Engineers Conclave - 2019

September 19-21, 2019
BEL, Bangalore

RECOMMENDATIONS

Jointly Organised by :

Indian National Academy of Engineering (INAE)
Bharat Electronics Limited

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Theme-I: Defence Technology & Innovation
Theme-II: Transformation of Rural India Using Digital Technologies

PROGRAMME

DAY-1 Thursday, 19 Sep 2019

0900-1000	**Registration**
1000-1100	**First Plenary Talk** on "Dimensions of Digital Revolution" **by Shri Gulshan Rai,** Former National Cyber Security Coordinator of India.
1100-1130	**TEA**

1130-1330 THEME-I: DEFENCE TECHNOLOGY & INNOVATION	**THEME-II: TRANSFORMATION OF RURAL INDIA USING DIGITAL TECHNOLOGIES**
Technical Session-I: Emerging Technologies & Trends for Defence **Session Chair:** Dr. AT Kalghatgi, Former Director (R&D), BEL **1130-1200 Topic 1:** Use of block chain technology in Defence **Keynote Speaker 1:** Shri Satyanarayan Kar, M/s Honeywell **1200-1230 Topic 2:** Towards Smarter Defence Systems **Keynote Speaker 2:** Prof. Bharadwaj Amrutur, IISc, Bangalore **1230-1300 Topic 3:** Cyber Security in Quantum Computing Era **Keynote Speaker 3:** Dr. Sarat Chandra Babu, SETS, Chennai	**Technical Session-I: Rural Digital Connectivity** **Session Chair:** Dr. Surendra Pal, Dr. DS Kothari (DRDO) Chair, office of DG Electronics and Communication Systems and Formerly VC, DIAT, Pune **Topic 1:** Digital Rural Connectivity **Keynote Speaker 1:** Shri RK Singh, Director, BBNL **Topic 2:** Rural Digital Connectivity **Keynote Speaker 2:** Shri Vipin Tyagi, ED, C-DoT **Topic 3:** Satellite Communication and Reaching the Unreachable Areas **Keynote Speaker 3:** Smt. TK Anuradha, Director, Sat Com, ISRO Headquarters, Bengaluru **Topic 4:** Transforming Rural India with Digital Connectivity **Keynote Speaker 4:** Shri Sanjay Nayak, CEO &MD, Tejas Network Ltd, Bengaluru

1330-1430	**LUNCH**	
1500-1600	**Inaugural Session** • Welcome Address by **Shri Mahesh V**, D(R&D) Chairman, Organizing Committee EC-2019 • Address by **Shri MV Gowtama**, CMD, BEL, Chair, EC-2019 • Address by **Dr. Sanak Mishra**, President, INAE & Co-Chair EC-2019 • Address by Dr G Satheesh Reddy, Secretary Department of Defence R&D and Chairman DRDO • Inaugural Address by Chief Guest Hon'ble Raksha Mantri Shri Rajnath Singh • Vote of Thanks by Shri VVR Sastry, FNAE, Former CMD BEL	
1600-1630	**HIGH TEA**	
1630-1830	**THEME-I: DEFENCE TECHNOLOGY & INNOVATION**	**THEME -II: TRANSFORMATION OF RURAL INDIA USING DIGITAL TECHNOLOGIES**
	Technical Session -II: R&D in Defence **Session Chair:** Dr. VK Aatre, Former Chief Controller R&D, DRDO and Former SA to RM **1630-1700 Topic 1:**Self-reliance in Defence Hardware; Challenges & Opportunities **Keynote Speaker 1:** Adm Arun Prakash (Retd), Former Chief of Naval Staff and Former Chairman of the Chiefs of Staff Committee **1700-1730 Topic 2:** Role of Startups in Defence R&D **Keynote Speaker 2:** Shri Vish Sahasranamam, Co-Founder & CEO Coimbatore Innovation & Business Incubator [FORGE] **1730-1800 Topic 3:** Fixed Wing Aircraft-Design & Development Challenges **Keynote Speaker 3:** Shri Prashant Bhadoria, DGM (Design- Electrical and Avionics), HAL **1800-1830 Topic 4:** Design Challenges in Launchers/ Autonomous Vehicle **Keynote Speaker 4:** Shri R. Muralidharan, CTO, Tata Power SED	**Technical Session -II:e-Governance and Services** **Session Chair:** Prof. LM Patnaik, Honrary Professor IISc Bangalore and Formerly VC, DIAT, Pune **Topic 1:** Geospatial Services Addressing e-Governance Issues **Keynote Speaker 1:** Dr. PG Diwakar, Director, EDPO, ISRO Headquarters, Bengaluru **Topic 2:** Tele-Medicine and Tele-Education Services **Keynote Speaker 2:** Shri Hanumantha Royappa, DD, SatCom, ISRO Hq, Bengaluru **Topic 3:** Innovations in Spatial Analytics and Advanced GIS – Enabling Farmers in Rural Areas with "Ready-To-Use" Information **Keynote Speaker 3:** Shri Mukund K Rao, Chief Executive, C-SAG, NIAS, Bengaluru **Topic 4:** Taking Frugal Innovations to Operational /Commercial Domains through Digital Technologies **Keynote Speaker 4:** Shri Vipin kumar, Director& Chief Innovation Officer, NIF, DST, GoI Gandhinagar, Gujarat
1730-1815	**Meeting at Tea** on Creating Ecosystem for Defence R&D in India (by Invitation)	
1830-1930	**Second Plenary Talk** by Art of Living Founder **H H Sri Sri Ravishankar**	
1930-2130	**Cultural Programme & Dinner**	

DAY-2 Friday, 20 Sep 2019		
0930-1030	**Third Plenary Talk** on "Engineering Marvel" by **Shri V Gopinath**, Chief Architect, EDRC/ Shri Mukesh Raval, Project Director (SOU) L&T	
1030-1100	**TEA**	
1100-1300 THEME-I: DEFENCE TECHNOLOGY & INNOVATION		**THEME -II: TRANSFORMATION OF RURAL INDIA USING DIGITAL TECHNOLOGIES**
Technical Session-III: Policies, Growth Drivers and Skill Development **Session Chair:** Dr. Mala Dutt, Additional Secretary & Financial Advisor (Acquisition) MoD, GoI **1100-1130 Topic 1:** Policies and Growth Drivers for Defence Exports **Keynote Speaker 1:** Shri Mohan Nair, Head International Defence Business, L&T **1130-1200 Topic 2:** Financial policies for Growth of Defence R&D in India **Keynote Speaker 2:** Shri RG Vishwanathan, Principal Accountant General, Rajasthan **1200-1230 Topic 3:** HR Strategies for Defence R&D **Keynote Speaker 3:** Shri Alok Verma, GM-HR, HAL		**Technical Session-III: Enhancing Rural Livelihood Opportunities** **Session Chair:** Dr. NK Tyagi, Formerly Director, Central Soil Salinity Research Institute, Karnal **Topic 1:** Creating Livelihood Opportunities – Experiences in Geospatial Applications **Keynote Speaker 1:** Dr. PV Narasimha Rao, Deputy Director, NRSC, Hyderabad **Topic 2:** Technologies for Development **Keynote Speaker 2:** Dr. Sriram K Rajamani, Head - Microsoft Research (MSR), Bengaluru **Topic 3:** The Role of modern ICTs in Building the 'move up' strategy of Livelihoods among Small Producers **Keynote Speaker 3:** Dr. Rengalakshmi, Director, JRD Tata Ecotechnology Centre, MSSRF, Chennai
1300-1400	**LUNCH**	
1400-1600 THEME-I: DEFENCE TECHNOLOGY & INNOVATION		**THEME -II: TRANSFORMATION OF RURAL INDIA USING DIGITAL TECHNOLOGIES**
Technical Session-IV: Strategic Partnerships / Enabling International Cooperation **Session Chair:** Shri I.V. Sarma, Former Dir (R&D), BEL **1400-1430 Topic 1:** Creating an Innovation Ecosystem in India with Tech Transfer **Keynote Speaker 1:** Shri Satish Menon, Head of Engineering Competence Centre (Bengaluru), Thales **1430-1500 Topic 2:** Industry R&D Partnerships for Future Technologies **Keynote Speaker 2:** Dr. S Guruprasad, DG (PC&SI) DRDO **1500-1530 Topic 3:** Open Innovation **Keynote Speaker 3:** Mr. Oded Ben David, M/s.Elbit **1530-1600 Topic 4:** Strategic Partnership – A Route to Self-Reliance in Defence **Keynote Speaker 4:** Cmde Mukesh Bhargava (Retd), Business Head for Submarines and Underwater Platforms Business, M/s L&T		**Technical Session-IV:** Capacity Building Needs of Digital Rural India **Session Chair:** Prof. PR Mahapatra, Former Professor of Aerospace Engineering and Dean, Faculty of Engineering, Department of Aerospace Engineering, IISc Bangalore **Topic 1:** Employment Opportunities for Graduates from Small Towns in India Addressing Global Needs **Keynote Speaker 1:** Dr. Sridhar Mitta, Next Wealth Entrepreneurs Pvt Ltd, Bengaluru **Topic 2:** Skill Development for Rural Services **Keynote Speaker 2:** Smt. Jyotsna Sitling, Joint Secretary, Ministry of Skill Development & Entrepreneurship (MSDE), GoI, New Delhi **Topic 3:** Digital Technologies That can Enable Inclusive Growth **Keynote Speaker 3:** Shri Hari Menon, India Country Director - Bill & Melinda Gates Foundation, New Delhi

Topic : Self-Reliance in Missiles (Anti-Tank to Anti-Satellites)+Mission Shakthi **Speaker:** Lt Gen (Dr) V J Sundaram, PVSM, AVSM, VSM, (Retd.), Advisor (Micro-Nano-Bio Systems), National Design and Research Forum, Bengaluru		**Topic 4:** The Technology Skilling Paradigm in India **Keynote Speaker 4:** Shri Achyuta Ghosh, Head-Research, NASSCOM, Noida
1600 – 1630	**TEA**	
1630-1830 THEME-I: DEFENCE TECHNOLOGY & INNOVATION **Technical Session -V:** Success Stories & Way forward **Session Chair:** Shri N Sitaram, Former CC R&D (ECS) **1630-1700** **Topic 1:** Self-Reliance in Defence Communication **Keynote Speaker 1:** Dr. Kanwar Jit Singh, Vice President Technology, Tejas Networks **1700-1730** **Topic 2:** STARS V to SDR **Keynote Speaker 2:** Shri V Nandakumar, CTO (Communication), BEL **1730-1800** **Topic 3:** Innovations in Naval Systems **Keynote Speaker 3:** Dr. OR Nandaguopan, Dir, NSTL (DRDO) **1800-1830** **Topic 4:** LCA to AMCA **Keynote Speaker 4:** Dr. Girish S Deodhare, Director, ADA		**THEME -II: TRANSFORMATION OF RURAL INDIA USING DIGITAL TECHNOLOGIES** **Technical Session -V:** Aspiring Rural India **Session Chair:** Dr. J Narayana Das, Dr. Raja Ramanna DRDO Distinguished Fellow and Formerly Outstanding Scientist & Chief Controller R&D (Naval System & Materials), DRDO **Topic 1:** Making Hope a Reality—Digital Initiatives for Early Intervention Programme for the Village based Disabled Children **Keynote Speaker 1:** Shri PS Kasturirangan, Amar Seva Sangam, Ayikudi, Tirunelveli District, TN **Topic 2:** Sparking Curiosity, Nurturing Creativity and Building Confidence among Economically Disadvantaged Rural Populace – Role of Digital Technologies **Keynote Speaker 2:** Shri K Thiagarajan, COO, Agastya International Foundation, Bengaluru **Topic 3:** Application of Advanced Technology in Rural Development: An Experience from Remote Area in Bihar. **Keynote Speaker 3:** Shri Manas B Verma, (Former Programme Director, ADA), Bihar

DAY-3 Saturday, 21 Sep 2019		
0930-1030	**Parallel Panel Discussion** on the two Themes	
Panel Discussion on Theme I: Defence Technology & Innovation **Panelists:** Technical Session Chairs of Theme-I **Moderator:** Shri Mahesh V, Dir (R&D) BEL, Coordinator, Theme-I, EC-2019		**Panel Discussion on Theme II:** Transformation of Rural India Using Digital Technologies **Panelists:** Technical Session Chairs of Theme-II **Moderator:** Dr. V Jayaraman, Coordinator, Theme-II, EC-2019
1030-1130	**Valedictory Session** • Introductory Remarks and Welcome by **Dr. Sanak Mishra**, President INAE • Summing up of Theme I: Defence Technology & Innovation by **Shri. Mahesh V**, Dir (R&D) BEL, Coordinator, Theme-I, EC-2019 • Summing up of Theme II: Transformation of Rural India Using Digital Technologies by **Dr. V. Jayaraman**, Coordinator, Theme-II, EC-2019 • Valedictory Address by **Chief Guest Dr. VK Saraswat, Member, Niti Aayog** • Vote of Thanks by **Smt. Padmini Balachandra**, GM TP/CO, BEL	
1130-1200	**TEA**	
1200-1300	**Fourth Plenary Talk** on "Made in India – How to Make It Happen" by **Capt S Prabhala** (Retd), Former CMD BEL	
1300 onwards	**Lunch and dispersal**	

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Theme-I: Defence Technology & Innovation

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Recommendations
Theme-I: Defence Technology & Innovation

Introduction:

Defence R&D in India primarily happens through DRDO and a few Defence Public Sector Undertakings (DPSU). India continues to be overwhelmingly dependent on arms and equipment imports making it the 2nd largest arms importer in the world. We still import about 70% of our military equipment and this has remained through many decades. In view of this, Government of India has taken initiatives to establish a Defence Manufacturing ecosystem and to enhance self-reliance like Make in India, Make-II, Indigenously Designed Developed and Manufactured (IDDM), etc. An innovation ecosystem for Defence titled Innovations for Defence Excellence (iDEX) was launched in April 2018 by Government of India which is aimed at creation of an ecosystem to foster innovation and technology development in Defence and Aerospace by engaging Industries including MSMEs, Startups, Individual Innovators, R&D institutes and Academia. However, results of these initiatives are not visible yet.

Defence R&D is very much essential to accelerate growth of indigenous Defence industry and obtaining self-reliance. Defence technologies are high-end and require sufficient maturity for deployment. Various factors that impact the outcome of R&D form the framework of R&D ecosystem. They include R&D eco system including culture, Organizational structure, Manpower, Skill development, Technology, Funding, Acquisition methods, Procurement policies, testing & evaluation methods etc. Thus, Defence R&D is integral component of national development, economy and job creation.

To accelerate Defence R&D, discussions were held during Engineers Conclave 2019, under the Theme-I, "Defence Technology and Innovation" with focus on creating ecosystem for Defence R&D in India. Following are the observations/recommendations from the deliberations:

1. Defence R&D policy

Noting that Defence R&D is not happening to the extent so as to commensurate to the needs of the country and to the size of the Defence industry, the following are identified as the main observations and the respective recommendations:

1. Observation:

i) There is very little strategic thinking mechanism on future needs of Indian Defence, Low Intensity Conflict fighting technologies and law & order keeping forces. All needs are derived from presentations of foreign Defence companies to respective armed forces through their representatives. This gives them a readymade solution to the perceived problem and hence a natural bias towards import of the readymade equipment, irrespective of its obsolescence.

ii) The ordnance factories have developed a culture of licensed production and are isolated from the R&D set up of DRDO and Defence industry. There seems to be lack of mutual hand holding.

Recommendation:

i) A think tank with experts (mostly retired but with established credentials) from armed forces, Defence R&D, Space, Atomic Energy and academia to be set up to identify R&D priorities in short term and long term, every year, by month of May. DRDO and other R&D set ups (mentioned below) to plan the R&D activities, keeping in mind the currently running plan and submit the plan for next Financial Year by October to approving authorities, Ministry of Defence (MoD), Ministry of Finance (MoF) etc

ii) A separate Defence R&D Commission on lines of DARPA (Defence Advanced Research Projects Agency of USA) to be created headed by a Defence R&D expert to execute Defence R&D in the Defence industry and academy (Defence Public Sector Undertakings, Private industries, Ordinance factories and academic institutions). In addition to 6% of Defence budget funding to DRDO, additional 4% funding of Defence funding be allocated for Defence R&D Commission. The commission will be served by a separate secretary (or additional secretary) in the Ministry of Defence (MoD). Chairman of the commission will report to RM. The R&D funding will be in tune with the recommendations of the think tank. Commission will create mechanism for very tight monitoring of the progress with provision for awards and penalties. This body has to be answerable for needed product launches and long-term self-reliance. Total Defence R&D funding of 10% of the Defence funding will result in much more savings in terms of overall Defence acquisition budget within a few years.

2. Observation:

The Defence R&D budget in India is identified as 6% of the total Ministry of Defence (MoD) budget and is allotted to DRDO. While DRDO draws its own priorities, there is no mechanism in the country to create Defence R&D outside DRDO. Even big establishments like HAL have focused on license production and very little effort goes in to R&D.

Recommendation:

The setting up of Defence R&D Commission as suggested above with additional 4% additional budget allocation for R&D will fill up the gap.

3. Observation:

Indian model of laying Qualitative Requirements (QRs) is that the Armed Forces generate QRs independently, based on foreign suppliers' catalogs, at times putting best features of all catalogues together and that becomes sacrosanct. It takes years to come up with acceptable QR and by that time technology changes. This lack of co-ordinations exists even with DRDO and the Defence industry comes in to picture much later. Obviously, there is no R&D connect to the industry.

Recommendation:

The Defence R&D is not close door exercise. It needs field experience even to come up with QRs. Also, the armed forces have to have the idea of emerging technologies. Hence

it needs a very close working together between Armed Forces, the R&D teams of industries and Defence R&D Commission. We need to have an eco-system like Boeing or Lockheed Martin have in US. Both these are private Defence R&D organizations.

4. Other Recommendations:

As a way forward, sectors and products must be identified and classified for production only by Indian industry say missiles, artillery guns etc. Govt. must reserve certain areas for Indian Defence Industries and stop importing what can be made in India. This assured market will attract Indian industries to do research and development in these areas. It is time to segregate product sectors as buy Indian and Make Indian as many Indian companies buy kits and supply without significant Indian component.

II. Procurement Policy:

Some drawbacks have been observed in the Defence procurement policy. The following are identified as the main observations and the respective recommendations:

1. Observation:

Procurement from Indian industry is made at No Cost No Commitment (NC-NC) basis. It takes significant amount of money and effort for the industry to develop the products. Without shared responsibility from customer, it is very difficult for industries to participate as well as sustain in such mode of development.

Recommendation:

Procurement should no longer be on NC-NC basis including Make-II. Instead the funding for these projects to be made through Defence R&D Commission. A mechanism to shortlist two/three vendors for funding based on evaluation of their technical competence and capability shall be put in place. Developing and retaining competition within the industry is very important for sustained R&D.

2. Observation:

Make-I procedure has not yielded the desired results. After spending lot of money by the industries for prototype development, user discontinues with the requirement.

Recommendation:

Products perceived for induction only has to be asked for prototype development and once Industry spends a lot of time and money, discontinuing the project has to be avoided. Where requirements are met, order has to be issued at the shortest time. Else, the industry has to be compensated for the investments made.

3. Observation:

Make-II procedure is very complex and allows industries to take technology from outside the country. This hampers indigenous R&D. Many times, products being developed by DRDO are listed under Make II also.

Recommendation:

Under Make II procedure, import of core technologies should not be allowed. Fully indigenous and home-grown technologies/products to be developed by funding through

Defence R&D Commission. Back door entry of Indian vendors by importing core technology and fielding for trials to be avoided.

4. Observation:
Presently the Defence contracts are short term. There is no assurance to the Industry on orders for Mk II (Mark-II) versions and upgrades.

Recommendation:
Defence to have long term Contracts. Once an industry is a production agency, some long-term promises are needed from the User. Production agency for MKI (Mark-I) of the product has to be nominated as the production agency for MK II (Mark-II) version also. Same industry has to be involved in all offshoots of a product. Spiral mode of development and pre-planned product upgrades are to be adopted.

5. Observation:
At present, in Ministry of Defence (MoD) contracts, the delivery date extension is to be obtained to enable:

i. The Inspection of goods by the Inspection Agency e.g. Chief Quality Assurance Establishment (CQAE)/ Directorate General of Quality Assurance (DGQA) / Missile System Quality Assurance Agency (MSQAA) etc.

ii. To deliver the goods if inspection is over but goods are not yet moved to the customer site

iii. To bill & get the money against the supplies made (against "provisional extensions").

The Contract Amendments for trivial issues like change in delivery dates, change of part number, delivery location etc, are lengthy processes resulting in further delays in deliveries of the equipment, spares & services to the User. This results in National wastages as the equipment & spares are manufactured but the same cannot be delivered to the User.

Recommendation:
The DPP & Contract clauses should allow for Inspection, delivery & payments (after Liquidated Damages deductions) without waiting for amendments to the Contracts if the vendor/supplier is not seeking Liquidated Damages (LD) waiver. If the Supplier/Vendor needs to apply for LD Waiver, it should be done through "Contract Amendment" process.

6. Observation:
Historically, it is found that trials take a lot of time and effort due to various stages of evaluation. Also, non-availability of user trial directive even after DRDO evaluation leads to longer time frames. Currently the trial time is as high as 6-7 years in major projects.

Recommendation:
Time frame for user evaluation has to be fixed. Trial directives to be frozen and to be part of RFP (Request for Proposal) by the user. Clear evaluation reports have to be provided to the development agency, specifying clearly the reasons for non-acceptance, if any. Also adding new requirements not specified in QRs (Qualitative Requirements) at the trial stage should not be allowed.

7. Observation:
Trials are tougher on indigenously developed products than on imported systems. But the fact is that imported systems perform sub optimally in our environment.

Recommendation:
User evaluation for indigenously developed products should be on par with that of the imported systems.

8. Other Recommendations:

1. If we have an Indian product nearly equivalent to a Global one, the Indian product to be purchased in preference to the global one.

III. Defence R&D Funding

1. Observation:
Presently most of the development projects are funded by Ministry of Defence (MoD) and end users are the Services. This mode of funding makes it an 'arm's length' activity for the Services.

Recommendation:
In order for the Services to have added sense of 'ownership' and enhanced commitment to indigenous development, Services/Customers not Ministry of Defence (MoD) must fund the development of what they need. The relative success of some development projects funded by Navy and Army Signals directly on industry is testimony enough to the adage, whoever pays the piper calls the tune.

2. Observation:
Infrastructure in the country is inadequate for capital intensive development, manufacture, evaluation and trials of current and futuristic technologies/products due to lack of funds with the industries. Even established Defence Public Sector Undertakings (DPSU) find it difficult to invest since the return on investment is not assured.

Recommendation:
Government funding is needed for unique and finance intensive R&D infrastructure.

3. Observation:
At present incentive for expenditure incurred on R&D for DSIR approved industries has been reduced from 200 to 150%, which is likely to be further reduced. This will hamper the R&D investments by the industries.

Recommendation:
Income tax benefits for R&D expenditure should be restored to 200%.

IV. General Recommendations:

1 User involvement to begin in early stages of development and should continue throughout the product life cycle. More user involvement and ownership leads to more chance for success. Periodical monitoring, critical appraisal of any trade-offs required during the course of development, develop/make/buy choices, etc. has to happen. User to provide feedback from field.

2. Academia can contribute significantly in development of technologies for Defence and can facilitate focused research in specialized areas of Defence technologies. Collaboration between academia and industry can bring out advanced technology products. The Academia Industry interface needs to be more effective as major industrial houses prefer to have their own full R&D, limiting themselves to the current business needs. As a way forward, multiplicity of technology parks needs to be created (funding through Defence R&D commission) in academic locations wherein there can be constant Industry Academia interaction.

3. Create a robust ecosystem of domestic System Integrators supported by a host of Tierised suppliers, who can become part of the global Defence and aerospace supply chain.

4. A National online Portal to be created to list the technology issues/ problem statements of all Defence Industries which can be taken up by academia/industries.

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Recommendations
Theme II: Transformation of Rural India Using Digital Technologies

The Government of India, as a part of its flagship Digital India Programme has brought in many policy initiatives, launched major schemes and implementation strategies to bring in inclusive growth across the country using the power of the enabling digital technologies and platforms, supported by strong outreach and capacity building and behavior change interventions to reach even the remotest rural villages. Establishing reliable broadband digital connectivity; ensuring good governance and creating livelihood opportunities and skilling at local level and improving the quality of life have been the prime motto of the Government in launching many mission-mode projects and monitoring them. Many such schemes launched by the Government are thus, specifically addressing various facets of human life in rural India like healthcare, education, energy, water, sanitation, and agriculture and skilling. Opening of bank accounts for millions of rural populace, ensuring digital identity through Aadhar, and enabling Direct Benefit Transfer through Unified Payment Interface (UPI) without any significant transaction cost was one of the major success stories of digital technologies providing level playing field for financial inclusion at a scale not done anywhere in the world.

EC 2019 noted the efforts of the Government of India to spread the outreach of the digital connectivity to rural India through 1) by tasking Department of Telecommunication (DoT)/BBNL to extend broadband fibre connectivity to rural areas; 2) by asking ISRO to specially focus on satellite communication connectivity to unreachable areas in North-East, J&K and Andaman Nicobar islands; and 3) by encouraging private sector to extend digital connectivity and 4G/5G or 5 G equivalent services to rural India, and that is now happening at fast pace. However, digital connectivity is just an enabling mechanism; but it takes very large, concerted efforts to bring about the transformation of the society. EC 2019 focused on how this powerful technology can be exploited optimally to bring about the transformation of rural India that enhances rural economy; improves rural habitat; and creates jobs in the rural sector so as to avoid migration to cities.

Following are the major observations/ recommendations emanating from EC 2019 Theme II Sessions:

1. BharatNet, the National Optical Fibre Network, the world's largest rural broadband fibre network forms that digital infrastructure for the country. Under this, it is planned to connect 2.5 Lakh Gram Panchayats by 2020/21, followed by the plans to link it to all the 6 Lakh villages in the country. It is well recognized that BharatNet will form the major broad-band backbone for rural India in the coming years to reap the full benefits of Digital Technologies.

   Hence, it is recommended for early completion of BharatNet with appropriate design considerations embedded, addressing the compatibility & adaptation, and maintenance requirements of emerging advances in the technology, while addressing the ever-increasing data requirements of the rural sectors. While 5 G itself is not a pre-requisite for rural development, it is hoped that appropriate strategy would be in place to implement 5G or develop our own system, meeting Indian requirements equivalent to 5G and also smooth transition from 3G/ 4G to 5G ensuring appropriate inter-operability standards in place.

2 It is recommended for developing an endogenous digital technology base in the country as we have vast & comprehensive potential developed in public sector and private sector industries. For example, Indian industries like C-DOT and Tejas Network, to name only a few, have developed necessary in-house innovative technology capability on par with international competitors. But they do not find full and sustained support in the digital world largely controlled by multi-national companies from the West and also from China. Ministry of Electronics & Information Technology (MeitY) should create adequate framework mechanism, say through a scientific/engineering body to assess such technology developments periodically, and take up these developments through adequate financial support in R&D (academic institutions, public and private industries) to indigenously develop and mass produce these digital technology equipment on a large scale. It will also serve as a key to generation of employment and skilling Indian youth in the surging market including in the rural areas.

3 Further, considering the extraordinary talent pool developed within the country and demonstrated indigenous capability in developing various H/W and S/W elements for Digital India, it is time for India to leverage this talent pool to enter the regional/ global market to emerge as a potential global telecom technology provider. Indian private telecommunication industry should be encouraged to aggressively market itself in the international market.

4 Also it is important to integrate High Throughput Satellite (HTS) satellite capacity with ground network for enhanced reliability and minimum guaranteed services to rural India. It is well recognised that an optimum synergy of broadband optical fibre terrestrial network with HTS communication network would provide specific solutions of broadband digital connectivity to rural populace; and enable access to needed data/information services including meeting the quality telemedicine & tele-education requirements for the rural areas on a sustainable and affordable basis. There is scope to extend these services by orders of magnitude and create a large network in the country through participation of Industry through CSR funding, NGOs and hospitals with synergy in planning and execution. Besides connectivity, ISRO and other technology leaders should help provide appropriate technology guidance and end-to-end solutions to many interested players including NGOs in the rural areas by working in synergy with them; and ensuring that all are done under the purview of concerned Ministries in the Central and State Governments.

5 Using digital technologies and social media as vehicle, there have been many examples of leveraging the frugal innovations from rural areas. The availability, accessibility and value creation the digital technologies provide has enabled rural entrepreneurs in finding operational and commercial openings in the larger urban market, providing meaningful business/livelihood breakthroughs for them. However mostly these success stories have largely remained local with limited outreach. Digital connectivity can enable pan India outreach and so, such innovations should be widely publicised and encouraged with full support for replication for larger scale productionisation. There are a number of institutions involved in promoting such innovative activities through many schemes in the country like the National Innovation Foundation, National Institute of Rural Development, and Panchayat Raj (Ministry of Rural development);

Ayush and a number of NGOs amongst the many. What is considered essential is an overall coordination mechanism amongst these bodies to bring coherence and focus; and involve SMSEs to create products that are cost effective and easily available in rural areas.

6 Similarly bundling of digital technologies seamlessly with traditional/conventional elements is important which will enhance the quality of service in line with the user requirements. Here, the Geospatial technology integration is a case in pointer.

Geospatial technology applications integrating satellite/aerial/UAV observations, Image Processing, location-aware navigation devices, GIS; smartly fused with mobile platforms as well as social networks along with relevant in-situ information and various spatial data analytics techniques, offer many possibilities for informed decision-making towards providing e-governance solutions, besides providing inputs for finding alternate livelihood opportunities for the rural populace. If effectively employed, geospatial technologies enable small farmers in accessing knowledge, institutional linkages and networks to move up in building sustainable development initiatives. However, it is seen that most of the times, these inputs are not reaching the end-users at rural villages in a timely manner and in a format& style they can easily understand and integrate themselves with their traditional practices. It is suggested that all these services with appropriate interpretations, bundled with other needed local level information such as crop insurance, soil health card at cadastral level, and market information should be delivered in a disaggregated way in local languages. Also, delivery mechanisms should be through local participatory mechanisms such as the Village Knowledge Centres / Village Resource Centres / Common Service Centres for effective utilisation by the local populace. There are many such successful examples in some States which could be considered scaling up as well as for appropriate adoption elsewhere for replication taking the local context into account.

Further, it is also seen that while there are good geospatial models working satisfactorily and many are emerging across the States, the efforts are often fragmented; and they are seen to operate mostly at very local level with State to State disparity. Advanced States are doing better than the not-so- advanced States, hence further adding to the disparity. Once the digital connectivity to rural India is achieved, say by 2022, we need to bring a mechanism to bring all these geospatial services to rural India as a whole through a well-oiled coordinating mechanism say, through Department of Rural Development, Government of India to bring coherence.

7. Same is the case that exists for e-governance issues. There are States such as Kerala, Tamil Nadu N, Himachal Pradesh, Telangana and Karnataka that are said to have implemented many e-governance services to rural areas at different scales. It needs to be done at pan Indian scale with an overseeing body at the centre, taking lessons from both the successful and not-so-successful stories.

8. Digital technologies are pacing fast and there is a need for capacity building/skilling rural entrepreneurs & educated rural youth on a periodic basis to reap full benefits. It is seen that Government has many schemes addressing the capacity building needs of the rural populace. But it is seen that there is a lack of synergy among these schemes launched by many departments of the

Government. It is felt that there should be an overarching framework harmonising various schemes of the Government, both Central & States, towards addressing the skilling and capacity building requirements from early stages to optimise the digital initiatives. For example, the computer education should start at very early stage at school level with hands on experience in villages, perhaps from 1st standard like any language learning.

9. In this connection, there were also projections on some interesting innovative concepts/initiatives that are emerging in the context of creating livelihood/skilling opportunities for the rural populace such as the following:

   a. Creating 'Digital Labour' a concept, long talked about as a part of APP-based as well as crowd sourcing platforms of digital economy and the opportunities it could provide for interested rural youth. Designed to support a wide range of language-based digital work (e.g., document digitization, prompted speech data collection, speech transcription) and other skilling tasks, Digital Labour provides varied opportunities, once affordable digital connectivity is given to the rural youth. Given the push toward a digital future, there is a huge source of local language digital work, exploitation of make it more inclusive and accessible to workers from rural communities in the coming days.

   b. Organizing more focused industry oriented 'Digitally Enabled Services' using rural graduates and other moderately educated youth in rural areas as work forces in their own towns as extended arms of digital industries/enterprises rather than they moving out to bigger cities. It will decentralise the skilling efforts from being concentrated in cities by shifting them to rural towns and making more meaningful inclusive development.

   c. Advocating the idea of 'Uberisation' in the areas such as mechanised farming services like levelling, ploughing and goods transportation extended to small farmers to improve productivity and enhance livelihood opportunities in the rural villages.

   Such initiatives, amongst many others, besides enthusing rural entrepreneurship, could also enable scaling up the services at lower cost for the enterprises while creating large employment generation in rural areas and in the process arresting large scale urban migration. Some of these ideas and concepts could be gainfully explored by rural entrepreneurs with necessary encouragement and support by the Government to make these activities economically viable and transformative to rural India.

10. Finally, user acceptability is most important while introducing any technology, more so with advanced innovative digital technologies in rural environment. To make the digital technology ubiquitous to the rural populace, it is important to ensure that the digital products & services are domesticated with simple interface with only essential features.

Notes

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INDIAN NATIONAL ACADEMY OF ENGINEERING

The Indian National Academy of Engineering (INAE), founded in 1987 comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering & technology and the related sciences for their application to solving problems of national importance. INAE is an autonomous institution partly supported by grant-in-aid from the Department of Science & Technology, Government of India. Among other activities, one of the important objectives of the Academy is to assist the Government from time to time in providing inputs related to engineering interventions for formulating national policies. INAE has established mechanisms in place for interacting with Government bodies such as DST, Niti Aayog and Office of PSA to seek inputs and work on thrust areas of the Government related to engineering and technology. As the only engineering Academy of the country, INAE represents India at the International Council of Academies of Engineering and Technological Sciences (CAETS); which is a premier non-governmental international organization comprising of Member Academies from 30 countries across the world, with the objective of contributing to the advancement of science and technology and promoting sustainable economic growth of all nations.

INAE had taken an initiative of organizing an annual mega event of engineers as "Engineers Conclave" starting from the year 2013, which is being organized jointly with major engineering institutions, essentially to provide a platform for all engineers/scientists to deliberate and address major engineering challenges and opportunities of vital engineering concern to the country. Each conclave has two themes, one specific to the host department and other specific to some social problem where engineering intervention is desired. These two issues are focused from point of view of finding engineering solutions and specific recommendations are formulated for action by the concerned government department and industry.

For more details, please visit INAE website www.inae.in

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