For example, cell phones (mobile phones) were originally developed as a unit for remote wireless communication. Since then, however, phones have been implanted with GPS chips that provide information about the device's geographic position.

Developments in the field of Outer Space have been fascinating. This is one technological field, which could be said to have made major contribution towards addressing various issues of socio-economic importance. Voice and data communication in real time and offering accurate inputs for various developmental aspects and managerial issues has been the key focus of space technologies. Today, communication, navigational, remote sensing (earth observational), weather and scientific satellites actually almost fully control humans lives.

Largely, technology could be said to have evolved as a response to the various requirements of society and it is expected that the S & T innovations happening in the future too would help humans to live more peacefully and happily. ❑

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YE-968/2018

Capitalizing on Technology for Farmers' Welfare

M S Swaminathan

Farming is both a way of life and means to livelihood for nearly 60 per cent of our population, a majority of whom are women and youth. The basic difficulties of farmers can be overcome only if integrated attention is given to pricing, procurement and public distribution. Compounding the difficulties of today, farmers are facing serious problems from climate change. The most unfavourable impact of climate change will be high temperature, wide variation in precipitation and rise in sea level. While looking at the problems of farmers there should be equal attention to the families living and cultivating in the following ecosystems: Arid zone, sem-arid dry farming areas, irrigated areas, groundwater farming and plantation crops in hilly areas. The support extended to farmers should be according to the requirements of those cultivating in above mentioned ecosystems.

The reports of the NCF give a clear sense of direction to shaping the future of agriculture based on farmers' welfare. The government of India has already changed on the recommendation of NCF, the name of the Agriculture Ministry to Ministry of Agriculture and Farmers' Welfare.

The progress made by our farmers in improving production and productivity is illustrated by the fact that wheat production in India has gone up from 7 million tonnes in 1947 to over 100 million tonnes in 2018. Such an impressive progress has been rendered possible due to interaction between technology and public policy. Technology has been mainly in the field of designing new plant architecture characterized by resistance to lodging and ability to transfer more of the photosynthesis to grain formation.

New technologies are the basic raw material for productivity improvement. There are adequate opportunities for anticipatory research involving new technologies.
We should capitalize on them to ensure the wellbeing of farmers and farming

The author is Founder Chairman, M S Swaminathan Research Foundation. He has been described as "the Father of Economic Ecology".

Ever since the publication of Mendel's Laws of Inheritance in 1865, many innovations have taken place in the effective use of genetic knowledge for improving productivity and profitability of crops. Among the innovations introduced by plant breeders, mention may be made of induced mutation, chromosome doubling through colchicine and genetic medication through the application of the new knowledge in molecular biology. Genetic modification has made it possible to transfer genes across sexual barriers. More recently, gene editing technologies have become available which can help to achieve directed mutagenesis.

Breeding helps to develop strains with a higher yield potential. However, for achieving the higher yield, we need interaction between technology and public policy. New scientific innovations, farmer friendly economic policies and farmer's own enthusiasm to take to new technologies are all important for achieving the desired goal of a quantum jump in production.

In more recent years, progress in technological innovation has become more rapid. What is however, important is to understand the risks and benefits associated with new technologies. As early as in 1962, Rachel Carson in her classic book titled *Silent Spring* pointed out that pesticides including DDT can result in long-term harm because of their long residual toxicity. This is why, before taking the new technology to the field, it is important that they are assessed for their positive as well as potentially negative effects.

New innovations are essential to overcome new challenges like those arising from climate change. More anticipatory research will be needed to ensure that our farmers are able to increase production under conditions of rising temperature and frequent floods.

The uncommon opportunities now available for improving agriculture should be mastered. The future belongs to nations which give importance to grains rather than guns. Let me quote from a recent article by Prof P C Kesavan and me published in Current Science:

Genetic engineering technology has opened up new avenues of molecular breeding. However, their potential undesirable impacts will have to be kept in view. What is important is not to condemn or praise any technology, but choose the one which can take us to the desired goal sustainably, safely and economically.

The National Commission on Farmers (NCF) which I chaired made the following goals for ensuring sustainable agriculture and food security:

- To improve the economic viability of farming by ensuring that farmers earn a "minimum net income", and ensure that agricultural progress is measured by the advance made in improving that income.
- To mainstream the human and gender dimension in all farm policies and programmes and give explicit attention to sustainable rural livelihoods.
- To complete the unfinished agenda in land reforms and to initiate comprehensive asset and aquarian reforms.
- To develop and introduce a social security system and support services for farmers.
- To protect and improve the land, water, biodiversity and climate

resources essential for sustained advances in the productivity, profitability and stability of major farming systems by creating an economic stake in conservation.

- To foster community-centred food, water and energy security systems in rural India and to ensure nutrition security at the level of every child, woman and man.
- To introduce measures which can help to attract and retain youth in farming by making it both intellectually stimulating and economically rewarding, by conferring the power and economy of scale to small and marginal farmers both in the production and post-harvest phases of farming.
- To strengthen the biosecurity of crops, farm animals, fish and forest trees for safeguarding both the work and income security of farmer families, and the health and trade security of the nation.
- To restructure agricultural curriculum and pedagogic methodologies for enabling every farm and home science graduate to become an entrepreneur and to make agricultural education gender sensitive.
- To make India a global outsourcing hub in the production and supply of the inputs needed for sustainable agriculture, and products and processes developed through biotechnology and Information and Communication Technology.

The NCF report was submitted in 2006. During the last four years, several significant decisions have been taken to improve the status and income of farmers. Some of them are:

- Designating the Ministry of Agriculture as Ministry of Agriculture and Farmers' Welfare to stress the importance of keeping farmers' welfare as the measure of agriculture progress.
- Issue of Soil Health Cards (SHC) to all farmers to promote the adoption of balanced nutrition. Soil health is basic to plant health and plant health is basic to human health. Hence the Universal Soil Health Card scheme is a very important one.
- Allocation of both budgetary and non-budgetary resources for promoting micro-irrigation through the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).
- Conservation and sustainable use of indigenous breeds of cattle through a Rashtriya Gokul Mission. The Prime Minister also inaugurated the First International Congress on Agro-biodiversity.
- Promoting online trade through electronic national agriculture market which helps to bring together different agriculture markets. The creation of Gramin Agriculture Markets (GrAMs) will provide scope for direct sales to consumers in both retail and bulk form.
- Introduction of Agricultural Produce and Livestock Marketing Act, 2017 and Agricultural Produce and Livestock Contract Farming Services Act, 2018 supported by electronic Negotiable Warehouse Receipt (eNWR) system for increased institutional credit to the farm sector
- Determination of Minimum Support Price (MSP) based on the recommendation of the NCF. Assured procurement at MSP of more crops.
- Integration of protein rich pulses and nutri-rich millets into welfare programmes including Public Distribution System (PDS), mid-day meals, ICDS etc.

- Increase in the income of farmers through activities like apiculture, mushroom cultivation, bamboo production, agro-forestry, vermi-compost and agro-processing for generating additional jobs and income for farm families. Prime Minister has also suggested that we should develop methods by which farmers' income can be doubled within the next five years.
- Setting-up several corpus funds to complete on-going irrigation production, modernised infrastructure in dairy cooperatives and strengthen the adoption of inland and marine aquaculture.
- Above all, the recent announcement of remunerative price based essentially on the recommendation of NCF is a very important step to ensure the economic viability and attractiveness of farming.
- While the Government has ensured in its notification that from Kharif 2018 onwards, the MSP of the notified crops would be minimum of 150 per cent of the cost of production, it is noteworthy that it ranges from 150 to even upto 200 per cent for coarse cereals which will provide an incentive to the farmers in achieving our objective of improving the nutritional intake of our population.

Anticipatory Research in an era of Climate Change

There are several reports in the media about the bioshield function of mangrove forests along coastal areas. Mangroves have helped to save both lives and livelihoods particularly of fisher and coastal communities. The beneficial impact of mangroves has been observed by the local community on several occasions including the recent Gaja in Tamil Nadu. Earlier, the damage caused by Tsunami as well as the super cyclone in Odisha were also considerably less in mangrove rich areas. It is in recognition of the critical role of mangroves in the conservation of coastal ecosystems that the famous temple at Chidamabaram chose a mangrove plant (*Excoecaria agallocha*) as a Temple Tree.

When MSSRF was started in 1989-90, the mangrove ecosystem at Pichavaram was taken up for priority attention. Both in the Philippines, where I lived for a few years and in India, the general appreciation of the role mangroves play in both ecological and livelihood security has been little. Mangrove areas were being converted into aquaculture farms and tourist centres. This is why we started a genetic garden of mangroves at Pichavaram near Chidambaram with support from Department of Biotechnology. Considerable amount of work has been done to promote public understanding of the need for protecting the mangrove forests and extending them to all coastal areas. A **Charter for Mangroves** was prepared and with the help of the Government of Japan and IITO, an International Society for Mangrove Ecosystems (ISME) was formed in 1990. It is only when natural calamities of the kind induced by cyclones occur that there is more awareness of the need to protect and propagate them. I hope the calamity caused by Gaja can be converted into an opportunity for saving coastal wetlands and more particularly mangroves.

New technologies are the basic raw material for productivity improvement. There are adequate opportunities for anticipatory research involving new technologies. We should capitalize on them to ensure the well-being of farmers and farming. ❑

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YE-862/6/2018

Space Programmes: Spin offs for Humanity

G Madhavan Nair

GSLV MK III

Future challenges related to space exploration, space travel, tourism application programmes based on space assets spin off technology benefits etc are going to provide lot of opportunity to the new generation. Those who are adventurous can plunge into it and reap the benefits

As I am writing this article, India has launched its largest and heaviest communication satellite into orbit. It weighs nearly 6 tons and has capability to support high speed data transfer to remote parts of the country. This mission GSAT 11 will fulfill yet another goal of ISRO's founding father Dr Vikram Sarabhai to use high technology for the benefit of the common man. Though the Indian space program started nearly 20 years later than in developed countries, today it has emerged as one among six nations i.e. USA, Russia, Europe, China and Japan having total indigenous capability in building satellites for earth observation communication and scientific research as well as launch them into orbits around earth and even take them to moon or Mars. Indian launch vehicles like PSLV, GSLV have proven track record and cost effectiveness so that even developed countries are approaching ISRO for launching their satellites. While perfecting these high technology ISRO's focus was on making use of them for the benefit of society. Direct to home transmission of TV signals, connectivity to banks and financial organisations, telemedicine, tele-education and disaster warning system are a few examples of that.

The author is former Chairman of the Indian Space Research Organization (ISRO). He was responsible for implementation of India's first mission to moon Chandrayaan, development of satellite launch vehicles starting from SLV3 to GSLV and was the chief architect of PSLV.

While fulfilling the dreams of the founding father of Indian space program, one has to look at what next. Space is going to be the next frontier for human exploration and presence of humans in outer space and planets is going to be the next challenge. Though USA, Russia and China have already taken a lead, India is yet to make an entry into this field. Though need for new initiatives in this field was felt nearly a decade back, the formal approval was given by the Prime Minister through his 2018 Independence Day declaration that India will be having its own human space flight in 2022. This is really going to be a great technology challenge but the goal has to be met if we have to maintain our leadership position in the global scenario.

Important developments related to the human space flight are the Crew module, life support system, Crew escape system and improvement in the overall reliability of the launch vehicle. Once in orbit, the capsule will be in almost zero G condition and hard vacuum and will be subjected to heavy radiation. Creating living conditions inside the module to support human life, providing oxygen ,water and food as well as waste disposal for several days needs development of innovative technologies. Training of astronauts to face zero Gas as well as high acceleration levels during launch and re-entry needs thorough understanding of behavior of human physiology and psychology as well as conditioning the astronauts by going through a series of simulated environmental tests. A branch medicine i.e. space medicine will emerge. Such facilities are not available in the country and need to be established through fresh development programmes.

Reliable Vehicles

The PSLV and GSLV have emerged as reliable satellite launch vehicles globally. That is the reason that other countries including USA, Europe and Canada are approaching ISRO for launching their satellites.

GSLV MK III

Demonstrated reliability of these launchers are around 95 per cent but not adequate to carry the manned capsule. Space Shuttle had estimated reliability level of 99 per cent, still NASA took the risk of sending astronauts in that. It is sad that they encountered two failures out of its 136 launches. No one will accept such level of risk now. The Space shuttle is decommissioned and further efforts are on to develop a new launch system in USA. At present the only launcher available for the free world for human space flight is Russian Soyuz rocket. Though the Chinese Long March can do such missions it is used only for their national needs. Though the GSLV MkIII recently developed by ISRO can take the manned capsule weighing nearly10 tonnes to low earth orbit, improvement of reliability of the launch system is a must before it carries human on board. The entire design and test results will have to be revisited. Designs margins have to be enhanced wherever required. More important is introduction of redundant and fail safe systems to ensure safety of the crew. This will have to be supported with adequate number of tests and simulations.

Structural Model of Crew Modules

GSAT 11

Providing oxygen and maintaining the temperature within reasonable limits, shielding the external radiation of charged particles and providing waste management onboard are other new developments. After completing the orbital mission, breaking the orbit, sending the module in precise trajectory in guided manner and managing re-entry heating load using appropriate ablatives and material which can withstand high temperatures require advanced materials and techniques.

Recovery System

While all attempts will be made to have a reliable launch system there is a remote chance there could be some chance of failure. In such a case how to bring back the astronaut has to be addressed. Recently, ISRO has demonstrated a crew recovery experiment using which astronauts will be ejected from the launch system and brought back to earth in case of a mission abort. The basic design of a space suit, crew module, its landing and recovery process from sea were demonstrated as part of the technology development. Development of new technologies and systems to perfect the manned mission are demanding a lot of innovation and hard work by thousands of scientists, technologists and supporting staff over the next few years.

Developing space transportation system and enabling humans to stay in earth orbit for few days and bringing them back is only a small step forward, It will provide a platform for detailed observation of planet earth, scientific observation and studies of stars and galaxies Conducting chemical or biological experiments under zero G condition to generate new molecules are some of the benefits. At the same time, people are dreaming of sending people to Moon and Mars with the idea of exploiting resources from the neighboring planets and even colonizing them. But it all needs not only new developments but also large funding. International cooperation, pooling the technologies and financial resources are the only way to achieve such ambitious goals.

While dreaming of the future and adventurous journey in the solar system we have to worry about our planet Earth. Climate change and associated changes in weather, sustainable development with optimum use of natural resources and forecast of natural hazards like drought, floods, earthquake etc are some of the priority areas. India has done well in making use of earth observation satellites, IRS and pictures from meteorological satellites for meeting these requirements on a day to day basis. The recently launched hyper spectral imaging satellite is going to be a powerful tool for monitoring natural resources and supporting agriculture in a big way. As demands are growing, advanced technologies are to be developed for providing high resolution hyperspectral images on a daily basis. Most of the imaging is done in visible range. To provide data on cloud covered regions, radar imaging techniques will have to be perfected and a constellation of Radar satellites are to be deployed. Satellite images can strengthen the security system and for continuous monitoring of sensitive regions high resolution imaging from geo stationary platform will have to be developed. Innovative solutions are to be found to combine optical and micro wave images from such platform from 36000 km is required. Warnings on cyclone drought weather phenomena can be met using precision multi spectral images from geo stationary satellites. But there is no proven technique for advanced warning of earthquakes. There are concepts suggesting variation in magnetic and electric field around the earth which can be monitored using satellites which give indication of eminent earthquakes but this has to be validated and a lot of efforts are required in this area.

Digital Connectivity

Today's knowledge society is totally dependent on digital connectivity. Geo stationary satellites always provided

solutions for this. The recent launch of GSAT11 is a clear example of how space is supporting the needs of the country in this area of high speed digital connectivity. Such resources will have to be multiplied. Advanced satellites with higher data throughput and coverage to every nook and corner of the country need new ideas and techniques. Through this, digital connectivity is assured not only to remote rural areas but also the doorstep of the poor. While access to knowledge is extended so are the services like health care through telemedicine. Today, telemedicine is limited to remote consultation but the day is not far off when even telesurgery can be done using satellite connectivity.

Today, space based services are efficient but expensive. The cost of launching satellites contribute a major share in this. If schemes are developed to recover and reuse the launch hardware considerable saving in cost can be achieved. Also, use of new propulsion systems using less expensive fuel like kerosene could bring down costs. Development of new generation launch vehicles along these lines poses several technology challenges before ISRO. One should not be lagging behind others in launch capacity. When they are targeting even 100 ton to orbit we should aim at least 20 ton in the near future.

Space research always has been fascinating and India has not lagged behind. Future challenges related to space exploration, space travel, tourism application programmes based on space assets spin off technology benefits etc are going to provide lot of opportunity to the new generation. Those who are adventurous can plunge into it and reap the benefits. ❑

(E-mail:gmnairg@gmail.com)

Online Portal to Facilitate DBT Launched

An online portal - "ENSURE' - National Livestock Mission-EDEG, developed by NABARD and operated under the Department of Animal Husbandry, Dairying & Fisheries was launched recently.

The National Livestock Mission has been conceived by the government for the sustainable development of the livestock sector. Under the Mission's component called Entrepreneurship Development and Employment Generation (EDEG), subsidy payment for activities related to poultry, small ruminants, pigs etc. through Direct Benefit Transfer (DBT) goes directly to the beneficiary's account. In order to make it better, simpler and transparent, the NABARD has developed an online portal "ENSURE" (https://ensure.nabard.org) so that the information related to beneficiary and processing of application can be made readily available.

Under the new process, controlling officer/branch manager of the bank, after scrutinizing and sanctioning of proposal, uploads the subsidy claims in the portal. The subsidy will be approved within 30 days from the date of sanction of loan. Access from the portal will also be on real-time basis and list of beneficiaries can be easily prepared.

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India's Heaviest Communication Satellite GSAT-11 Launched

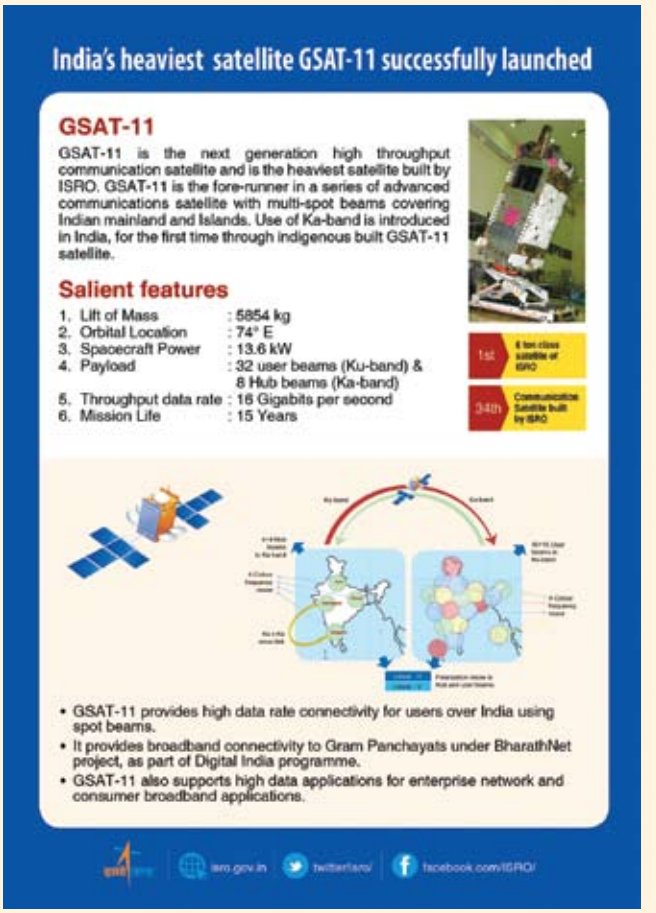
Indian Space Research Organisation's heaviest and most-advanced high throughput communication satellite GSAT-11 was successfully launched from the Spaceport in French Guiana on the early hours of 5th December 2018.

The 5,854-kg GSAT-11 will provide high data rate connectivity to users of Indian mainland and islands through 32 user beams in Ku-band and 8 hub beams in Ka-band.

"GSAT-11 will boost the broadband connectivity to rural and inaccessible Gram Panchayats in the country coming under the Bharat Net Project, which is part of Digital India Programme," ISRO Chairman Dr K Sivan said.

The Bharat Net Project aims to enhance the public welfare schemes like e-banking, e-health and e-governance among others.

He said GSAT-11 will act as a forerunner to all future high throughput communication satellites.



Narendra Modi
@narendramodi

Congratulating the scientists of ISRO on the successful launch of GSAT-11, the Prime Minister tweeted,"A major milestone for our space programme, which will transform the lives of crores of Indians by connecting remote areas!

Congrats to @isro for the successful launch of GSAT-11, which is the heaviest, largest and most-advanced high throughput communication satellite of India.

India is proud of our scientists, who keep innovating and setting high standards of scale, achievements and succcess. Their remarkable work inspires every Indian. @isro

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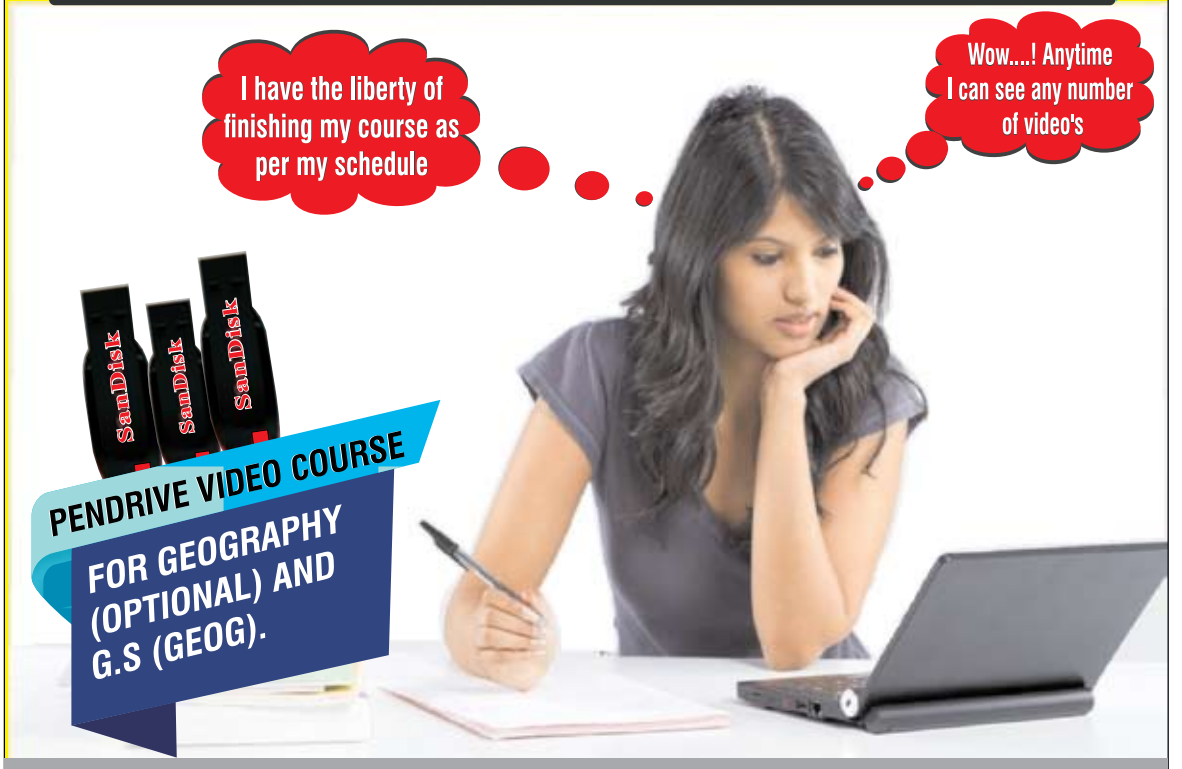

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DO YOU KNOW?

NANO MISSION

The Nano Mission is an umbrella programme of Government of India for overall development in the field of Nano technology through studies, research and innovations. Nano technology deals with variety of applications in medical, space, telecommunications, food processing and environmental protection. Acknowledging its vast potential, the Department of Science and Technology (DST) launched a programme called Nano Science and Technology Initiative (NIST) in 2001. The Nano Mission is successor of this programme. The Government approved Nano Mission in 2007 with an initial allocation of Rs 1000/- crore.

The Nano Mission has been structured in a fashion so as to achieve synergy between the national research efforts of various agencies in Nano Science and Technology and launch new programmes in a concerted fashion. International collaborative research efforts will also be made wherever required.

Today, India has emerged 6th worldwide in terms of scientific publications. An active research community of about 1000 researchers has emerged. Besides, some interesting applications have already come out of the country.

OBJECTIVES OF THE NANO-MISSION

Basic Research Promotion – Funding of basic research by individual scientists or groups of scientists and creation of centres of excellence for pursuing and research.

Infrastructure Development for Nano Science and Technology Research – For optimal use of expensive and sophisticated facilities, it is proposed to establish a chain of shared facilities across the country.

Nano Applications and Technology Development Programmes - The Mission proposes to promote application-oriented Research and Development (R&D) Projects, establish Nano Applications and Technology Development Centres, Nano-Technology Business Incubators etc. Special effort will be made to involve the industrial sector into nanotechnology R&D directly or through Public Private Partnership (PPP) ventures.

Human Resource Development – The Mission shall focus on providing effective education and training to researchers and professionals in diversified fields. It is planned to launch M.Sc./M.Tech. programmes, create national and overseas post-doctoral fellowships, chairs in universities, etc.

International Collaborations – Apart from exploratory visits of scientists, organization of joint workshops and conferences and joint research projects, it is also planned to facilitate access to sophisticated research facilities abroad, establish joint centres of excellence and forge academia-industry partnerships at the international level wherever required and desirable.

The Department of Science and Technology is the nodal agency for implementing the Nano Mission. At the apex level, it is steered by a Nano Mission Council (NMC). It is currently being chaired by Professor CNR Rao of Jawaharlal Nehru Centre for Advanced Scientific Research, (JNCASR) Bangalore.

The technical programmes of the Nano Mission are also being guided by two advisory groups, viz. the Nano Science Advisory Group (NSAG) and the Nano Applications and Technology Advisory Group (NATAG).

DST ACTIVITIES IN NANO SCIENCE AND TECHNOLOGY SO FAR

Around 130 projects have been supported to individual scientists mainly working on fundamental scientific research so far. Significant results have been reported from these projects.

Establishment of Centres of Excellence

Eleven Units/Core Groups on Nano Science have been sanctioned across the country. These centres of excellence house some of the more sophisticated facilities for sharing with other scientists in the region and would help in promoting scientific research. Seven Centres for Nano Technology focusing on development of specific applications have also been established. In addition, a centre of excellence on Computational Materials Science has also been established at JNCASR, Bangalore.

International Collaborative Programmes

As expected, Nano Science and Technology has prominently figured in all S&T cooperation agreements entered into in recent times. Joint R&D activities are already taking place with several countries. For example, with the US, several projects have been funded on CNTs in composites, nano-encapsulating materials, etc. under the DST-NSF programme. Several Indo-US Workshops have also been held. With Germany, a programme on engineered functional nano composites has started which would focus on magnetic properties, magnetic interactions, gas-solid interactions including catalysis, etc. Programmes are also on with Italy, EU and developing with Taiwan. ARCI, Hyderabad, which is an autonomous institute of DST has active programme in nano materials with institutions in Russia, Ukraine, Japan, Germany and USA. ❑

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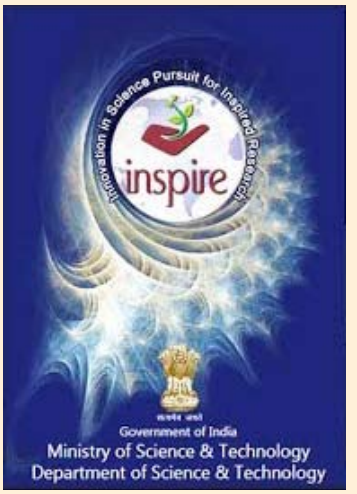

Mahatama Gandhi once said "*The world has enough for everyone's need, but not enough for everyone's greed*". Today, India is taking a lead in realizing that needs are non-negotiable and inclusive innovations by citizens of all ages are increasingly contributing to their fulfilment. In the contemporary Indian society, there is paramount focus on innovation to solve unmet needs and more importantly on its successful execution and delivery as evident from the country's consistently improved performance in the Global Innovation Index. Consequently, Innovation is ubiquitous in India and increasingly becoming a driver to solve abundant problems in almost every corner of the country by its citizens irrespective of the constraints. The world bears testimony to the fact that our young citizens are actively working in this direction in a mission mode and their ability to innovate and entrepreneurial spirit is at par with the best in the world. Augmenting the efforts of our entrepreneurs who are driving this cultural shift is creative and innovative thinking of our school children which is institutionalized through INSPIRE Awards – MANAK, world's biggest idea and innovation competition for school children jointly implemented by the Department of Science and Technology (DST) and National Innovation Foundation – India (NIF) and aligned with the action plan for the Start-up India.

It is an established fact that experimentation is at the heart of Science and Technology based innovation which is essentially embedded and deeply rooted in the architecture of INSPIRE Awards – MANAK, country's core programme on innovation. Nearly seven lakh schools in India are required to conduct idea competitions internally for students studying in class 6th to 10th and in the age group of 10-15 years, thereby scouting original and creative technological ideas and innovations focusing on common problems and nominate the best ideas through an online portal. This would create a pool of one million ideas on parameters like novelty, social usefulness, practicality etc. About one lakh ideas are short listed and one time supported financially through Direct Benefit Transfer (DBT) such that students may experiment, build Proof of Concepts or Prototype and present them before experts at a District Level Exhibition Project Competition (DLEPC). If successful, then it moves to next stage of State Level Exhibition Project Competition (SLEPC) and if further successful to National Level Exhibition Project Competition (NLEPC). Mentoring support is provided to all students who are gearing up to participate in the NLEPC and top 60 are taken up for incubation such that they acquire the status of start-ups and be commercialized. To ensure that the programme is effective, comprehensive awareness campaigns are executed all over the country including workshops for stakeholders at National, State and District levels.

The key purpose underpinning INSPIRE Awards – MANAK is to help the country build a critical human resource pool for strengthening, expand science and technology system and increase the research and development base by inviting students from all government and private schools throughout the country and enabling them to send their original and creative technological ideas and innovations. The experience of the programme so far suggests that not only this objective is being achieved, but is also very effective when it comes to mobilizing innovative ideas even from disadvantaged children or those located at the last mile in remote locations. This year students from all States and UT's were represented, 92 per cent of the districts participated, male

candidates accounted for 55 per cent and female students accounted for 45 per cent, Interestingly, remote locations like Lakshadweep's ratio of count of ideas vis-à-vis its population was highest in the country. It was also heartening to realize that State Government and Local Body administered schools accounted for more than 72 per cent of the ideas and students aligned their thought process and execution approach towards current priorities of the country as evident in their choice of ideas which related to missions like Skill India, Swachh Bharat, Make in India, Digital India, Swasth Bharat and others.

The country's socio economic progress is often measured in terms of delivery of underlying socio economic activities of which INSPIRE Awards – MANAK is gradually becoming an example. The idea of a Manual Garbage Dumping Cart by Master Sikanto Mandal from Mathura scouted through this programme, was value added and prototyped by NIF and later licensed to Gujarat based Sarjan Innovations Private Limited, a Start Up establishing that innovators and entrepreneurs are connected through an Institutional mechanism in the country. Not only it will ensure that "every idea is attended irrespective of the source" but also children will start contributing to the nation in a more direct way relatively early and for good which also means that the country will invest in abilities of its children sooner which will further strengthen the eco-system. It is also in alignment with the country's fast paced progress in ease of doing business index during the past few years as the process of connecting the dots required for starting a business is being executed in a time bound manner and India is perhaps one of the few economies in the world where ideas of children are really transforming into start-ups which are contributing to GDP and creating several job opportunities.

A major differentiator that characterize INSPIRE Awards – MANAK is its unique ability to offer "*exposure*" to students at an early stage itself which counts a lot few years later in one's career. This exposure to an idea rich creative student of today, translates into a more focused, confident, self-reliant, diversified, well-groomed professional of tomorrow who is not only able to tap existing opportunities, but also develop the ability to create the non-existent ones. It will help us identify drivers of tomorrow, today itself, such that the country can invest in their abilities in Science and Technology and reap social, cultural and economic benefits for its citizens. The INSPIRE Awards – MANAK continue to strengthen our innovation eco-system by empowering and bringing together innovators and entrepreneurs who may not have otherwise known each other through an institutional mechanism but now are together contributing towards nation building. ❑

(Source: National Innovation Foundation)

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Contributing to a Knowledge Based Revolution

R Ramanan

India got left behind in the Industrial Revolution that swept the world in the last century. But India does have a unique opportunity to contribute in the knowledge based revolution that is sweeping the world today. That is why Atal Innovation Mission initiatives are so important and need to be embraced by all. The children and youth of our country deserve it

India, over the centuries has never had a dearth of great thinkers, scientists, engineers, innovators, philosophers, and artists. Indian intellectual capabilities are second to none. Our philosophy, culture, fine arts, temples and sculptures over thousands of years also bear testimony to the same.

Whenever Indians go abroad they excel. Many like Sundar Pichai, Satya Nadella and other Indians are leaders in some of the largest and most innovative companies of the world like Google, Microsoft , etc. Access to an innovative ecosystem in these developed countries has allowed them to realize their aspirations, convert their dreams into reality, and helped them flower and blossom to their true potential.

With over 1.3 billion+ people, 1.4 million+ schools, 10500+ engineering related institutions, 150+ million youth of India entering the work force, we need to ensure that our youth can also realize their true potential through the creation of a vibrant ecosystem of innovation and entrepreneurship in this country.

Towards this end a strategic national flagship initiative **Atal Innovation Mission (AIM)** has been set up under the auspices of the NITI Aayog (National Institution for Transforming India).

The author is the Mission Director of the Atal Innovation Mission (AIM).

AIM's focus is to create and promote a world class innovation and entrepreneurial ecosystem throughout the length and breadth of our country and to provide such an innovation ecosystem that will also transform our job seekers to job creators of the future.

A Holistic Framework

The Atal Innovation Mission has adopted a holistic framework to achieve its objectives.

At the school level there is a tremendous need for creation of an innovative , problem solving mindset in the students of the high schools. These students are going to be the future of our country and we need to ensure that thousands of entrepreneurs and innovators blossom from our school educational systems.

At the university and industry levels, there are a growing number of startups thanks to several startup initiatives in the country both from the private sector as well as from the government . But there is a growing need for world class Incubators in various institutions of the country to foster and nurture start-ups enabling their success. Startups need vital access to technology labs, research labs, mentoring networks, venture capital, finance, hiring networks, etc to succeed. Incubators would help in providing this support. With 100+ smart cities identified in the country, we need to ensure world class Incubators in all these smart cities.

Finally a cultural shift in attitudes towards entrepreneurship is needed. We have traditionally been a risk averse society. Education and awareness of the immense opportunities for entrepreneurial ventures is needed. Incentivization of relevant product innovations with commercial and social impact through national challenges are necessary. These will trigger and incentivize entrepreneurial thinking and minimize the fear of risk taking.

About Atal Tinkering Labs

The word Tinkering is often associated with a garage where you use hundreds of tools in a garage to repair or fix a vehicle or even experiment with new possibilities. The very environment and atmosphere in a garage makes you apply your theoretical knowledge to practical applications and innovations.

Theoretical classroom based knowledge in the various fields of science, physics, chemistry, maths triggers the spark of curiosity in a child to acquire more of such knowledge.

Practical knowledge, access to tinkering with latest tools and technologies ignites the imagination of children as they learn to apply abstract concepts learnt in the classroom to real world solutions. It triggers a problem solving innovative mindset in the school students. This is very important for the children and youth of our country.

The world is changing at a dizzying pace. Revolutionary technological advancements are transforming the world and giving rise to new technologies and business innovations at an exponential rate. Electronic miniaturization has enabled a computer the size of a room to fit in the size of our pockets. Convergence of computing, storage and communications at incredibly lower costs has enabled new innovations like the iPhone . Robotics and artificial intelligence are driving next generation productivity and automations. 3D printers are enabling real time conceptualization,

design, prototyping and manufacturing. IoT or the Internet of Things are connecting sensor technologies to man, machine, devices, mobile and satellite technologies in every industry enabling precision agriculture, water cleansing and conservation, climate change controls, disaster prediction and management, driverless cars and advanced transportation systems. Big Data and Analytics, Artifical Intelligence is enabling complex data processing and decision making through advanced easy-to-use tools.

All such tools and technologies are available today and very affordable too. Unless children in our schools have access to these technologies and get familiar with them, tinker with them, experiment with them, design solutions with them, prototype them, test them, allowing unbridled expression to their imagination and creativity, they will be left far behind. If one can start creating innovative prototypes and solutions at the school level one is also creating a mindset to become potential job creators of the future.

AIM has already launched the implementation of 5441+ Atal Tinkering Labs across 715 districts of the country. These span both government and private schools all of which will become operational in FY1819. The results of these interventions are amazing to see.10th grade girl students from a government school have been able to develop solar panel IoT device based irrigation management and water conservation solutions using soil sensors. Another student from one of these Tinkering labs was a winner in a World Robotics Olympiad by designing a Robotic waste segregation and management system.

Atal Incubators

The Atal Incubators initiative is to create world class incubators to support the burgeoning number of startups in the country.

AIM has already launched 101 incubators to date all of which would be operational by end 2019. These incubators will provide the necessary ecosystem of access to technology labs, hiring, training, mentoring, finance, venture capital networks and corporate networks.

India is the world's largest democracy with over a billion people, with each state having different issues and problems to solve both from an economic growth as well as societal needs perspectives. It is important to expose the magnitude and impact of these problems to the future innovators of the country so as to enable them to understand the enormous positive impact of solving these problems.

The long term vision is to have world class incubators in the Top 10 academic and engineering institutions of every state and in every city identified as a smart city for development.

Atal Challenges

India is the world's largest democracy with over a billion people, with each state having different issues and problems to solve both from economic growth as well as societal needs perspectives. It is important to expose the magnitude and impact of these problems to the future innovators of the country so as to enable them to understand the enormous positive impact of solving these problems.

There is, therefore, an urgent need to incentivize relevant problem solving innovations at local, regional and national levels across the country – at school, university and industry levels.

The Atal Tinkering Challenges at a school level, the Atal New India Challenges at Industry levels, the Atal Small Business Innovation and Research challenges at a national level will incentivize relevant problem solving. 24 Atal New India Challenges stimulating product innovations in five sectors have been launched in areas such as drinking water and sanitation, urban housing and development, climate smart agriculture, rail safety and transportation which can have great benefit for the country. In the recently held Atal Tinkering Marathon over **35000+** students participated creating 6000+ innovations in five challenges launched nationwide. The Top 100 innovations from these school students are being considered for possible conversion from prototypes into market ready products.

Collaboration is the Key

AIM is convinced that that none of these initiatives are going to succeed without proactive collaboration with corporates, individual mentors, specialists and professionals who want to give back to society in some way and

be a part of the India in the making, Corporates and SMEs can adopt ATLs and coach the students into problem solving, ideation, prototyping, triggering small innovations. Global partnerships can enable sharing of best practices. NGOs and multinational companies can collaborate on almost all these initiatives. None of these initiatives will succeed without a certain degree of selfless commitment and passion to the cause of innovation and to the cause of betterment of the world we live in.

Collaboration will be key to the success of these initiatives. AIM has, therefore, launched a **Mentors of Change – Mentor India Network** across the country and plans to extend it worldwide. Over 10000 mentors have already registered as mentors of change, and many corporates have adopted Atal Tinkering Labs.

Long Term Goals

AIM's future initiatives include establishment and promotion of Small Business Innovation Research and Development on a national scale for accelerating innovation on a large scale in small businesses/startups/MSME sector. AIM would also collaborate in Science and Technology Entrepreneurial Ecosystem Rejuvenation (AIM STEER) of innovations in major research institutions of the country like Council of Scientific Industrial Research (CSIR), Indian Council for Agricultural Research (ICAR) and Medical Research (ICMR) aligned to national socio-economic needs.

India got left behind in the Industrial Revolution that swept the world in the last century. But India does have a unique opportunity to contribute in the knowledge based revolution that is sweeping the world today. That is why Atal Innovation Mission initiatives are so important and need to be embraced by all. The children and youth of our country deserve it. We all need to collectively make it happen. ❑

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National Challenge for Youth

A National Challenge for Youth, "Ideate for India - Creative Solutions using Technology" was launched in New Delhi recently. The aim of this National Challenge is to give school students across the country a platform and opportunity to become solution creators for the problems they see around them and their communities.

"Ideate for India" will empower and enable these students to transition from being 'users' of technology to become 'creators' of new indigenous technologies to solve local problems in their community by re-imagining solutions to work out critical local issues

The National Challenge is open to students of classes 6 - 12 all across the country - all 29 States and 7 Union Territories and aims to reach out to at least 1 million youth over the next 3 months. There are 11 core theme areas on which students can share their ideas. The Challenge requires students to access online videos and understand how to identify problems and share a 90 second video explaining the problem and their proposed solution.

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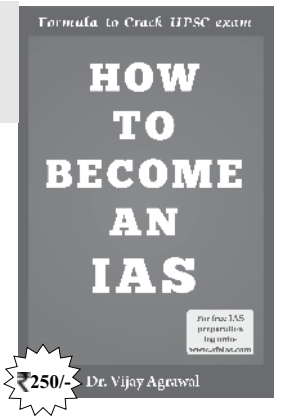

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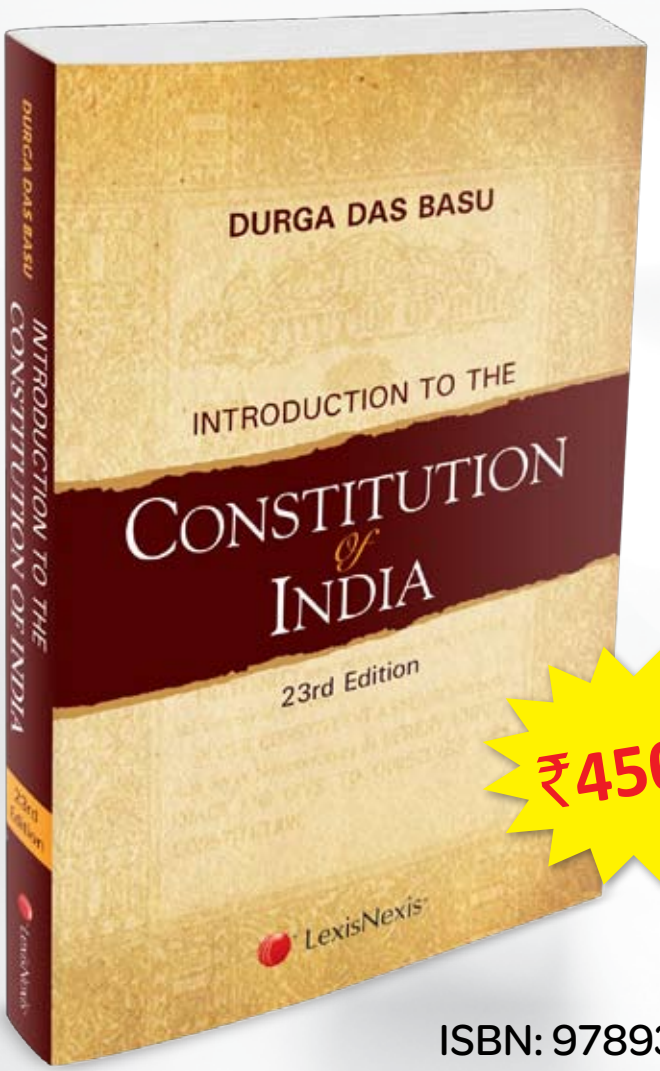

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Innovation-Oriented Initiatives in Higher Education

Indranil Manna

The highest education is that which does not merely give us information but makes our life in harmony with all existence

Rabindranath Tagore

Statistically speaking, India for its 1.25 billion people offers higher or tertiary level education through nearly 800 universities (including central, state, private, deemed and all other categories) who are mostly governed by the University Grants Commission (UGC) and nearly 100 Institutes of National Importance (INIs) which were created through special acts of the Parliament or State Assemblies who directly report either to the Central or State Government. The latter group includes the famed Indian Institute of Technology (IITs), Indian Institutes of Management (IIMs), All India Institutes of Medical Sciences (AIIMS) etc. The chain of IITs and National Institutes of Technology (NITs) represent the top echelon of technology institutes in the country which can boast of the most modern curriculum and infrastructure, though many state level university engineering departments are no less eminent in terms of their contributions and track record. Like all other seats of higher learning, engineering institutions too primarily deal with and focus on a single entity – knowledge, which they either disseminate (by teaching) or create (by research). In order to remain relevant and serve the society, engineering education needs a special outlook or approach different than conventional pedagogic style only consisting of lecture, discourse, monologue, text books, notes and examination leading to a degree without practical training for invention and innovation.

Science-Engineering-Technology

Successful pursuit in science, engineering and technology yields discovery (a new law, element or compound, phenomenon), invention (a new principle, device, drug, machine, process), and innovation (a new and economical product or process), respectively. Therefore, engineering education must build on relevant scientific theories and principles to address the issues of 'need' of the society; e.g. high strength material, greater thermal/electrical conductivity, affordable health care, sustainable

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Innovation has become synonymous with evolution and progress in life. Education is the only way to effectively train the population not only to benefit from the exploits and fruits of innovation but also to actively participate and contribute to this crusade for creating a better, safer and healthier planet.

To promote the culture of 'innovation' in tune with the declaration of 21st century as the century of innovation and our Prime Minister's desire to dedicate 2010-20 as the 'Decade of Innovation', MHRD has launched MHRD Innovation Cell (MIC) and Atal Ranking of Institutions on Innovation Achievements (ARIIA) to systematically foster the culture of innovation in all higher education institutes (HEIs) across the country.

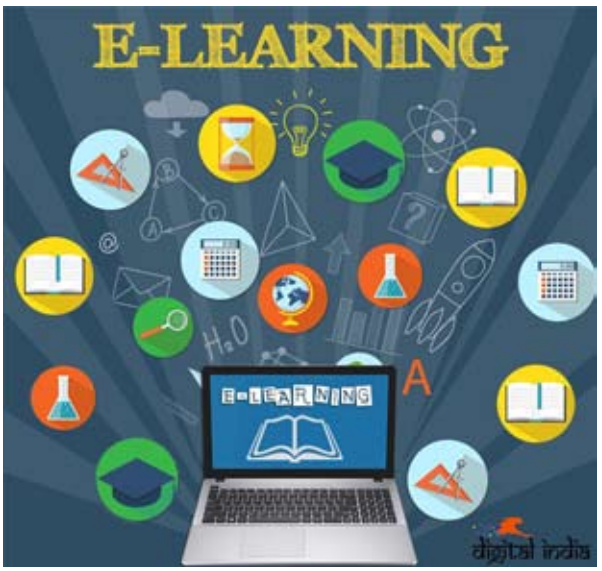
energy resources, remedial measures for carbon footprint, efficient devices/ machines etc.

MHRD Initiatives on Promotion of Innovation

In recent times, the Higher Education Department of the Ministry of Human Resource Development (MHRD) has launched several new and innovative programs to make higher education more pervasive and effective and usher in significant positive changes in the higher education system, particularly in engineering and technology. Some of the notable initiatives are summarized below:

Research and Innovation: Start up India Initiative for HEIs

To promote the culture of 'innovation' in tune with the declaration of 21st century as the century of innovation and our Prime Minister's desire to dedicate 2010-20 as the 'Decade of Innovation', MHRD has launched MHRD Innovation Cell (MIC) and Atal Ranking of Institutions on Innovation Achievements (*ARIIA*) to systematically foster the culture of innovation in all higher education institutes (HEIs) across the country by encouraging and nurturing young students to explore new ideas that can result into innovative products and activities and in turn can make them successful entrepreneurs one day. The initiative envisages creation of 1000 Institute Innovation Centers (IIC) across the country to spread awareness, promote the culture of innovation among students and create an effective eco system for ushering in 'New India' that can compete with the likes of Stanford and MIT.



Global Initiative for Academic Network (GIAN)

MHRD initiative on creating a new program titled Global Initiative of Academic Networks (GIAN) in Higher Education aims to connect the Indian academia with the international talent pool of scientists and entrepreneurs by inviting them to teach and participate in research in Indian HEIs. GIAN should augment quality of professionals in academia, and elevate India's scientific and technological standing in the global benchmark.

Scheme for Academic Research and Promotion by Collaboration (SPARC)

SPARC is a new and logical follow up initiative of MHRD after GIAN for improving the research ecosystem of India's HEIs by facilitating academic and research collaborations between Indian academia and best institutions in the world. Under this Scheme, 600 joint research proposals will be funded for 2 years to facilitate strong international research collaboration with leading foreign universities. Lack of international faculty and scholars in Indian institutions adversely affects our ranking. SPARC may significantly help Indian universities close that gap and facilitate new inventions and innovation.

Digital India-e-learning

The main objective of this virtual classroom initiative is to enable millions of youth outside the university

Cluster Innovation Centre

campus to access best quality teachers and teaching courses in an easy paced manner without having to pay large admission/tuition fees or even qualify through JEE or other entrance examinations. MOOCs will allow limited interaction with faculty, take examinations and even earn certificates that may help in getting employment.

Research and Innovation

It is envisaged that design-centric innovation can be a force multiplier that can help India move up the value chain and make its industry globally competitive. Under this initiative, 20 new Design Innovation Centers (DIC), one Open Design School (ODS) and a National Design Innovation Network (NDIN) are planned to be set up with interlinks.

Uchhatar Avishkar Yojana (UAY)

UAY promotes industry sponsored, outcome-oriented research projects with an outlay of Rs. 475.00 crore for a period of two years beginning 2016-17. The project cost is met to the extent of 50 per cent by MHRD and 25 per cent each by the Industry and host Institute. The objectives of UAY scheme are to promote innovation in IITs, connect with manufacturing industries, spur innovative mindset and promote collaboration and cooperation between academia and industry.

Innovation in HEIs - IMPRINT

The relevant question now is what is next?

The Government of India, in order to promote the culture of innovation in India, particularly in the technology institutions like IITs, NITs and all other HEIs, recently formulated a new and unique scheme called Impacting Research Innovation and Technology (IMPRINT), primarily with the goal of translation of knowledge from research into viable technology (product or process). Initiatives to promote research and innovation is nothing new. Yet why was IMPRINT conceived? What is different about IMPRINT? Let us address these two issues first.

As we all know, India with its over $ 2.5 trillion gross domestic product (GDP) eyeing a double digit growth is a mighty economic force in the world supported by a formidable 1.25 billion population with more than 800 million below the age of 35. Furthermore, India may soon be crowned the youngest nation in the world with average age of 28. However, it is also a reality that our nation faces multitude of daunting challenges in terms of energy/physical/cyber security, potable water scarcity, environment and climate change, poverty and unemployment, and easy and affordable education and health care for billions. A vast majority of these tasks demand engineering intervention and technological innovation. A clarion call was made by the Honorable President and Prime Minister of India to address all engineering and technological challenges faced by the nation through a nation-wide unique initiative called IMPacting Research INnovation and Technology (IMPRINT) launched on November 5, 2015 from the Rashtrapati Bhavan. Thus, the initial version of IMPRINT was conceived as a national initiative of MHRD through an inclusive and sustainable mode of translational research.

Imprint

IMPRINT is different from usual research initiatives because (i) it is meant not only for creation but for translation of knowledge into viable technology, (ii) it addresses not just one but all technology challenges faced by the nation, (iii) it relies upon a total inclusive model of crowd sourcing and involving all concerned stakeholders from Ministry to industry. Consequently, the initial round of IMPRINT (IMPRINT I) created an unprecedented enthusiasm among the researchers in academia. From 2612 initial proposals only 259 were selected and 142 projects are

now underway with an outlay of Rs 485 crore for three years. Until now IMPRINT I has culminated into more than 200 peer review publications and about 25 patent applications and invention disclosures. Over 250 project staff including about 100 PhD scholars and 50 post-doctorates have been engaged in various projects. In order to disseminate the progress of all the 142 projects, a new KNOWLEDGE PORTAL has been created in the IMPRINT website (https://imprint-india.org/knowledge-portal) to display the recent exploits and progress, significant results and possible breakthrough achieved on a monthly basis from each project, apart from documenting the knowledge (publication, report, patent) and facilities (instrument, device, laboratory) created, manpower (student, scholar) trained, financial resources obtained/utilized, collaboration (with industry or partners) pursued, and above all, the prototype, pilot or product developed under the on-going IMPRINT I research project. The portal will remain active until the logical conclusion of the projects. All the products and prototypes will be displayed in public through an exhibition in February 2019.

Imprint II

Encouraged by the success of IMPRINT I, a newer version called IMPRINT II, was planned in a more inclusive manner by expanding the catchment of implementing institutions, by adopting a more demand-driven strategy of solution development and by incorporating the specific requirements of the states of India so as to make end-user translation and technology adoption easier. The SERB (Science and Engineering Research Board) in the Department of Science & Technology (DST) was made the nodal agency for implementing the IMPRINT II initiative working along with the National Coordinator. All faculty members and researchers in all Government of India funded HEIs working in engineering and technology areas, especially in IITs, NITs, IISERs, IIITs or CUs are eligible to submit proposals in IMPRINT II as the Principal Investigator (PI). IMPRINT II shall maintain an appropriate inventory of stakeholder needs and map the same against various products/technologies/knowledge base likely to be developed under the initiative.

Overall outlay for IMPRINT II is about Rs 670 crore during 2018-19 to 2021-22 with 50-50 budget sharing between MHRD and DST. Like IMPRINT I, this version also evoked wide spread enthusiasm. From 2145 initial proposals screened to 549 final proposals, eventually only 122 projects were selected for funding after two rounds of rigorous review running over three months. Help from over 500 experts including the Expert Pool of Indian National Academy of Engineering (INAE) was utilized for blind project review and knowledge management. Core mandate of IMPRINT II has been:

- Develop products/processes and viable technologies for addressing the identified challenges in different domains
- Formulate and develop focused translational projects against identified technology thrust areas by various stakeholder ministries
- Evolve new technology transfer models for enabling technology diffusion to industry and stakeholders
- Continuously monitor and refine the challenges and gaps in the various technology domains and collect feedback from stakeholder ministries/industry
- Align the programmers and projects with the needs of various industry sectors and the States of India in order to achieve end-user translation
- Facilitate building capability and competence in identified technology thrust areas in the various HEIs and universities in order to plug the demand-supply gap

Detailed information about the scope, mandate, eligibility, review/monitoring mechanism, and format/procedure for submission of preliminary and final project proposals are available in the IMPRINT website (www.IMPRINT-2.in).andwww.imprint-india.org). An extended version of IMPRINT II will soon be rolled out to address special societal challenges covering issues on pollution, waste management, health care, personal security etc.

Conclusion

In the present era of knowledge based society, science is no longer only a curiosity driven act but is felt as an intrinsic necessity and urge to translate knowledge into societal benefit through engineering invention and technological innovation. Scientific pursuits demand continuous efforts, not sequential. Outcome is mostly slow and incremental but at times disruptive leading to paradigm shift and opening new chapters and avenues. Innovation has become synonymous with evolution and progress in life. Education is the only way to effectively train the population not only to benefit from the exploits and fruits of innovation but also to actively participate and contribute to this crusade for creating a better, safer and healthier planet. ❑

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Improving Governance in Public Systems

C Achalender Reddy
Avik Chakraborty

Government agencies around the world are constantly innovating new ways of managing operations and rewarding people for innovative work. Put simply, public sector innovation involves creating, developing and implementing practical ideas that achieve a public benefit. These ideas have to be at least in part new and they have to be taken up for implementation rather than remaining simply as ideas. And, most important is that they have to be useful.

Innovations are both conceptual and perceptual, and, therefore, the innovators working in various public systems should look out, interact and listen to both the persons who are delivering and receiving the services. There is a need to study the expectations, values and especially the needs of the people to put in practice the innovative practices which have been found useful.

Definition of Innovation

Public systems tend to adopt innovations which enhance service delivery, increase efficiency and ensure cost reduction. An innovation in public systems can be defined as a process/policy intervention that

- Improves the public service delivery
- Enhances the efficiency of governance structure i.e. simplifying procedures etc.
- Improves citizen satisfaction
- Promotes transparency and accountability
- Reduces the time taken for service delivery
- Reduces the cost without affecting the efficacy and efficiency
- Leverages the use of technology

Types of Innovations

Innovations which exist in the public domain are often overlapping and are not restricted to a particular category. However, for a better understanding, innovations in public systems may be broadly categorised under the following heads:

Service Innovations– intend to introduce a new service, product or improvement in the quality of an

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existing service or product. **Bharat Interface for Money (BHIM)** is a mobile application developed by the National Payments Corporation of India (NPCI) which enables e-payments directly through banks.

Service Delivery Innovations create a new or improved way of delivering specific public service to the citizens that aim at improving accessibility, targeting user needs more accurately, bringing in simplification of procedures etc.

Common Service Centres (CSCs) are the access points for delivery of essential public utility services, social welfare schemes, healthcare, financial, education and agriculture services, apart from a host of Business to Citizen (B2C) services to citizens in rural and remote areas of the country. It is a pan-India network catering to the regional, geographic, linguistic and cultural diversity of the country, thus enabling the Government's mandate of a socially, financially and digitally inclusive society.

Administrative/Organizational Innovations target to change the hierarchical structures and administrative routines in the Government

Electronic National Agriculture Market (e-NAM) is a Pan-India electronic trading portal launched in 2016 completely funded by the Central Government and implemented by Small Farmers' Agribusiness

Consortium (SFAC). It creates a national network of physical mandis which can be accessed online thus enabling buyers, situated even outside the State, to participate in trading at the local level.

Policy Innovations bring about the systemic culture of nurturing fresh ideas. Best practices that have a proven record of sustainability may be incorporated and be advocated as a policy. Drafting a policy for promotion of innovations itself is a policy innovation. This may include incentivising mechanism, identifying and appointing innovation officers in each Department etc. among others.

National Policy on Biofuels (2018) was first drafted by the Ministry of New and Renewable Energy in 2009 but later was shifted to the Ministry of Petroleum and Natural Gas in 2017 and was finally launched in 2018. The policy encourages the use of biofuels by extending appropriate financial incentives under various categories which results in reduced import dependency, a cleaner environment, employment generation etc. The role of twelve Ministries has been specified for effective implementation of biofuels programme in India.

Systemic Innovations employ new or improved ways of interacting with the citizens and engage them in service design which encourages a participative approach in governance and improves the magnitude of stakeholder consultation in decision making.

It is fair to conclude that innovations in public systems are indispensable and it is both a continuous process as well as a result. It is also a specific area of high importance where tools, methods and approaches are in constant evolution to facilitate identification, documentation and replication of innovations.

India Innovation Growth Program is a public, private partnership of the Department of Science and Technology, Government of India and Lockheed Martin Corporation. This initiative throws open a chance to the public to suggest innovative solutions to major societal problems.

Promoting Innovations in Public Systems

Understanding Opportunities and Problems

- Begins with a prompt or trigger including problems, failures

and complaints which makes innovation either possible or necessary.

- Attuned to new trends, customer demands, data or technologies and innovations that are happening elsewhere.
- Emphasise better understanding of how people live their lives, and how services are used to help improve them.
- Find new insights into what people need, to end up with a clearly defined problem.

Generating and Sharing Useful Ideas

- Prioritise the areas of concern (e.g. health, education, infrastructure, water supply, sanitation, PDS etc.) which need to be addressed.
- Identify different types and sources of data, information and knowledge that are relevant.
- Channelise data, information and knowledge into a usable form so that it can be fully exploited to support evidence-based decision making.
- Share information collected with wider sets of actors.

Collaborating with Like-minded Stakeholders

- Identify and assess the importance of key people, group of people, or institutions.
- Define whom to involve in designing a multi-stakeholder process.
- Understand the role of multiple stakeholders who are likely to be involved in promoting innovation. These include both direct users who take action in implementing the initiative, and other individuals who will need to be involved in supporting initiative implementation (e.g. administrators, specialists, the staff of community agencies etc.).
- Describe the roles and responsibilities of those expected to support the long-term sustainability of innovations.
- Sensitise/build the capacities of relevant stakeholders to develop a culture of ownership and responsibility amongst them.

As the country has set out on the Swachh Bharat Mission, one of the major attributes is to end open defecation. ECOSAN, an initiative that is one of its kind, offers an economical and simple-to-use option in contrast to the conventional waste transfer methods where the human excreta and body wash water do not go waste.

- Create a knowledge repository that facilitates the availability of information in the public domain.

Documenting Innovations

While documenting an innovation, the following heads shall be covered

- Concept and Types of Innovations
- Skills and Tools Involved
- Learning based Monitoring and Evaluation System
- Processes and Linkages for scaling up
- Change in Practices
- Use of new knowledge/new use of existing knowledge

Potential Challenges

The following challenges are likely to be encountered while identifying, documenting and replicating innovations:

- Resource mobilisation
- Departmental silos and lack of convergence mechanism
- Fading away of the innovations due to a change in the personnel
- Lack of institutional memory
- Transfer of ownership
- Lack of domain expertise
- Internal animosity between different wings of Government/ Organization

Innovative Practices: High Potential for Adoption/Replication

Ecological Sanitation (ECOSAN)

As the country has set out on the Swachh Bharat Mission, one of the major attributes is to end open defecation. ECOSAN, an initiative that is one of its kind, offers an economical and simple-to-use option in contrast to the conventional waste transfer methods where the human excreta and body wash water do not go waste. The toilet is in daily use and never smells. The urine is collected in

a drum/pot outside the toilet for later use, and body wash water is used beneficially by diversion to the trees outside. ECOSAN toilets are much more helpful in flood-prone areas as it is completely sealed and would not result in overflow. And they are highly useful in drought-prone areas for being a remarkable alternative in the sustainable use of water. ECOSAN toilets reduce health risks due to contamination of drinking water by human waste; to prevent ground and surface water pollution, and to reuse the energy content within the human waste.

Use of Plastic Waste in Road Construction

Disposal of plastic waste is a serious concern in India and one technological approach developed by Prof. Rajagopalan Vasudevan has been found to be very useful in utilising plastic waste on a large scale. The salient feature of the whole process of constructing plastic roads is simple and easy and does not require any new machinery and industrial involvement. The utilisation of plastic waste to improve the properties of the bituminous mix offers a very promising alternative with its bulk and eco-friendly usage. The plastic roads ensure enhanced load carrying strength, water resistance, negligible maintenance cost and reduction of bitumen consumption by 10 per cent.

Urban Greening Activities by Kochi Metro Rail Limited

Kochi Metro Rail Limited (KMRL) is in the process of adding greenery to the infrastructure being created, thereby contributing to the enhanced green cover in and around Kochi. City dwellers have raised the demand for improving the greenery by the renovation of city parks and open spaces. KMRL, as a part of the environmental impact assessment report, has to compensate for the trees removed during the process of project implementation by planting trees in the ratio of 1:10. This will be complemented by the development of a green belt around the coach maintenance depot at Muttom and development of a green ribbon along the 25 Km stretch of the metro. In this way, KMRL will act as a catalyst for urban greening activities to reduce the carbon footprint.

Mother Tongue Based-Multilingual Education (MTB-MLE)

MTB-MLE is an approach to address the educational challenges faced by the indigenous population. In this approach, children start learning in their mother tongue in early grades with a gradual transition to a regional language and an international language. It contributes to 'quality education' as it facilitates the learning process, improves the ability to learn other languages and enables to strengthen the process of education by reaching out to grass-root levels.

Establishment of Vision Centres

Establishment of Vision Centres in rural villages with tele-ophthalmology connectivity with Base Hospitals is an effective model to reach patients who otherwise do not have access to quality eye care. Aravind Eye Care System in Madurai (Tamil Nadu) has successfully implemented this model covering a total population of over 3 million. This model makes eye care services available for the rural population at their doorsteps thus leading to a considerable reduction of the burden of cost and in preventing avoidable blindness. Most of the problems are addressed locally at the Vision Centres, and only a minuscule number of them are referred to either a secondary or a tertiary level hospital for further management. This considerably reduces the financial burden of patients by saving their expenditure on travel, food and lost wages.

Conclusion

CIPS, being a national body established by the Government of India in 2010 as an autonomous centre at ASCI, Hyderabad with a mandate to promote innovations in public systems, is working with Central Ministries, State Governments, Union Territories and Not-for-profit organizations to actively promote and disseminate practices which have resulted in enhanced service delivery, increased efficiency and cost reduction. CIPS also acts as a platform for sharing and disseminating knowledge on themes of critical importance.

It is fair to conclude that innovations in public systems are indispensable and it is both a continuous process as well as a result. It is also a specific area of high importance where tools, methods and approaches are in constant evolution to facilitate identification, documentation and replication of innovations.

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YE-953/2018

Transforming Public Transport in India

Anuj Dayal

With rapid growth of population in the cities and increase in motor vehicles, the urban space in India for creation of the necessary infrastructure is shrinking every year. An average of 60,000 vehicles are sold every day in India. On the other hand, the consistent growth of population is further widening the gap between demand and supply of public transport needs. At a time when traffic in mega cities like New Delhi, Mumbai and Bengaluru is gradually slowing down the mobility, an effective public transport system like Metro Rail has become the core priority of urban administrations to ease the urban commutation.

Metro Rail, one of the popular mass transit modes is a form of public transport that operates on exclusive right-of-way and carries a large number of commuters in urban space. This system is operated on

non-pollutant energy and is most preferable in densely populated urban spaces. Undoubtedly, the Mass Transit System is by far the most remarkable invention in public transport. The idea of having an exclusive transport system to provide comfortable means to commute was born out of the then emerging issues of early urbanisation in Britain, which led to the construction of underground train network in the late 19th century.

The success of earliest MRT Systems such as London Tube and New York Metro paved the path for similar systems across the world. Today, MRT Systems are operated in massive metropolitan cities like Tokyo, Seoul, Moscow, Beijing, New Delhi, Shanghai. Hong Kong, Paris, Amsterdam and Mexico City etc. It can be said with certainty that MRTS proved to be an effective mode of public transport in most of these cities. Indian cities are no different. In India, 10 cities already have operational Metro networks and many more projects are proposed to be built soon.

The Metros across the world have undoubtedly smoothened the public transport wherever they were introduced. Besides offering the best public transport, cities like Hong Kong and Tokyo are running Metros with operational profit. Delhi Metro too earned a spot as an operational profitable metro in the world. This success of Delhi Metro sparked a new era of Metro revolution in India. As of today, 524 kilometers of metro network is already operational in India and 620 kilometers of network is under construction.

Traditional System: A Pollution Hazard

Large cities like Delhi and Mumbai have drastically changed over the past few decades. As predicted, the changing demography of urban space is posing complex challenges to urban administrations. One can observe that almost all major cities in the country are facing similar challenges in public transport. Unfortunately, the traditional means of public transport are outdated and carry only limited capacity. They are far from matching the growing needs of the population. Not to forget, they are also contributing to pollution and the never ending traffic woes. With people stuck in traffic, billions of productive working hours are lost every year. The stranded vehicles on roads are also intensifying the toxic emissions in the urban sphere.

Given the current scenario, the cities need an innovative public transport system that operates on non-pollutant resources and meets the specific mobility needs of large populations. The Metro Rail which offers solutions to the issues that are not dealt by the traditional transport systems could be the perfect choice of public transport. Metro provides an eco-friendly and comfortable travel experience. This system can carry a large number of commuters from one point to another quickly and provides hassle-free journey. In addition, it is the most competent way of reducing the ever-growing traffic congestion of the developing cities.

Charging Urban Mobility needs

Metro Rail is undoubtedly a landmark innovation in the public transport system. It would not be an exaggeration to say that the Metro rail has completely changed the way urban mobility needs are met. But, building the metro alone does not ensure its successful operation. In order to make a system viable and reliable, we must constantly update the system to match the changing needs of commuters. The Delhi Metro Rail Corporation (DMRC)'s success is owed to the countless innovative practices that were initiated in every stage of its journey.

When Delhi Metro began its operations in 2002, the global MRT sector already had advanced technology in place. In fact, we were quite late to enter the field, but, we made the best use of this delay. DMRC had an opportunity to adopt the best practices of efficient metros across the world and it did so. In fact, Delhi Metro was the first to introduce contactless tokens for single journey in 2002. DMRC's interest in sophisticated technology is more visible in the systems used by DMRC.

The author is the head of Corporate Communications for the Delhi Metro Rail Project with over 32 years experience in the field of Management and Communications.

Delhi Metro experiment shows that MRT system is capable of carrying large number of people from one point to another without occupying too much space for infrastructure. This system is the answer to future transport challenges that will emerge as the cities grow bigger. In future, we are going to see more successful metro projects like Delhi Metro

Delhi Metro: Technology Survey

The trains brought in by the Delhi Metro were among the best in the world with sophisticated energy efficiency tools and they substantially improved the passengers' convenience over three phases. Since the inception of its operations in 2002, the DMRC has been continuously improving the quality of services and added several new features to the equipments used for day-to-day operations.

For instance, the trains used by Delhi Metro in its Phase - III expansion are equipped with unattended train operation mode, which enables the possibility of operating trains without drivers. With this, the Delhi Metro has joined the pool of very few highly advanced metro systems in the world. The Delhi Metro introduced the highly sophisticated 'Communication Based Train Control (CBTC)' system which enables headway improvement to about 90 seconds. In simple words, the CBTC system facilitates higher frequency of train operation, which subsequently helps transporting more people in busy hours. This comes in handy especially during the peak hours of traffic. At the same time, this system also provides high level of safety with trains running at close headway ensuring continuous safe train separation.

Other effective innovations include the installation of automatic screen doors on platforms which help maintain better crowd management. The LED screens installed inside the train coaches help commuters identify the destinations easily. In addition to this, announcements are made in the trains to inform commuters of current stations and next station to arrive. With such initiatives the Delhi Metro has managed to meet the high expectations of people of national capital region.

Innovation has always been at the heart of DMRC in planning and construction. The Delhi Metro team left no opportunity to come up with unconventional ideas to improve the efficiency of the services and make the travel experience a delight to commuters.

New Features

Most of the innovative ideas emerged from the changing needs and feedback of commuters. For instance, it was noticed that commuters might need to charge their laptops and phones while travelling. To facilitate this, power connections in all the 131 trains in Phase-II were provided for them. Later on, USB plugins for charging facilities were also introduced.

The new Rolling Stock (trains) that has been acquired for Phase - III operations has many new features both in its interior and exterior from the aesthetic as well as commuter facility points of view.

The new features are as follows:

- There is a change in the look of the front cab of the trains. There is glass on the front emergency door to give it a better look.
- LED based lighting is used inside the trains. Presently, the rolling stock used in DMRC has fluorescent lighting.
- The display panels inside the trains are LED based, where graphics, public information messages and advertisements also will be aired if necessary. Currently, only the station names or messages are displayed there.
- The dynamic route maps have been changed to LCD technology for better understanding.
- The noise levels inside the trains have been reduced further from the present limit of 68 dB to 65 dB.
- Higher number of grab rails and grab handles have been provided for the convenience of the standing passengers.
- Broader gangways between the coaches provide more convenience to the commuters.

Energy Efficient Techniques

The introduction of Metro in Delhi did more than just smoothening the public transport. A large number of people in Delhi switched from private vehicles to the Metro in recent years. According to a study conducted by Central Road Research Institute, around 3,90,971 vehicles were taken off the roads after Metro started operating in Delhi.

This in turn helped reduce around 5,53,203 tonnes of CO2 from environment every year. In fact, DMRC became the first railway project in the world to win carbon credits. The carbon credit is a permit which allows a country or organisation to produce certain amount of emissions which can be traded if full allowance is not used.

Delhi Metro is one of the pioneers in adopting energy-efficient techniques. In order to bring down the energy consumption levels, the Delhi Metro developed its own solar power generation plants on rooftops of stations and depots. Currently, the DMRC is producing around 25 Megawatts of solar power annually and is aiming to raise the capacity to 50 Megawatts in future. We also adopted different methods such as regenerating braking and model shift projects for optimisal use of the energy.

The Delhi Metro experiment has emerged as the example for many other Indian cities which are facing similar urban challenges. When Kolkata Metro was constructed in 1970s, it caused severe inconvenience to the public. Therefore, the city planners were apprehensive of launching such massive construction projects in crowded cities. However, the Delhi Metro Rail Corporation changed that perspective with its efficient and innovative construction methods.

Creating Awareness

The early years were more challenging for DMRC. When metro was launched, it was an alien system for many living in the close vicinity of metro stations. DMRC had to bring a sea change in the culture through awareness campaigns to make them use the advance facilities offered in the metro. Numerous social campaigns to raise awareness on use of escalators, lifts, automatic fare collection (AFC) gates and usage of smart cards were carried out. For this, DMRC used highly engaging theatre arts such as Nukkad Nataks and Puppet Shows.

This out of the box approach was followed by DMRC right from the beginning. For instance, during the construction stage work, it was ensured that all construction sites were

properly barricaded and construction vehicles always left the sites after being thoroughly cleaned. Marshals were deployed by DMRC at the construction sites to manage traffic. DMRC also organised community interaction programmes to engage the residents near construction sites and to listen to their grievances and suggestions. For the first time, reverse countdown clocks indicating the schedule for opening of each section were put up in all offices to constantly remind the time left to complete the work.

In the context of India, these measures taken were highly innovative. No other construction projects in the country had adopted such procedures ever before. This helped DMRC complete its Phase - I of 65 kilometers of network 2 years and 9 months ahead of its schedule. Similarly, the Phase – II network of 125 was completed five months ahead of the deadline. DMRC is about to complete the Phase – III network soon. With this, DMRC proved to the world that such massive projects can be completed within the deadline without causing inconvenience to the public.

Unlike other public transport systems, the Delhi Metro is highly punctual. On average, 99 percent of the train trips are recorded on time and redefined the punctuality norms to 59 seconds. Currently, the Delhi Metro operates 4000 train trips every day from 6 AM to 11 PM with its 280 train sets. The trains are operated on average frequency of 2 to 3 minutes during peak hours of traffic.

These steps embraced by DMRC made it extremely popular. This also prompted other cities in India to take up similar projects of their own. In fact, the success of Delhi Metro sparked a metro revolution. Metros in cities like Hyderabad, Mumbai, Kolkata and Chennai are already carrying lakhs of commuters every day. But, Indian metros other than Delhi Metro are still in preliminary stage.

Delhi Metro experiment shows that MRT system is capable of carrying large number of people from one point to another without occupying too much space for infrastructure. This system is the answer to future transport challenges that will emerge as the cities grow bigger. In future, we are going to see more successful metro projects like Delhi Metro. ❑

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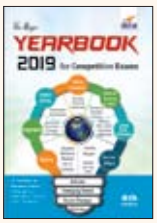

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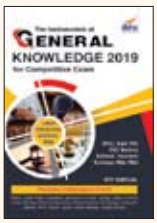

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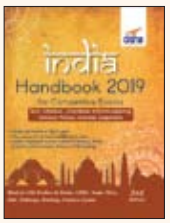

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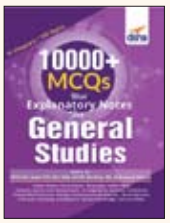

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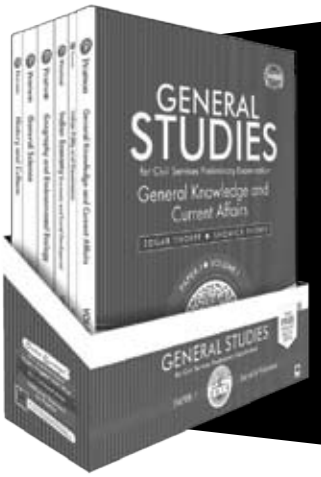

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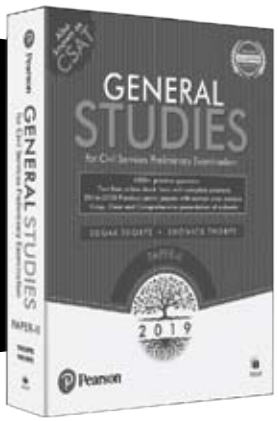

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YE-951/2018

Improving Competitiveness in SMEs

Manjula Wadhwa

Innovation plays a critical role in shaping the industrial and firm competitiveness of any nation. It has often been discussed in the context of developed countries but the rise of emerging economies such as India has generated a new interest in innovation in the context of developing economies.

Undoubtedly, Small and Medium Enterprises play a highly significant role in India's developing economy. They contribute to economic growth, employment, reduction of poverty and thus aptly are considered as the engines of growth. Apart from this, Entrepreneurship and Innovation activities enhance competition and productivity growth as well. In addition, SMEs are more productive because they are more flexible and can adapt to the changes in the market.

Given the paramountcy of the sector, it is critical to ensure that our SMEs remain competitive both nationally and globally. Indian SMEs face a formidable challenge in this regard. The updation of GOI Science, Technology and Innovation Policy 2013, provided a big impetus to build an innovation ecosystem and to enhance the role of the private sector to do the same. The Ministry of MSME, apart from providing them financial subsidy and incentives to buy machinery, file trademarks, and gain access to tools, training, and expert advice, runs various schemes and programs to support the technological and other innovations in Indian SMEs.

...the efforts of the Government have started bearing positive results and showing remarkable improvement and India has succeeded in attaining 57th rank in 2018 Global Innovation Index.

Initiatives

Virtually, innovation does not occur in silos. However, just offering institutional support will not suffice. It is equally crucial to ensure that the operating firms are aware of different institutional support mechanisms and are able to access them. So now, let us discuss a few significant initiatives taken during the year by the Government with an objective of promoting innovation to further strengthen the competitiveness of the MSME sector and thereby accelerating economic development at the grass-root level.

First and foremost is the huge allocation of Rs. 3794 crore in the current FY Union Budget, for enhancing the financing and innovative capacity of the MSME sector. Pradhan Mantri **MUDRA Yojana** is another milestone with a provision of Rs. 3 lakh crore for the sector. Reduction in tax rates to 25

The author is Asstt. General Manager, NABARD, Haryana Regional Office, Chandigarh.

Table: 1

Sr. No.	Item	Amount (Rs. In crore)
1	Creation, updation and maintenance of database of the technology centres network	2.00
2	Capacity building including Awards, studies, Surveys, Exposure visits, engaging consultants, monitoring and evaluation	17.75
3	A. Fund for setting up of incubation centres by NSIC/KVIB/Coir Board or any other agency of GOI/state Govt.	62.50
	B. Fund for setting up of technology incubation centre	61.50
4	Administrative cost @ 10% of 3(A) above	6.25
5	Fund of Funds for startups to be managed by SIDBI	60.00
	Total:	**210.00**

per cent made by the Government during the last financial year, again, has proved to be a positive step which has paved the way for making available additional capital to the SME sector. This has, of course, helped in augmenting the innovative capacity of SMEs. Budget allocation of Rs. 550 crore for setting up ultra-modern technology centres, is also worth mentioning here. A grant of Rs. 415 crore for the promotion of Khadi Udyog, is also going to help the growth of this sector.

A scheme for promotion of innovation, rural industry and entrepreneurship (ASPIRE) was launched on 16th March 2015. The most important component of this scheme is setting up 100 livelihood and 20 technology related incubators through provision of Rs. 232 crore for this purpose in Union Budget estimate 2018-19. The funding pattern for different components is as in Table 1

With a view to generate employment opportunities in rural as well as urban areas of the country through setting up of new self-employment ventures/ projects/micro enterprises, **Prime Minister Employment Generation Programme** was launched on 15th August. 2008. An allocation of Rs. 1800 crore made under it in current FY budget, will enable the setting up of 8800 micro enterprises, thus benefitting approximately 7 lakh people.

Another boost provided by the Government for the growth of MSME sector is the **CGTMSE** (Credit Guarantee Fund Trust for Micro and Small Enterprises), the whole idea behind which has been to provide financial assistance to these industries without any third party guarantee/ or collateral. These schemes provide the assurance to the lenders that in case of default by them, a guarantee cover will be provided by trust in the ratio of 50/75/80/85 percent of the amount so given. Apart from augmenting the fund corpus from Rs. 2500 crore to 7500 crore necessary structural changes have also been made so as to remove the hurdles in SME financing.

An allocation of Rs. 1800 crore made under it **(Prime Minister Employment Generation Programme)** in current FY budget, will enable the setting up of 8800 micro enterprises, thus benefitting approximately 7 lakh people.

The Revamped **Scheme of Fund for Regeneration of Traditional Industries (SFURTI)** launched on 1st August 2014 with an outlay of Rs. 149.44 crore for developing 71 clusters (including coir) with coverage of 44500 artisans (approx.) in the first phase, has further been infused with Rs. 125 crore in 2018-19 budget.

As a result of the above initiatives taken by the Government a positive revelation has been made in a recent survey done by ***American Express*** in collaboration with ***Oxford Economics*** - India's small and medium businesses are using their advantages such as size, agility and innovation as their top three strategies for driving revenue growth in 2018.

Thus, the efforts of the Government have started bearing positive results and showing remarkable improvement and India has succeeded in attaining 57th rank in 2018 Global Innovation Index.

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** The second edition of the American Express Global SME Pulse 2018

*** SME Biz Innovation summit 2016-questexevent.com

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Adding More Meaning to Money

Shishir Sinha

...financial innovations have made life easier for a larger section of people. And the best thing is that changes are being incorporated based on filed experience making these schemes more effective.

Invention is challenging, but innovation is equally or sometime more challenging. The reason is obvious. Normally, invention starts with uncertainty and end result could be different from what an inventor had visualised or conceptualised. However, this may be not be the same with innovation as it is an act of making changes to the existing product or the process by introducing new ways or ideas. Nonetheless, both have one common thing and that is their success or failure depends upon how it affects people at large.

Success or failure of an innovation also depends upon use of technology and this can be said more specifically in the context of innovations in the financial sector in India. Starting from Pradhan Mantri Jan Dhan Yojana to Pradhan Mantri MUDRA Yojana or even Goods and Services Tax (GST), all are being implemented with the help of information technology making them emphatic and more importantly cost effective, both for the Government as well for the masses. Best part is that most of these innovations are complimenting each other and thus providing a bigger basket of schemes for welfare of the common man. Let us discuss some recent innovations in financial and banking sectors which have impacted the economy and benefited the common man:

Pradhan Mantri Jan Dhan Yojana (PMJDY): Launched on August 28, 2014 and improvised on September 5, 2018, the scheme aims to ensure access to various financial services like availability of basic savings bank account (no need to maintain minimum amount in the account), access to need based credit, remittances facility, insurance and pension to the excluded sections i.e. weaker sections and low-income groups. This deep penetration at affordable cost is possible only with effective use of technology. The initial estimated target of PMJDY was to cover 6 crore uncovered rural households and 1.5 crore uncovered urban households with at least one Jan-Dhan account. Subsequently, it is being targeted to cover all the uncovered adult population in the country.

This scheme was an innovation as the present Government made significant changes in the then scheme of the financial inclusion scheme, Swabhimaan, and made it more practical. PMJDY focuses on coverage of households as against the earlier plan which focused on coverage of villages. It focuses on coverage of rural as well as urban areas. The earlier plan targeted only villages above 2000 population while under PMJDY whole country is to be covered by extending banking facilities in each Sub-Service area consisting of 1000–1500 households such that facility is available to all within a reasonable distance, say about 5 kms.

Normally when one thinks of the bank, one gets an image of brick and mortar structure, but PMJDY was

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implemented with more of machine than a concrete structure. The scheme also prescribes plastic currency in the form of RuPay card for all such accounts making a bigger impact in digital payment system. The scheme envisages channelising all Government benefits (from Centre/State/Local Body) to the beneficiaries' accounts and pushing the Direct Benefits Transfer (DBT) scheme of the Union Government. DBT transfer is a win-win situation for both the common man and the Government. On the one hand, with the help of DBT in the bank accounts directly, common man gets the welfare amount in full while the Government manages to remove duplicate/ fake beneficiaries and plugging of leakages etc., and thus is able to target the genuine and deserving beneficiaries and save resources. So far, the Government has managed to save over Rs 90000 crore through DBT.

Another key feature of PMJDY is ease of opening bank accounts. The Reserve Bank of India (RBI), vide its Press Release dated August 26, 2014, said that that those persons who do not have any of the 'officially valid documents' can open "Small Accounts" with banks. A "Small Account" can be opened on the basis of a self-attested photograph and putting his/ her signatures or thumb print in the presence of officials of the bank. Such accounts have limitations regarding the aggregate credits (not more than Rs. one lakh in a year), aggregate withdrawals (nor more than Rs. ten thousand in a month) and balance in the accounts (not more than Rs. fifty thousand at any point of time). These accounts would be valid normally for a period of twelve months. Thereafter, such accounts would be allowed to continue for a further period of twelve more months, if the account-holder provides a document showing that he/ she has applied for any of the Officially Valid Document, within 12 months of opening the small account.

The Government, on September 5, 2018, decided not just to continue with PMJDY (beyond August 14, 2018) but also improve it further. Now existing overdraft limit will be Rs 10,000 as against Rs 5,000. As earlier,

overdraft facility will be available to one account holder per household after 6 months of satisfactory conduct of the account. However, there will not be any conditions attached for overdraft upto Rs 2,000. Age limit for availing such facility to be revised from 18-60 years to 18-65 years. Accidental insurance cover for new RuPay card holders to be raised from Rs 1 lakh to Rs 2 lakh to new PMJDY accounts opened after August 28, 2018.

Latest data shows that over 33.4 crore PMJDY accounts have been opened with more than Rs 84,800 crore of deposit balance. Among all the account holders, 53 per cent are women and 59 per cent accounts are in rural and semi urban areas. More than 83 per cent operative PMJDY accounts (except states of Assam, Meghalaya, J&K) are Aadhaar seeded, with issuance of approximately 24.4 crore RuPay cards to these account holders. More than 7.5 crore PMJDY are receiving DBTs. Banking Correspondents (BCs) have been deployed in 1.26 lakh Sub Service Areas (rural areas), each catering to 1000-1500 households and that is an important factor in the success of the scheme.

Insurance and Pension Schemes for Social Security: PMJDY gave a base to start social security schemes for masses. No doubt there were life, non-life and pension schemes, but they were not as successful and penetration was very low. Learning from various shortcomings of existing schemes, Government innovated schemes and introduced three schemes, two for insurance and one for pension. All three schemes were launched on May 9, 2015, eight months after beginning of PMJDY. Though any one can participate in these three schemes, but they are targeted especially for the poor and the under-privileged. Here are some key features of these schemes:

1. **Scheme for Life Insurance:** The Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) is a one-year life insurance scheme, renewable from year to year, offering coverage for death due to any reason and is available to people in the age group of 18 to 50 years (life cover upto age 55) having a savings bank account who give their consent to join and enable auto-debit Life cover of Rs. 2 lakhs is available for a one year period stretching from June 1 to May 31 at a premium of Rs.330/- per annum per member and is renewable every year which means premium of less than Re 1 per day. It is offered / administered through LIC and other private Life Insurance companies. A person can join PMJJBY with one Insurance company with one bank account only. In case of claim the nominees/heirs of the insured person have to contact respective bank branch where the insured person was having

bank account. A death certificate and simple claim form is required to submit and the claim amount will be transferred to nominees account.

2. **Death and Accident Cover through non-life insurance scheme:** Pradhan Mantri Suraksha Bima Yojana (PMSBY is aimed at covering the uncovered population at highly affordable premium of just Rs.12 per year i.e. Re 1 a month. The Scheme will be available to people in the age group 18 to 70 years with a savings bank account who give their consent to join and enable auto-debit on or before 31st May for the coverage period 1st June to 31st May on an annual renewal basis. Under the said scheme, risk coverage available will be Rs. 2 lakh for accidental death and permanent total disability and Rs. 1 lakh for permanent partial disability, for a one-year period stretching from 1st June to May 31. It is offered by Public Sector General Insurance Companies or any other General Insurance Company who are willing to offer the product on similar terms with necessary approvals and tie up with banks for this purpose. Participating Bank will be the Master policy holder on behalf of the participating subscribers. It will be the responsibility of the participating bank to recover the appropriate annual premium in one instalment, as per the option, from the account holders on or before the due date through 'auto-debit' process and transfer the amount due to the insurance company. Further, in order to assure a hassle-free claim settlement experience for the claimants a simple and subscriber friendly administration and claim settlement process has been put in place. The simplified procedures and the documentary requirements and the procedures can be completed at point of contact which a claimant is likely to get in touch in case of an accident resulting in a claim under the scheme. An IT enabled, web-based system is there to keep the claimants informed seamlessly about the progress and status of the claim, till it's settlement. Claim settlement is made to the bank account of the insured or his nominee in case of death of the account holder. The scheme intends to serve the goal of financial inclusion by achieving penetration of insurance down to the weaker sections of the society, ensuring their or their family's financial security, which otherwise gets pulled to the ground in case of any unexpected and unfortunate accident.

3. **Pension Scheme:** Atal Pension Yojana (APY) is open to all bank account holders. However, the Central Government is co-contributing 50 percent of the total contribution or Rs. 1000 per annum, whichever is lower, to each eligible subscriber, for a period of 5 years, i.e., from Financial Year 2015- 16 to 2019-20, who joined the scheme before December 31, 2015 and who are not members of any statutory social security scheme and who are not income tax payers. Such a move will encourage pension culture among people in the unorganised sector. A subscriber joining the scheme of Rs. 1,000 monthly pension at the age of 18 years would be required to contribute Rs. 42 per month. However, if he joins at age 40, he has to contribute Rs. 291 per month. Similarly, a subscriber joining the scheme of Rs. 5,000 monthly pension at the age of 18 years would be required to contribute Rs. 210 per month. However, if he joins at age 40, he has to contribute Rs. 1,454 per month. Monthly pension would be 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. The subscribers would receive the fixed minimum pension of Rs. 1000 per month, Rs. 2000 per month, Rs. 3000 per month, Rs. 4000 per month, Rs. 5000 per month, at the age of 60 years, depending on their contributions, which itself would be based on the age of joining the scheme. Therefore, the benefit of minimum pension would be guaranteed by the Government. However, if higher investment returns are received on the contributions of subscribers, higher pension would be paid to the subscribers. The minimum age of joining APY is 18 years and maximum age is 40 years. Therefore, minimum period of contribution by any subscriber under APY would be 20 years or more.

Latest data shows that there are over 5.47 crore subscribers under PMJJBY with 1.10 lakh claims, involving an amount of Rs. 2206.28 crore settled so far. Similarly, number of subscribers under PMSBY is over 13.98 with 19,436 claims,

involving an amount of Rs. 388.72 crore. APY has managed to get over 1.11 crore persons. These are the numbers achieved in just three and half years and the Government is hopeful of accelerating the pace of digitalised, financially included and insured society with the help of JAM (Jandhan-Aadhar-Mobile).

MUDRA: Launched on April 8, 2015, MUDRA (Micro Units Development & Refinance Agency) is another financial innovation that aims to help micro (stands for first M in MSME – Micro, Small and Medium Enterprises). This scheme aims at Non–Corporate Small Business Segment (NCSB) comprising of millions of proprietorship/partnership firms running as small manufacturing units, service sector units, shopkeepers, fruits / vegetable vendors, truck operators, food-service units, repair shops, machine operators, small industries, artisans, food processors and others, in rural and urban areas. It is a refinancing Institution and does not lend directly to the micro entrepreneurs / individuals. Mudra loans under Pradhan Mantri Mudra Yojana (PMMY) can be availed of from nearby branch office of a bank, NBFC, MFIs etc. Borrowers can also now file online application for MUDRA loans on dedicated portal (www.mudramitra.in). Loans can be availed upto Rs 10 lakh under three products namely 'Shishu (loan up to Rs 50,000)', 'Kishore (loan between Rs 50,000 to Rs 5 lakhs) and 'Tarun (loan between Rs 5 lakhs and Rs 10 lakhs)' to signify the stage of growth / development and funding needs of the beneficiary micro unit / entrepreneur and also provide a reference point for the next phase of graduation / growth. Between April 1 and December 7, 2018, total of over 2.81 crore loans have been sanctioned under Mudra with sanctioned amount of over Rs 1.48 lakh crore, out of which over Rs 1.42 lakh crore already disbursed.

Stand-Up India: In order to promote entrepreneurship among Schedule Caste/Schedule Tribe and women, it is an innovation over existing credit mechanism of various banks and is intended to facilitate bank loans between Rs.10 lakh and Rs. 1crore to at least one SC/ST borrower and at least one woman borrower per bank branch for setting up greenfield enterprises which may be in manufacturing, services or the trading sector. The scheme which is being implemented through all Scheduled Commercial Banks is to benefit at least 2.5 lakh borrowers. The scheme is operational and the loan is being extended through Scheduled Commercial Banks across the country. Till March 7, 2018, public sector banks gave loan to 51,888 intended beneficiaries for the private sector and regional rural banks, the numbers were 2,445 and 1,009 respectively.

These financial innovations have made life made easier for a larger section of people. And the best thing is that changes are being incorporated based on field experience making these schemes more effective. ❑

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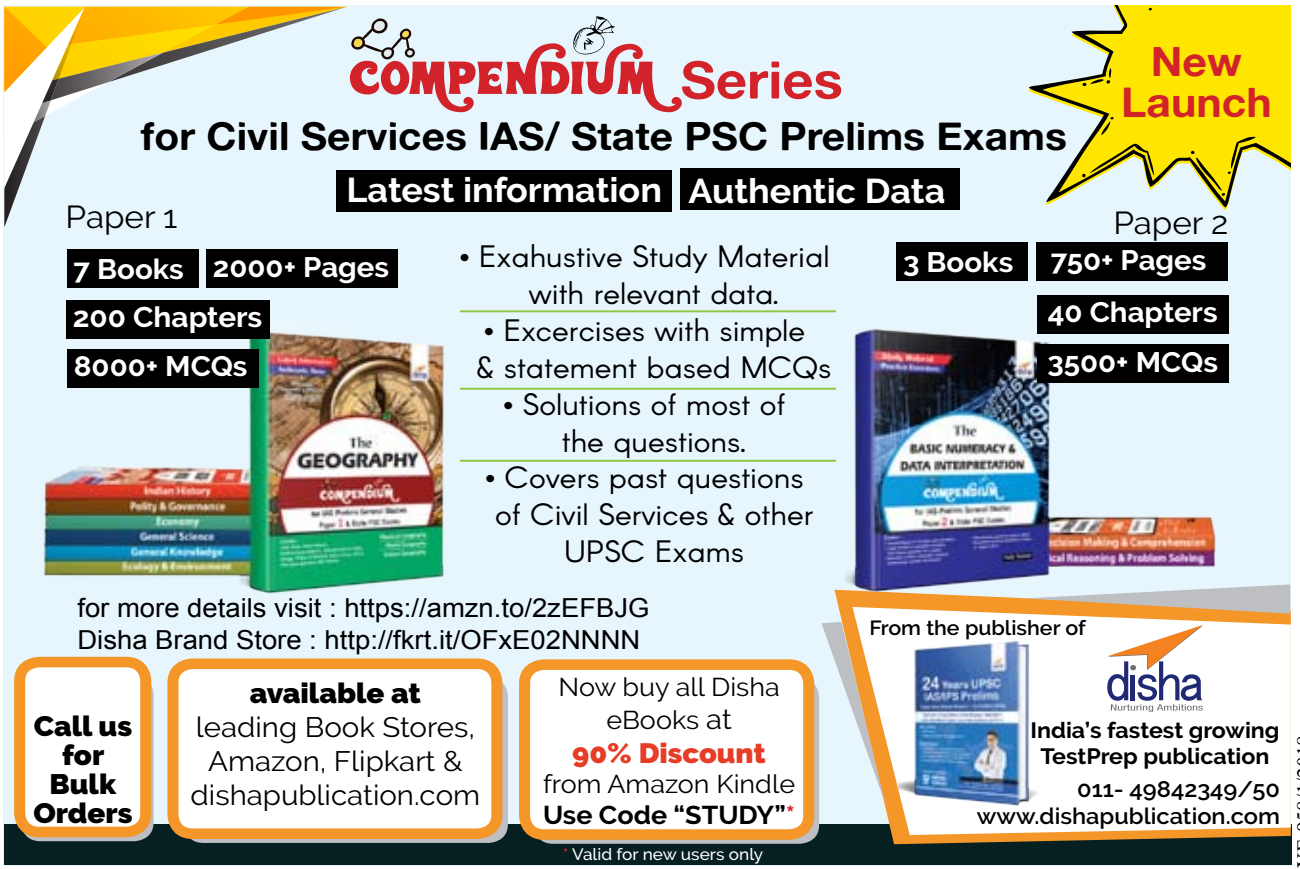
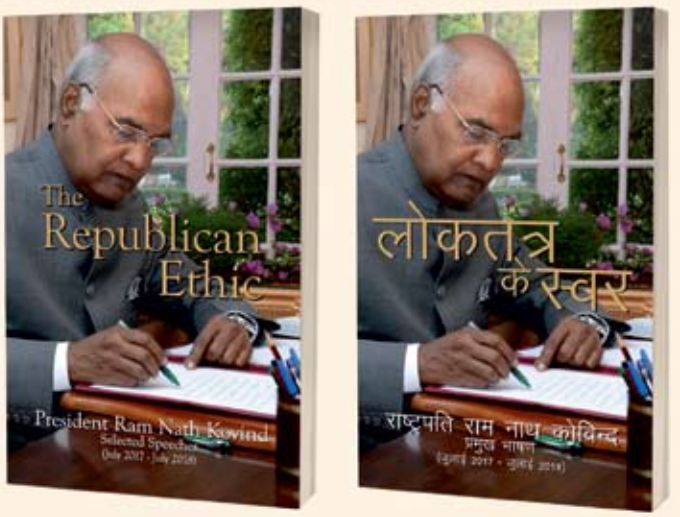


"A Republic is its people. Citizens do not just make up and preserve a Republic; they are its ultimate stakeholders and in fact pillars " - Ram Nath Kovind



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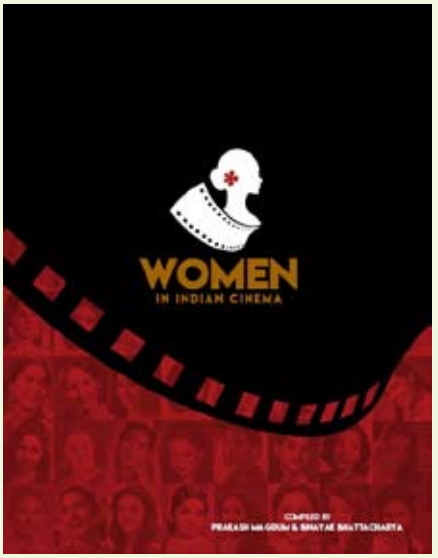
About Our Books

I&B Minister releases book "Women in Indian Cinema" during IFFI 2018

Minister of State (Independent Charge) for Information & Broadcasting and Youth Affairs & Sports Col. Rajyavardhan Rathore recently released the book "Women in India Cinema" during the inauguration ceremony of International Film festival of India (IFFI 2018) at Goa. The book has been brought out by Publications Division in partnership with National Film Archive of India, Pune.

In the Foreword of the book the I&B Minister writes: "Conceptualised to act as a visual journey of the story of 'Women in Indian Cinema', her aspirations, struggles, triumphs and many shades of in-between, this book may reveal to its readers the interesting ways in which movies have been re-imagining the many ideas of womanhood, while shifting the many lenses, breaking the mould, and looking at possibilities beyond."



Cinemas across the regions of India have mirrored the changing social and economic realities of the country and showcased the women characters in tandem. The book tries to touch upon these changing aspects too. The book portrays the stories and shifting roles of women through the lens of Indian cinema and the way different cinemas in India have depicted the idea of womanhood in varying ways. With chapters divided into themes such as 'Myths being Retold', 'The Social Messenger', 'An Ode to the Creator', 'Many Battles to be Won', 'Feminine under Disguise', 'Uncanny is the Name', and 'Influenced by the West', the book looks at a wide range of roles being represented by women.

The book is available at Book Gallery, Publications Division, Soochana Bhawan, CGO Complex, New Delhi. Email at: businesswng@gmail.com to order your copy.