आज़ादी का अमृत महोत्सव

Imagining India@2047 through Innovation

SYMPOSIUM BOOKLET

7th – 9th March

प्रशासनिक सुधार और लोक शिकायत विभाग
DEPARTMENT OF ADMINISTRATIVE REFORMS & PUBLIC GRIEVANCES
सत्यमेव जयते

INDIAN INSTITUTE OF TECHNOLOGY MADRAS

iitm research park
Bringing unlike minds together

INDEX

Introduction

Forty Young IAS Officers teams with forty young faculty of IITM, forty Seed-stage Entrepreneurs and forty established Young Entrepreneurs are brainstorming to evolve what will they like India to be in 2047. This 3-day symposium is from 7th to 9th March 2022, supported by the Department of Administrative Reforms and Public Grievances (DARPG), is being held at IIT Madras Research Park.

The Vision 2047 will be evolved in 10 theme areas,

(1) Energy and Net Zero
(2) Education
(3) Health Care and Assistive Technologies
(4) Water
(5) Infrastructure and Communications
(6) Transport and Mobility
(7) Urbanisation and Housing
(8) Rural Development and Agriculture
(9) Fintech and Inclusion and
(10) Information Security and Defence

The overarching thread will be **Research and Development, Innovation and Digital Governance**. This will be pursued in each of the Theme areas.

Programme Organisation

1. Forty NUCLEUS Teams, each consisting of One Young IAS Officer, One Young Faculty, One Seed-Stage Entrepreneur and One Established Young Entrepreneur is formed. Each four-member NUCLEUS forms a basic team, which will bond with each other to ideate, conceptualise, and strategize the Vision 2047, not just during the symposium but over the next three years, over the next ten years and over the next twenty-five years. Each NUCLEUS Team will have four hours meeting, including two hours during dinner (S4 and S5), on day 1.

2. Four such NUCLEUS Teams form a CELL Team. The CELL Team is responsible for one of the ten Theme areas. There are ten CELL Teams.

Each CELL will meet for three hours (S7 and S9) and will be coordinated by an Officer from IITMRP. On day 3 of the symposium, each CELL Team (cell will chose a leader amongst them) will make a 10-minute presentation on Vision 2047 for the Theme for the entire symposium.

3. For each of the ten Theme areas, a two-page note is prepared and has been sent to all Members of the CELL handling the theme before the Conference. The note is prepared by Senior Faculty and Innovators at IITM and IITMRP.

4. In addition, there will be 19 presentations of 15 minute each in four sessions (S1, S3, S11 and S12) on day 1 and day 3. These will be sharp presentations by Senior Faculty and Entrepreneurs of IIT Madras. The presentations will help the CELLS to evolve the vision 2047 for each Thematic area.

5. Within 7 days of the end of the Conference, that is by 16th of March 2022, each CELL will prepare a three-page report in their Thematic areas.

6. Each CELL is expected to prepare a detailed twenty-page Vision paper by 15th of June 2022 for their Theme. This paper will be updated every six months over the next three years. The CELL Members and the IITMRP Coordinator for each Theme is expected to stay in touch regularly in virtual mode to evolve these documents.

7. IITMRP will put together the individual Theme papers into Vision 2047 document and keep updating it periodically.

1. ENERGY & NET ZERO

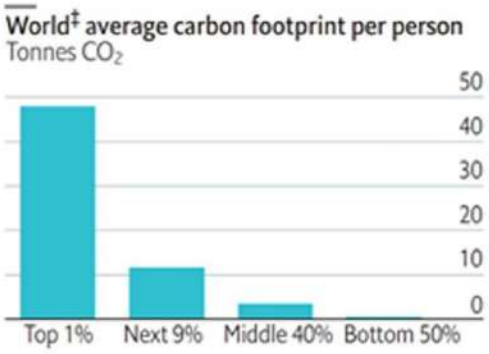
Speaker : Prof. Ashok Jhunjhunwala

ashok@tenet.res.in

94444 44408

Energy & Net Zero

There is unanimous consensus around the world today that Green House Gas (GHG) emissions is rapidly destroying the earth. Currently, India ranks 103rd in terms of per captia CO2 emissions, and therefore may not be considerd a primary culprit. However, in terms of total emissions, India 3rd and its GHG emissions has been increasingly rapidly as its GDP grows[1]. For example, home air-conditioning is estimated to grow from about 25 million units in 2010 to about 500 million units by 2040. India would soon become the second largest contributor. It is to be noted that it is the low-income people in India or in the the world, who contribute the least to the problem, but would be the hardest-hit as the climate changes



India therefore needs to strive to be amongst the leader in the world in this transition towards net-zero energy and also help others accelerate this shift. How do we go about doing this? The first tasks would be to identify, develop and demostrate technologies, make it economically viable and enable scaled commercialisation of technologies, which would help us get there. The second and an equally important task is to manage the change, as a large number of people and industries associated with traditional fossil-fuel sector will be disrupted in the process.

Technologies to move India towards Net-Zero

Fortunately, continuous technology advacement over the last twenty years, has made the cost of electrcity generated from solar and wind fall even lower than that for coal. Yet over 75% of electrcity generated in India today uses fossil fuels. Renewable Energy (RE) does amount to almost 25% of generation capacity, but in terms of electricity generated, it contributes to a mere 8% of the total, because of its lower capacity utlisation factor. Therefore, even as we aim to install 500 GW RE (targeted by 2030), coal-based energy may continue to dominate. We would therefore have to move to RE even faster and would need to invest heavily to get there. Instead of always depending on the Government inititives and funds, one may look at tapping our higher-income group sections to enable this shift to RE based systems. As long as there is Return on Investment (RoI), they would be ready to garner the required funds. The task therefore would be

technologies which would give a strong RoI. Even though several technologies are available today towards this, much more would need to be done. While significant R&D efforts will be required, it is equally important to take these tecnologies all the way to commercialstion. Therefore the steps involved include (i) R&D (ii) early pilots to prove technology readiness (iii) pilots towards proving economic viability (iv) early stage commercial deployments with some government support and conducive policies (v) full-scale commercial deployments. While stages (i) and (ii) would require some R&D funding and grants (including CSR), venture funds could be tapped in for stages (iii) and (iv). Stage (v) will tap in banks and other commercial financing. It is important to understand which technologies could reach different stages in 0 to 5 years, 5 to 10 years and 10 years and beyond.

Near-term technologies (0 to 5 years for commercialisation)

Solar and wind based electrcity has already proven its economic viability. With R&D going on in solar cells, it is expected that the cost of solar-based electrcicity would further come down (say with Perovskite). Higher height and larger-capacity wind-turbines would similarly reduce costs . As solar and wind energy is not available 24 x 7, energy storage would be the next important thing to scale RE. The short-term energy storage options are (i) Li Ion Battery Storage and (ii) chilled water storage, especially in places where air-conditioning usage is high. With some engineering innovations, the add-on costs of storage could be reduced to make 24x7 electricty from RE cost competitive to fossil-based energy, in the near future. Cleaning up our hydro-electrc genertion plants will add-on to the clean electrcity push. Further strenthening of the electrcity grid would be required to carry this energy efficiently across the country. This electrcity can also be used to power electric vehicles (EVs) to replace petrol / diesel based vehicles, which heavily contribites to GHG emissions today. 2-wheeler and 3-wheeler EVs are already cost-competitive, whereas as 4-wheelers may take a couple of more years to get there. We can also start working on convesrion of construction and agricultural equipment to electric, though the full conversion may require R&D beyond five years. Enhancing energy efficiency in all appliances, especially in heating and air-coditioning, would play a key role. Similary effective integration and management of energy generation, storage and consumption would be critical to move towrds 100% RE.

Mid- to long term technologies (5 to 15 years for commercialisation)

While Li-Ion and chilled water storages are great for short-term (a few hours to a few days), storing energy for months together would require a different set of technologies. Some batteries like Zn-air and Al-air look promising, but would take significant R&D for a few years, before becoming vaible. Same is the case for all Green Hydrogen based technologies; they remain too expensive today. But in 5 to 7 years, new electrolysers and fuel-cells are likley to reduce costs substantially. One could then use this Green Hydrogen to make Ammonia for feritilisers, and for use in steel and cement manufacturing[2] to reduce the use of fossil fuel consumption. Even then there will be significant CO2 emssions, especillly from calcination of lime-stone. One would need to capture CO2 from such plants, carry it (possibly in gas pipes) and sequester it in concrete blocks or under the sea in the form of hydrates. There is no reason for India not to be on top of such technogies in the next 7 to 10 years. The other technology that may help India to get to net-zero is electricty generation from ocen and tidal waves. A lot of work is however required for these sources to compete with solar and wind based electrcity. Simailarly, Small modular Nuclear reactors and compressed air energy storage are also technologies which may play a major role in future. R&D in these areas need to start soon to enable commercialistion in 12 to 15 years.

Managing Change

Moving towards Net-Zero in India will disrupt many existing industries and business units, and heavily impact employment in these sectors unless carefully managed. One of the worst affected industries will be the coal mining and coal-based power plants. While coal mines were privatized a decade ago, almost 65% of todays coal plants were also set up in the last decade alone. The investments made in these plants would not have been recovered to any significant extent yet, and the banks especially in the public sector may be holding a large part in it. These sectors are also very large employers of low and middle-income people. The transition to RE would be a massive disruption across the board. The third industry affected would be the State-owned Power Distribution companies (DISCOMS). Most of them are already in the verge of bankruptcy, even though they provide essential services to people. While RE would also require transmission and distribution, most State utilities are not prepared for this change. Note that coal mines,

coal-based power plants and DISCOMS are all under the control of States and their impairment could escalate center-state tensions as well. The fourth and fifth industries that would be disrupted are the automobile sector and refineries & fossil fuel distribution companies. Along with their ancilliaries, they contribute to over 12% of the country's GDP and also generate huge employment.

The transition to net-zero will not reduce GDP or employment, if India carries out R&D, design and manufacture of every subsystem required for RE generation, storage and consumption, along with recycling of all batteries for recovery and reuse. The employment and GDP would both only go up. On the other hand, if it largely depends on imports or just assemble products with imported know-how there would be a negative impact. India's young S&T talent can be nurtureed to carry out R&D, design & development efforts across the entire valuechain. We must motivate, support, challenge and believe in these young minds. Equally important would be to mange this massive change carefully such that the existing industries are able to transition to this new and renewable energy future. Enabling this shift in an effective manner would be a significant governance challenge to address.

References :

1 https://businessindia.co/magazine/moving-india-towards-net-zero

2 Steel and cement plants are estimated to contribute to over 16% of total GHG emissions in the world today

Nucleus & Cell Information

Energy & Net-Zero

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Dr.Senthil Raj K DC Thoothkudi 94441 86000	Aravind Kumar Chandiran aravindkumar@iitm.ac.in 80563 80100	Ankit Poddar (Zedbee) ankit@swadhaenergies.com 9884796960	Nallasivam Jeganathan (X2Fuels) nallasivamprpc@gmail.com 8072655194	A6 - Lounge - A Block 6th Floor	Saha Hall - E Block Ground floor	B1 to B12
2	Shri Vijaykumar Siddappa Director Of Census Operation/Citizen Registration 94492 09885	Rajnish Kumar rajnish@iitm.ac.in 88053 40709	Pradeep Thangappan (Aerostrovillos) pradeep@aerostrovilos.com 9750959770	Sreejith Swaminathan (Zedbee) sreejith@zedbee.in 8943021886	A6 - Lounge - A Block 6th Floor		
3	Shri S N Tripathi DG IIPA sntripathi@iipa.education sntripathi@gmail.com	R. Kothandaraman rkraman@iitm.ac.in 94442 31700	Rohit Grover (Aerostrovillos) rohit@aerostrovilos.com 9600067714	Keshav Vijay (Waste Chakra) keshavvijay.57@gmail.com 9790936504	A6 - Lounge - A Block 6th Floor		C1 to C13
4		Preeti Aghalayam preeti@iitm.ac.in 91766 59760	Sirisha Sumanth (Grinntech) sirisha.sumanth@grinntech.com 9940411933	SR Suseendiran (Elicius) suseendiran@eliciusenergy.com 94435 39219	A6 - Lounge - A Block 6th Floor		
COORDINATOR - Anson Sando | anson@respark.iitm.ac.in | 97421 41685							

2. EDUCATION

Prof. Andrew Thangaraj

andrew@nptel.iitm.ac.in

99404 89032

Prof. Vignesh Muthu Vijayan

vigneshm@iitm.ac.in

95000 46940

Education

Education plays a fundamental role in the development of an individual. Since independence, India has focused on improving access to education for students from all walks of life. Based on the available data, it is evident that we have by and large succeeded in providing access to primary education. While continuing these efforts, our country has reached a point where imparting inclusive, equitable, and skill-based education is needed to accelerate India's ascent at the global stage.

The scientific and technological advances are also pushing the need for skill-based training in cutting-edge multidisciplinary domains. Along with delivering content, the teaching-learning process must evolve to help the learner think critically and apply the knowledge gained to solve real-world problems. In addition, designing holistic education that nurtures well-rounded citizens with social and civic responsibility is critical. In this document, we have summarized the current status and how to achieve these goals by 2047.

Improving infrastructure

According to Unified District Information System for Education Plus (UDISE+) 2019-20, more than 15% of the schools still do not have electricity. Less than 40% of the schools have computers, and under 23% have Internet access. Although these are concerning, it is important to note that these numbers have significantly improved since 2012-13. We need to continually improve the infrastructure to ensure all students have access to the best facilities. This will greatly help in narrowing the gap between students from various backgrounds. Every school must have basic amenities like water, toilets, electricity, and infrastructure for children with special needs.
In addition to these facilities, schools should also have a strong digital and technology infrastructure. Strengthening the digital infrastructure is essential for accessing the learning resources, interacting with peers across the world, and updating knowledge and skills. Every student should have access to tinkering labs where they can learn by doing. These science labs and technology centers in schools will train the students on advanced technologies and enthuse them to innovate. Mushrooming of these initiatives by the government will ensure we grow into an innovation-driven economy.

Inclusive and accessible education

As per UDISE+ 2019-20, the gross enrollment ratio (GER) drops from 78% at the secondary level to 51.4% at the higher secondary level, clearly showing that a significant fraction of students exits the system at this stage. This dropout is even more prominent among tribal students (42.9%). According

to the GER data from the All India Survey of Higher Education (AISHE) 2019-20, there is another significant dropout at the higher education level (27%), which again is much more exacerbated among SC (23%) and ST (18%) students. It is obvious that improving inclusivity and accessibility in education is a critical factor for our nation's growth.

Improving accessibility requires designing systems that will optimize access for everyone. The system needs to carefully weed out any impediments that make it harder for a group of students to participate in the learning process. This could include establishing schools, improving access to existing schools, improving infrastructure, adopting assistive technologies, etc. It is also essential to create an inclusive learning environment through innovative curriculum development and sensitization of the stakeholders. Inclusion, with appropriate mentorship and handholding wherever necessary, will empower the students. The classroom activities need to be planned appropriately to facilitate each student to reach their full potential. The curriculum needs to include locally relevant themes and contributions from marginalized groups. We can groom the future generation to be socially aware and empathetic citizens through these initiatives.

Equity in education

Although equity and equality are used interchangeably on many occasions, it is vital to understand the differences to achieve substantive equality. The education system needs to understand a student's circumstances and provide the necessary support and resources to address their specific needs. Equity in education ensures that everyone has an opportunity to succeed, irrespective of their original circumstances. Providing equitable education does not just help students from disadvantaged backgrounds. Studies have shown that equity strengthens the academic performance of all students. Equity also builds a better community by strengthening the students' social-emotional well-being.

Skill-based and employment-oriented training

Students at the higher education level should have the flexibility to choose their educational path. They should be provided with a support system that they can rely on for mentoring and guidance when needed. However, the curricula of higher education programs need to nurture multidisciplinary learning opportunities. The existing programs need to adapt to today's world and adopt a more flexible curriculum. In addition to flexibility, the students should be encouraged to pursue self-directed and experiential

Nucleus & Cell Information

Education

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri Rai Mahimapat Ray Deputy Secretary m.ray@ias.nic.in	Shantanu Mukherjee shantanu@iitm.ac.in shantanu@physics.iitm.ac.in 97482 19355	Prasad Sukumaranunni (Beebox) prasad.s@beeboxstudios.com 8754483451	Jagadeesh Kanna (Vaayusastra) vaayusastra@gmail.com 9360545176	Ramanujam Hall - E block Ground floo	Sarabhai - E Blk	B13 to B19
2	Shri V.Vishnu DC Thirunelceli collrtut@nic.in 94441 85000	Janakiraman Viraraghavan janakiraman@ee.iitm.ac.in 94497 52143	Balamurugan (GUVI) spbalamurugan@guvi.in 9840224594	Kumaran (Edsix) kumaran@skillangels.com 9566688250			C14 to C21
3	Smt G V Rashmi CEO Atal Bihari Vajpayee Institutre of Good governance & Policy Analysis Bhopal 89897 78200	Vignesh Muthuvijayan vigneshm@iitm.ac.in 95000 46940	Arun Prakash (GUVI) arunprakash@guvi.in 9176054456	Sujareetha Venkatanarayanan (Beebox) sujareetha@beeboxstudios.com 9940093249			D15 to D21
4	Shri Naresh Bharadwaj deputy Secy Dept of Pension and Pensioners Welfare	Kartik Chandra Mondal csdkartik@iitm.ac.in 73587 55811	Rajani Seshadri (Indepenn) rajani@indepenn.com 9884915785	Karthik Pondugula (Crion) karthik@criontech.com 9940592917			
COORDINATOR - Pragadhish C | pragadhish@incubation.iitm.ac.in | 9884513451							

3. Health Care and Assistive Technologies

Prof. Mohanashankar

mohan@ee.iitm.ac.in

98845 11692

Prof. Sujatha Srinivasan

sujsree@iitm.ac.in

94449 27559

Affordable Quality Healthcare for all

As our country's socioeconomic progress continues, the demand and focus on quality healthcare – physical and mental wellbeing of our citizens – continues to increase. The recent COVID crisis acted as natural test to the healthcare system bringing out its strengths and weaknesses at scale. Currently, India spends nearly 3.8% of its GDP on health care, of which the share of Government is about 1.2%. Among the various sources of financing health care, government sources (including both central and states share) account for 32%, while the out-of-pocket payment from households is the largest source at 63.2%. The public healthcare delivery system in India is almost entirely financed through tax, both at central and state level. Our goal as a country must be to provide access to quality healthcare at an affordable price to every citizen of ours. Today, around 25% of our population does not have quality health coverage at affordable cost, which to many of them is essentially close to zero. This is the primary challenge of healthcare in India.

There are four key pillars of healthcare delivery – infrastructure, healthcare workers, medical equipment and consumables, drugs and vaccines – all of which need to be strong for the country to succeed in its mission of healthcare for all.

India has 0.5 public hospital beds per 1,000 population and 1.4 beds, including public and private hospital beds per 1,000 persons. Specifically on the public healthcare front, there are 155404 and 2517 Sub Centres (SC), 24918 and 5895 Primary Health Centres (PHCs) and 5183 and 466 Community Health Centres (CHCs) respectively which are functioning in rural and urban areas of the country. The density, quality and access of public healthcare facilities is highly variable across states, with the socioeconomically lagging states well below par in all metrics. Even overall as a country, the infrastructure requirements are about 2X short. A major weakness of the primary health care system is the weak gatekeeping mechanism for referring patients through levels of delivery system. A very large section of outpatient care takes place in secondary and tertiary care facilities. This not only crowds out the valuable and limited secondary and tertiary care facilities, but it also reduces efficiency and trust in the public primary care system. Ensuring the primary-tertiary funnel requires inducing major behavior changes through innovation and governance, backstopped by assurance of outcomes throughout the funnel.

There are around 5.76 million health workers which included allopathic doctors (1.16 million), nurses/midwives (2.34 million), pharmacist (1.20 million), dentists (0.27 million), and traditional medical practitioner (AYUSH 0.79 million). Around 70% of them are actively employed in the healthcaresystem. This is further skewed in terms of distribution across

For example, there is a shortfall of 78.9% of Surgeons, 69.7% of Obstetricians & Gynecologists, 78.2% of Physicians and 78.2% of Pediatricians in CHCs across the country...! This problem is difficult to solve, and it is directly linked to the reluctance and inability of qualified healthcare professionals to reside and work in rural areas. While telemedicine can provide certain degree of relief, this requires a creative solution through some form of PPP or differential-mode public service where specialists are indeed available in non-urban areas. Without solving for this problem, quality healthcare cannot reach rural and remote regions of the country.

India is strongly self-reliant in drugs and vaccines, and a significant player in the global pharmaceuticals sector. India is the world's largest supplier of generic medications, accounting for 20% of the worldwide supply by volume and supplying about 60% of the global vaccination demand. Over 80% of the antiretroviral drugs used globally to combat AIDS are supplied by Indian pharmaceutical firms. One critical dependency India faces in growing and sustaining its self-reliance and exports of pharma drugs is its import of active pharmaceutical ingredients (API). India is also weak in new drug discovery that would make it a global leader in new drugs in addition to generics. The country's large pool of scientists and engineers should be put to expand the current industry to developing cutting-edge drugs, including niche leadership in biopharmaceuticals. The biopharma sector also has an indirect impact in building capacity for the biotechnology area that includes bio-services, bio-agriculture, and bioinformatics.

The country imports around 80% of its medical equipment requirements, in particular, the high-tech category. As our overall healthcare expenditure increases organically, and with increased coverage across the country, this is an important area that needs attention. Limited R&D, weakness in high-tech manufacturing, nascent domestic regulatory system that is not of global standards, poor adoption of home-made innovations and products by public healthcare system are key factors limiting progress on this front. Our healthcare systems are yet to take critical advantage of internet, communication, and digital technology ecosystem, like the way other public service delivery systems have successfully done in the country. In recent years, digital health technologies have been used to enhance the coverage of health service delivery, improve the quality of services and to assist in monitoring and supervision. There are also several examples of digital technology being used in payment for secondary and tertiary health care services as part of the public funded health insurance schemes. This needs to move wider and deeper to fully take advantage of the digital infrastructure which is steadily maturing in the country.

Nucleus & Cell Information

Healthcare & Assistive Technologies

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri Vikram Singh Director vikramsingh-cea@gov.in	M< Arun Kumar Thittai akthittai@iitm.ac.in 76679 38200	Dr. Steward Gracian (SocioDent) stuvia2j@gmail.com 9940787153	Mr Sakthivel Thayappahn (Yali Mobility) sivamsakthivel@gmail.com 6382191526	Raman Hall - E Block Ground floor	TV Lounge - E Block Ground floor	B20 to B31
2	Dr.Sumit Garg Deputy Secretary sumit.g@nic.in	Ms Kavitha Arunachalam akavitha@iitm.ac.in 97909 86993	Mr Siddarth Daga (Neomotion) sdaga@neomotion.co.in 9445383599	Mr Jayakanth S Kesan (zMed) jay@zmed.tech 7358262047	Raman Hall - E Block Ground floor		
3	Dr.Neha Garg Director NHM II nehagarg.irs@gov.in	Ms Smita Srivatsava smita@iitm.ac.in 98843 14735	Dr. Bhasi Sukumaran (BrainwaveS) bhasis@srmist.edu.in 9383845040	Mr Sabarish RC (Medisim VR) sabarishrc21@gmail.com 9444106666	Raman Hall - E Block Ground floor		C22 to C34
4	Shri Jitendra Kumar Soni Mission Director (MD) National Health Mission Rajasthan rajnag@nic.in 91667 55000	Mr P. Anbarasan anbarasansp@iitm.ac.in 98401 22302	Dr. Anirudh Ranganathan (Sekkei Bio) anirudhranganathan@gmail.com 9884982855	Mr KV Pravin Kumar (DextroWare) pravinofficial14@gmail.com 9940579393	Raman Hall - E Block Ground floor		
COORDINATOR - Muthusingaram | ceo.incubation@htic.iitm.ac.in | 9790932420							

4. WATER

Prof. T Pradeep

pradeep@iitm.ac.in

98408 81724

Water

Water – gaps, opportunities and hope for tomorrow

Water is both local and global, just as carbon dioxide. However, while number of water molecules on the planet is roughly constant at 33.4 x 1045, total CO2 continues to rise. The magnitude of water, represented this way appears small, although it is massive, measuring 1.386 billion km3 or in other words, a billion, billion tons. Nature circulates water from one form to the other – soil to sea to air. Eventually, the Earth is nourished by rain, its principal way of regeneration. Ecosystem on the land survives only because about 0.5% more water falls on land as rain than the amount evaporates from it. This excess water is taken to the sea through various ways and the process makes the land bloom. Our wealth is largely due to this nourishment. The foregoing makes it obvious that the singular ingredient that enables civilisation is water.

The context: India has just 4% of the global freshwater resources but 18% of the world's population. The country, which was largely rural years ago, has en-masse become urban in the past two decades. The urban population has risen from 28% in 2000 to 33% in 2016. With a growth rate over 6% in gross domestic product (GDP), the most populous countries, such as India and China, are increasing their chemical, pharmaceutical, agrochemical, automotive, petrochemical, semiconductor, and many other outputs, which will eventually "enrich" our ecosystem materially. Simultaneously, their rapidly declining water resources will be burdened by unprocessed industrial waste. The World Bank has predicted that achieving a growth rate of 8% or above for India will be possible only with a robust water management system. These emerging issues, like those existing throughout the world, present a complicated suite of problems that will require technological advances, limits on usage, and collective wisdom, and compassion to create sustainable solutions. For instance, the control over carbon emissions by developed countries is probably not the reason for the globe's survival, but the lack of development in less-developed countries is, according to the Intergovernmental Panel on Climate Change (IPCC). Sustainable economic and technological development for all is needed, although acquiring a quality of life comparable to the United States for the rest of the world would require significant advances in treating, purifying, and manging water. Water challenges are highly interdisciplinary, and solutions therefore must cut across boundaries of disciplines. Water in diverse forms is related to climate, food, health, and many other aspects of life, including its origin. The need for urgent, concerted action from all fronts is clear from just one observation: ca. 83% of freshwater species have declined globally in the last 50 years!

Our challenges: Of the global precipitation of 505,000 billion cubic meters (BCM), India gets its < 4000 BCM for a geographical area of 328.7 million

hectares, with an average rainfall 1085 mm, 85th in a list of 186 countries with Egypt at 51 mm at the bottom and Columbia at 3240 mm at the top (as on 2014). Water footprint, estimated by considering production and consumption of goods and services, works out to 2842, 1071 and 1089 m3 per capita per year (PCPY), respectively for USA, China and India, the global average being 1385 PCPY. Therefore, with a water availability of around 1100 m3 PCPY, India has no water to lose and no water to dirty during its activities. Besides, the country experiences extremes such as ambient temperatures in the range of -40 to +50 oC and rainfall between 210 to 11800 mm, making every possible water technology necessary. These technologies have to address all the sectors - agricultural, industrial and domestic - major domains of water use, and for every region of the country.

Our agriculture is becoming increasingly unsustainable. In several regions, intense farming run on ground water has made the land dry and this depletion calls for urgent reversal of our policies and widespread rainwater harvesting, to ensure food security. Poorly-crafted agricultural policies have flooded our fields with poison. For example, arsenic has been found in South Indian paddy fields where it is geologically impossible, and has ultimately reached our dinner table, making the population vulnerable. While this occurs, our rivers have run out of water and all of them have been polluted and each one of them has lost significant biodiversity.

Every segment of our industry – mining, clothing, leather, pharma, tourism, and many others need to implement sustainable practices. Climate change is increasingly manifested in the country with receding glaciers, changing monsoons, unprecedented droughts, and frequent typhoons, and each one impacts water, either causing excess or scarcity.

Although a drive to provide 70 litres per capita per day (lpcd) for the whole nation in the rural areas and 40 lpcd in the cities is being pursued, availability of this water at acceptable quality is an issue. This quantity accounts for drinking, cooking, cleaning and livestock needs. It is estimated that over 20% of India's diseases are connected to water, 1 in 5 children die below 5 years of age by water-related causes, poor sanitation or inadequate hygiene. We have some of the worst water contamination issues: Over 130 million people are affected due to fluoride and about 100 million due to arsenic. Several pockets of uranium, mercury, chromium, perchlorate, nitrate, etc., poisoning exist across the country. There are issues of antibiotics, emerging contaminants, pesticides, etc., as well. Environmental issues are too many, such as frothing and coloured rivers. In water crises, the most affected are poor, who earn less than Rs. 100 a day. Our religious practices often contaminate water bodies and everyone, regardless of faith, and the ecosystem suffers.

Water

For a typical city dweller, about 130 litres of water per day is used for bathing, washing and flushing. With about 40% of the population living in cities, we could in principle run about 73 billion litres per day through our sewers and about 90% of it could be recycled. Currently, we recycle just about 30% of the 19 billion litres of sewage from our cities.

Looking towards 2047: While all the needs of water availability, recycling, irrigation, inequality, environmental sustainability, conservation, etc., need to be addressed, mostly with known solutions but with better management practices, enforcement and water literacy, more emphasis is needed on affordable, reliable and sustainable technologies. Large scale deployment of each one of those solutions, to meet our own internal aspirations, and sustainable development goals, are sure to result in completely new opportunities for the global community. In that process, it is expected that India could provide new examples for the world to emulate.

Where to look for new opportunities: Nearly 40% of the global population resides within 100 km distance of an ocean or a sea, rendering desalination a crucial solution to water scarcity. Presently, there are 19,744 desalination plants operating across 150 countries supplying 100 million m3 of water per day to 300 million people globally. However, desalination is still energy-intensive and hazardous to the environment. It consumes 0.4% of the global electricity, that is, 75 TWh per year. Three major challenges for desalination technologies are (1) high specific energy consumption (SEC), (2) CO2 emissions from burning of fossil fuels, and (3) negative impacts on marine ecosystems due to the discharge of concentrated brine back into the sea. Desalination technologies are either pressure-driven, temperature-driven, or chemical-driven processes and all these need innovations. In the foreseeable future, seawater desalination could be driven by solar hydrogen, at 0.9 paise per litre. In this case, water is both the source and the product!

The earth's troposphere contains approximately 1.42x1019 liters of water in the form of water vapor, and the world population today is about 7.6 billion. Therefore, there is nearly 1.8 billion litres of water available per person in the atmosphere. Atmospheric water harvesting, thus, has vast potential, even if only a miniscule fraction of this resource is used. Note that the oceans of the planet were once dry and were filled by rain. Water harvesting using renewable power could make deserts bloom.

Globally, the water sector is too broad to estimate its net worth. Yet, the value of water infrastructure for a connected global population of 9 billion people by 2050 is estimated to be about US$60 trillion. Compare this with India's total wealth, estimated as US$13.5 trillion. Including water-related services such as sensors and associated analytics and subsequent predictions, water related service industry is expected to grow to

comparable numbers. Increasing awareness of the need for essential minerals in water and the dangers of harmful ones will necessitate optimal mineral content to be delivered through drinking water. Next-generation technologies that can retain certain minerals or reject others completely would make it possible for water purifiers to select purification technologies according to need. Big data analytics would thus help create personal health advisories. The availability of such data across a population would be of use to communities and governments to understand and plan for the health of their people. Water purifiers may become intelligent devices in the foreseeable future. Future solutions will need to be implementable both locally and nationally. The decentralization of water technologies is essential for any country, but especially for emerging economies. Many nations have adequate resources to empower local governments with region-specific solutions. The decentralization and implementation of technologies will also trigger the generation and employment of local manpower, which would help strengthen the economy, if carried out nationwide. It is vital for new technologies to be environmentally friendly with no net carbon emissions.

How will all these drive innovations of tomorrow? Look at two scenarios, among the many possibilities. (1) Make desalination Net Zero. Global CO2 emissions due to desalination were nearly 76 million tons (MT) in 2015, and global methanol requirements that year were approximately 75 MT. Can an efficient catalytic system make CO2-to-methanol conversion possible with renewable energy so that India contributes to Net Zero as far as desalination is concerned (and subsequently in other sectors)? (2) Implement water audit on every product. We need to count the water cost from food to toiletries. For example, cradle-to-grave life cycle assessments of the process of washing 5 kg of laundry (requiring medium hardness water at 40 C and consuming 120 g of liquid detergent, 49 L of water, and 0.53 kWh of electricity per washing cycle) reveals a primary energy footprint of 6.57 MJ equivalent and a carbon footprint of 0.54 kg CO2 equivalent. This understanding may change the consumer's choice of detergents, packaging materials, chemicals, building materials, clothing, etc., and consequently lead to new products which are less harmful to the environment, while being affordable. This thought would extend to create new agriculture, clothing, infrastructure, transportation, etc. We may move to more efficient irrigation, 'water smart' foodstuff, which will also be animal friendly. Water for all sustainably calls for radically new innovations.

It is clear that water is big in every scale – Gaps, opportunities, wealth and ultimately professional satisfaction.

Nucleus & Cell Information

Water

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri S Majhl Deputy Secy Ministry Of Animal Husbandry & Fisheries sarbeswar.majhl@gov.in 92898 51880	Boby George boby@iitm.ac.in 94454 85273	Varun Sridharan (Greenviroment) varun@greenvironmentindia.com 9962663255	Abhishek Jose (Earth Fokus) info@earthfokus.com 9487535673	IC 1 - D block 3rd Foor	Incubation Conference - D Block 3rd Floor	D1 to D14
2	SDr. Adeela Abdulla Director Dept of Fisheries Kerala 98955 05256 / 88486 78982	Tiju Thomas tijuthomas@iitm.ac.in 80564 56442	Kathirmani Sukumar (Greenviroment) kathirmani@greenvironmentindia.com 9701344400	Bhavesh Narayani (Solinas) bhavesh@solinas.in 8838697838	IC 2 - D block 3rd Foor		
3	Dr.Piyush Singla DC Anantnag, South Kashmir anantnag@nic.in 94690 81000	Jitendra S. Sangwai jitendrasangwai@iitm.ac.in 98843 10593	Moinak Banerjee (Solinas) moinak@solinas.in 738762104	Dr. Bala Yeshwanth Ram (Inger) yeshwanth.v@gmail.com 93447 47299	IC 3 - D block 3rd Foor		E1 to E14
4		Somnath Chandra Roy somnath@iitm.ac.in 80560 81266	Ramesh Kumar (Vayujal) ramesh@vayujal.in 8939017761	Nishanth S (Novatex) nishanthprime18@gmail.com 6383450870	Thalaiva 1 - D block 3rd Foor		
Coordinator - Dr.Tamaswati Ghosh | tamaswati@incubation.iitm.ac.in | 80562 62894							

5. Infrastructure and Communications

Prof. Krishna Balasubramaniam

balas@iitm.ac.in

98402 00369

Prof. Radhakrishnan Ganti

rganti@ee.iitm.ac.in

98402 64563

Krishnan Balasubramanian (Infra) and Raghuttama Rao (Infra) and Radha Krishna Ganti (Comm)

While the Infrastructure Sector consists of many entries, in this paper we focus on the following; **Transportation Infrastructure** (Roadways, Trains, Ports, and Airway), **Energy Infrastructure** (Electricity, Fuel, Dams, etc.

The current state-of-affairs of Infrastructure sectors in India

a) Transportation (Roads & Highways)

· India has the 2nd longest road network in the world (~6mn km) and transports two-thirds of goods. Some issues:

Highly inefficient and carbon intensive;

Quality of state and local roads is poor (Pace of construction is good at NH level)

Low level of automation (and electrification)

No regulator for the Roads & Highways sector renders policy making incoherent (NHAI plays role of operator, financier, and regulator!)

b) Transportation (Ports)

· Ports in India handle 95% of international (merchandise) trade in and out of India. Capacity of 1.5 bn tonnes/year. Some issues:

Ports lacking capacity to handle expected growth in trade. Close to capacity.

Most Indian ports suffer from low draft and Inland and coastal shipping are way below potential despite programs like Sagarmala

Regulator for Ports sector (TAMP) is weak, has less powers, and lacks capacity.

c) Transportation (Railways including Metro projects)

· Indian Railways (IR) is one of the largest rail network in the world under one management; it is the largest employer in the world (maybe second to Chinese Army). Some issues:

Due to issues with GoI freight policies, losing most of it to inefficient road traffic. Main revenue from moving coal. Passenger fares are subsidised vastly. Expensive physical assets.

Lack of investments in IR for several decades until the past decade (electrification, and dedicated freight corridor projects have boosted investments).

c) Energy Infrastructure (Electricity, Oil & Gas, Hydro, Renewable, and Nuclear)

- India is currently the 4th largest consumer of energy after USA, China, and Russia and the electricity access in India has reportedly reached nearly 100% in 2021.

- Thermal power plants (Coal, Oil, Biomass and Gas) constitute 68% of total power generation in India of which Coal is 58.5%. The other sources include Hydro (17%), Renewable (Solar and Wind= 12%), and Nuclear (3%). India has achieved one of her NDC goals of 40% power capacity from RE.

- Surplus in electricity generation, but per captia consumption is still low. Fragile infrastructure with last mile losses.

- By the end of 2019, import dependence on crude oil and coal is estimated to be 78% and 22% of the demand respectively.

- Solar power has the potential to meet 7% of our power needs by 2022, mitigate 2.6% of carbon emission, and reduce coal imports by 71 million tonnes per annum saving Rs 33,000 crore.

- There is no National Policy on Energy endorsed or supported by Parliament.

Communication infrastructure:

Communication infrastructure is and will be a critical component of India's growth saga, particularly given the modern-day dependence of business and daily lifestyle activities on ICT.

Wired Infrastructure: Wired internet infrastructure is the most reliable and stable way of providing internet to households. The two most popular technologies in this regard are the Fiber and DSL. These technologies (particularly Fiber) will allow data rates upwards of 100 Mbps to a few Gbps. However, in India only 9.1% [2] of the households have fixed broadband access. Out of these connections, about only 6% are in Rural India. While Fiber and DSL provide network connectivity to home/office, the last meter connectivity is through WiFi.

Wireless Infrastructure (Cellular): Cellular (Mobile) broadband is the main mode of connectivity for a majority of Indian population. About 600 million

people in India [1, 2] are connected to the internet using their mobile phones, which is significantly higher than wired connections. In addition, it should be noted that the cellular tariff in India is one of the lowest in the world [3]. Cell phone assembly is being done in India (in the recent years, there is a significant increase of assembly because of Govt Policies on PLI). Some observations:

1) Cellular is the main mode of broadband connectivity in India and India has almost lowest tariff.

2) Most of the cellular infrastructure is still imported. Also, major importer of chipsets (Cellular and WiFi) and royalty outflow is quite high.

3) Also the cellular penetration is still low because of the lower ARPU.

Projected Vision for 2047 of the above Infrastructure sectors in India

a) Transportation Infrastructure

- To become the #1 roadways in the world through a comprehensive network of highways.

- To become the #2 railways system in the world with 100% private operators with integrated connectivity in urban areas with other transportation systems. To become the #2 hyperloop alike infrastructure in the world.

- Metro and Metro like urban transportation in all Tier 1 and Tier 2 Cities across India.

- To integrated transportation across the roadways, railways, ports, and airways through an operation i.e. An integrated national transportation system that can economically move anyone and anything anywhere, anytime, on-time.

- To achieve a national integrated transportation system that has low dependency on foreign energy and is compatible with the environment.

b) Energy Infrastructure (Electricity, Oil & Gas, Hydro, Renewable, and Nuclear)

- Through smart grid and other mitigation initiatives, India will have to reduce this projected oil demand by 75% to 1 mb/d, thereby reducing foreign dependencies.

- Coal generated electricity should be down to 25%. This requires we have a substitute baseload fuel.

- To achieve 60% share of renewable sources out of the total energy supply.

- To leverage the clean hydrogen economy to 20% of the total energy demand.

- The share of non-fossil fuels in electricity generation capacity reaches almost 60%, well above the 40% that India pledged at the Paris Convention.

- India's leadership in the deployment of clean energy technologies expands its market for solar PV, wind turbine and lithium-ion battery equipment to over $40 billion per year.

- India's clean energy workforce grows by 5 million over the next twenty five years.

- To develop robust smart grids with 100% national coverage

- India becomes a global leader in battery storage with a target of 200 GW capacity.

C) Communication infrastructure:

- Real broadband connectivity: 1 Gbps average per house hold and 100 Mbps minimum internet speed across the nation and good QOS (available 99.99%).

- Broadband everywhere: Good quality broadband should be available at every nook and corner of the country. This means that ICT infrastructure should be scaled massively for rural connectivity.

- Indigenous infrastructure connectivity: 90% of the Network infrastructure should be designed and manufactured in the country.

- Indigenous Cell phones: We should have an Indian company who can manufacture the cellular SOC and WiFi SOC and can produce these in India.

- Local standards for global adoption: India should play a significant role in global standards and should have (Indian companies and organisations) 15-20% IPR in any wireless global standard.

What can the GoI do to achieve Vision 2047 in Infrastructure

Transport

- Central Govt. must declare that "Transportation & Energy Infrastructure area the foundation of our entire economy and quality of life". Create a

permanent National Infrastructure Advisory Committee, that reports directly to the Ministries, with representatives from all stakeholders

- Formulating a strategy for winding down coal usage

- Create a transportation investment fund with the transportation sector . Significantly increase funding for long-term, high risk enabling research over the next 10 years.

- Create National Centres of Eminence, with a strong industry participation, in the promising areas such as (a) Hydrogen Economy, (b) New Battery Technologies, (c) 3D Printing of infrastructure, (d) Digital Twins for Infrastructure, etc. that will make a difference over the next 25 years.

Electricity

- Create a comprehensive policy and provide an effective action plan for achieving energy security through increasing fuel availability by narrowing demand-supply gap; addressing energy pricing through periodic tariff revision, reforming free and unmetered agriculture supply etc.; bringing policy reforms; and ensuring power sector reforms such as reducing distribution losses etc.

- Privatise discoms and give DBT based subsidy to poor households and agriculture (sub-scale farmers only).

- Strengthen SERCs (today they are puppets of state governments) by giving them a constitutional budget and composition of members from outside government.

- Structural reforms required in wholesale electricity markets

- Create Innovation programs for MSME, like SBIRs and STTRs that are prevalent in the US, to fuel innovation and Entrepreneurial in the infrastructure sector through industry-academia-end user partnerships.

- Create Large and Comprehensive Testbeds for testing and validation of new technologies for infrastructure developmental projects, like NATRIP initiatives for intermodal transportation and energy transport sectors.

- Encourage further research and development to advance smart grid functionality by developing innovative, next generation technologies.

Railways

- IR needs to corporatized and privatised for improving efficiency and viability.

Infrastructure and Communications

- Cargo pricing should be recanalized and subject to competition. Likewise passenger fares. Subsidies for passenger fares can be given through DBT or such means for better direction.

- IR should move to full mercantile accounting at the earliest. Technology upgradation for digital asset tagging (bridges, track sections, all railway assets along the network) for monitoring/maintenance

Communications:

- Incentivising Indian wireless start ups by preferential access to market.

- Design and fabricate in India.

- Focused R&D research areas: Become world experts with multiple centers of excellence in a few areas.

- Govt incentives for infrastructure rural coverage.

Nucleus & Cell Information

Infrastructure & Communication

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Dr.S Chitra Labour Commissioner Govt of Kerala 88489 32016	Radhakrishna Ganti rganti@iitm.ac.in 98402 64563	Chakkaravarthy Ramachandran (Theta90 & Agalsearch) charam@theta90tech.com 9566281749	Utkarsh Kulshrestha (Detect) utkarsh@detecttechnologies.com 8446333683	Exhibition 2 - E Block Ground floor	Ramanujam - E Block Ground floor	E15 to E22
2	Shri Ravinder Singh Addl CEO YEIDA Uttar Pradesh 99533 93892	Sheetal Kalyani skalyani@ee.iitm.ac.in 98841 48132	Makesh Janakaraj (Azeriri) makesh@azeriri.com 9384098705	Janani Suresh (Detect) janani.suresh@detecttechnologies.com 9043000705	Exhibition 2 - E Block Ground floor		
3	Shri D Krishna Bhaskar Director Industries & Commerce - Commissionerate of Industries coi.inds@telangana.gov.in 95811 13222/73311 87595	Devaprakash Muniraj deva@iitm.ac.in 99004 57257	Dr. Nishanth Raja (Xyma) nishanthraja@xyma.in 9442949347	Sunil G D (Detect) sunil@detecttechnologies.com 9176135603	Exhibition 2 - E Block Ground floor		F13 to F21
4		V Sriram vsriram@iitm.ac.in 94455 56802	Rani Muralidharan (Indepenn) rani@indepenn.com 9842413262	Pragyan Prasu Patnaik (Aavrtti) pragyan.online@gmail.com 9738848674	Exhibition 2 - E Block Ground floor		
COORDINATOR - Nirmal Panickar | nirmalpanicker@respark.iitm.ac.in | 98462 97055							

6. Transport and Mobility

Prof. Ashok Jhunjhunwala

ashok@tenet.res.in

94444 44408

Prof. R K Krishnakumar

rkkumar@iitm.ac.in

98402 25856

Transport and mobility

India has 14 of the twenty most polluted cities in the world; it spent $106 billion in the first 11 months of current fiscal (2021-22) on oil imports. The automotive sector, a 200-billion-dollar industry in India, growing at nearly 10% and the largest employers in the engineering sector, is one of the major offender in this context. But the sector is set to have disruptive change in coming years.

By 2047, and probably much before, most of these Internal Combustion Engine (ICE) vehicles are likely to change to Electric Vehicles (EVs). They may be driven by a battery or Green Hydrogen, depending on how both these technologies evolve. Faster this happens, India would gain in terms of pollution control as well as foreign exchange outgo. However, the challenge is to look at these two systems and evolve a solution that does not hurt the industry and employment and, at the same time, creates benefits for all citizens in a sustained fashion. In one sense, we are talking about a paradigm shift that satisfies all the stakeholders. It must enable the existing large, medium and small industries to transition. This may be possible, only if every subsystem of the new vehicles is Made in India.

R&D and Manufacturing in India

Battery packs, which dominates the costs of EVs would anyway have to be designed, developed and manufactured here considering India's temperatures, road-conditions and low-affordability. Fortunately, India is quickly developing the capability. Equally important is to manufacture battery-cells locally. The recent PLI encourages this. As the chemistry changes every couple of years, bringing the costs down, India would need to carry out continuous R&D and collaborations, to keep the costs in par with the world. Electric Motors and Controllers constitute the second largest costs in EVs. This is where India can excel with R&D focused on commercialization. Vehicle Chargers is the third component and India will need to sharpen its power-electronics capabilities, to develop and manufacture them. India's vehicles are dominated by its two and three-wheeler industry. It is here that India would have to strive to maintain its leadership, as it transitions from ICE to EVs.

As Hydrogen-powering of EVs may happen in future, India would have to produce green-hydrogen at lowest possible costs. Thus, technologies for electrolysis and Fuel Cells (to convert Hydrogen to Electricity) must be developed at minimum costs. These technologies will be equally useful for making Green Ammonia fertilisers, steel making and cement making tomorrow.

Transport and mobility

Shared mobility and congestion

India's vibrant auto- industry is today focuses on personalised mobility that has congested our cities to such an extent that travel to work may take up to an hour. This cannot be the future. The answer would be to focus on (a) shared mobility and public transport and (ii) redesigning our cities and towns to overcome congestion and encourage use of public transport and walking or cyling.

The shared mobility involves simultaneous (buses and trains) or independent use of a system (taxis), irrespective of the ownership. Top on the list is the mass transit system. Buses or trains can move up to 25,000 people per hour. Public transport will be preferred by people only when it is convenient and faster for even the well to do people. The next important source is ride-sourcing; Ola and Uber have already made great strides, including shared-autos and taxis. Rapido is making waves. A luxury 12 to 14-seater, which would pick one up within minutes and drop where one wants to go fast would be the next step; walking on each-end should be less than 100 meters.

Redesigning future living places (towns and cities) so that one should be able to travel to work withing 15 minutes will be a challenge worth taking. Road safety is another field, where significant attention is needed. This will involve designing of vehicles and roads as well as greater emphasis on traffic rules. India has far too many road-accidents today. This must not continue in future.

Goods transport

While trains and electric trucks can move goods between cities, smaller electric transport vehicles would be required for last-mile transportation. Enabled by mobile-data communication and the two-wheelers, Couriers, Swiggy, Zomato and Dunzo have emerged as great services over the last few years. These are only likely to expand. They are convenient to customers, low-cost and quick. All these two-wheelers are going to be electrified soon. Electric three wheelers (e-rickshaw to e-auto) will move larger goods quickly, not only in cities and towns, but also to and from rural areas. Start-ups are playing a great role in enabling all this. Over the next few years, one would see emergence of UAVs for very quick delivery of small-sized payloads (for example medicines). Regulations will be required, so that our air space is accident-free and avoids congestion.

Transport and mobility

Long-distance Transport

Transport, be it surface, water or air transport, are essential movers of the economy. Though road transport is more expensive than rail and waterways, the past few years have seen their growth outperforming other modes. One should not forget the advantages of each system. Road transport is the choice for perishable items and door-to-door delivery. Rail transport is recommended for bulk transport.

Challenges

1. Infrastructure and services: Space for non-motorized transport, vehicle pick-up and drop-off points etc.
2. What can be the policy and regulations?
3. How to promote mass transit, which is moving away from aspirations of the middle class?
4. How to integrate different transport modes?
5. How to promote broader geographic coverage?
6. How to address safety and security?

The critical question is: What can be a scheme for the future transport network in the country?

Nucleus & Cell Information

Transport & Mobility

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri Gaurav Hariom Gupta Director Ministry of Road Transport and Highways ghgupta155-cgo@gov.in	Gitakrishnan Ramadurai gitakrishnan@iitm.ac.in 95000 90172		Vivek (Meras) viveksam@meraspluginss.com 9715378723	Exhibition Hall 1 - E Block Ground floor	A6 Lounge - A Block 6th Floor	D22 to D34
2	Shri Pronjol Chandra Director M/O Civil Aviation	CS Shankar Ram shankarram@iitm.ac.in 94443 88122	Deepak Mohan (Ozone) deepak@ozonemotors.in 8939040408	Arun Kumar (Skyraptor) arunkumark@skyraptor.in 8056009778	Exhibition Hall 1 - E Block Ground floor		
3	Shri Vinay Kumar Prajapati Director Ministry of Ports,Shipping & Waterways vinay.prajapati@gov.in 84458 89991	Srikanthan Sridharan srikanthan@iitm.ac.in 96209 38545	Visakh Sasikumar (PiBeam) visakh@pibeam.com 7418449556	Suseendar Marimuthu (Blunav) susee@blunav.in 9994482016	Exhibition Hall 1 - E Block Ground floor		E23 to E35
4	Shri Vishesh Garhpale Director, MSME Dept MD, Laghu Udyog Nigam & M.P. Silk Federation Commissioner, Sericulture Department Bhopal vishesh@ias.nic.in 96692 66077	Chaitanya Yamijala yamijala@iitm.ac.in 88380 43462	Rakesh Rajagopalan (Grinntech) rakesh.rajagopalan@grinntech.com 9791097983	Jana Lakshman (Debrique) janalakshman@modulushousing.com 8248624962	Exhibition Hall 1 - E Block Ground floor		
Coordinator - Sandhya Ravikumar | sandhyaravikumar@tenet.res.in | 9176679291							

7. Urbanisation and Housing

Prof. Ashwin Mahalingam

mash@civil.iitm.ac.in

98409 82190

Urbanization and Housing

Nearly half a million people live in India's cities and towns today. Over the next 25 years, this number will increase substantially. Conservative estimates suggest that another 300 million people will move into urbanized areas by 2047. Many of our cities are already bursting at their seams and are facing considerable challenges in delivering basic urban services. Not everyone has access to safe drinking water, and even fewer are connected to wastewater networks (nearly 60% of urban sewage is untreated). Large urban agglomerations generate considerable amounts of solid waste that municipalities struggle to collect and safely manage. Travel times are starting to increase in several cities due to traffic congestion on the roads and the lack of reliable mass-transit options.

The development of our existing cities has also happened in a haphazard manner. In contrast to planned development where infrastructure services precede the development of residences, commercial and industrial facilities; low land costs have led to development outpacing the delivery of infrastructure in the periphery of cities leading to the phenomenon of urban sprawl in many Indian cities. Such development has several environmental and social consequences and has resulted in the loss of agricultural land, open green spaces and water bodies. Furthermore, several of our cities are characterized by the rise of informal settlements and encroachment of water bodies, especially among low-income residents. All of this decreases the resilience of cities to withstand shocks and stresses and leads to cities becoming prone to disasters such as flooding and places an ever-increasing burden on municipalities to deliver water, transport and other services. How do we fix our cities? How will we simultaneously cater to a massive increase in the population of cities over the next 25 years? These are key questions to ponder.

One of the challenges that India's urban settlements have faced stems from a fragmentation in the governance framework for urban management. While cities such as Paris and London have elected Mayors who are vested with powers to coordinate services across the city, our municipal governments are not vested with sufficient responsibilities or resources – both human and financial. Decision making is in the hands of multiple authorities. Take for instance the management of water resources in the city of Chennai. Various responsibilities pertaining to water sources, distribution and management are divided between multiple agencies such as the Public Works Department, the Chennai Metrowater Sewerage and Sanitation Board, The Chennai Metropolitan Development Authority, the Greater Chennai Corporation, and the Chennai River Restoration Trust to name a few. This scenario persists in other sectors and in other cities as well. Policies for each of these agencies are often made independently, coordinating these policies is extremely challenging and the result is often policy incoherence leading to haphazard growth.

Urbanization and Housing

Further, our planning processes are often outdated and assume predictable growth in cities. Masterplans are often reduced to zoning plans which do not take into consideration the nature of cities as dynamic, complex systems. We lack a scientific understanding of critical parameters of our cities – trends in land-use and density changes, the hydrology of cities and so on. In some cases, the data for scientifically understanding the state and evolution of cities is not available, while in other cases the data is dispersed and hard to aggregate. As a result, while several cities across the world have used Urban Simulation models and other sophisticated methods to understand and plan for urban growth, these techniques are at a very nascent stage of adoption in India.

How do we then approach this problem? First we have to rethink our urbanization strategy. Currently India is in the process of expanding the boundaries of many of its cities and is creating mega-cities. Alternate options to explore are whether we can create and strengthen smaller agglomerations. Can we make Tier 2 and Tier 3 cities more attractive destinations for urban expansion? Can we develop satellite towns and cities or industrial townships that can decrease the requirements for travel? Should we consider building new towns altogether and if so where would we situate them in relation to existing cities? How would we motivate investment in physical and social infrastructure in these towns in order to entice communities to form?

Second, we need to think through how we would design these cities. What spatial and technological choices would we make? For instance, would we increase urban density by building vertically in our cities. If so, how would we deal with associated challenges such as the quantum of solid and liquid waste that would be generated, the need for parking and so on? Can we consider decentralizing these functions through smaller scale infrastructure such as decentralized water supply and treatment plants. Can innovative technologies be developed in this area? Can a new-urbanism style philosophy be applied to urban design to ensure mixed-use development leading to reduced transportation requirements and congestion. These and a number of similar issues need to be thought through.

Third, we will need to relook at the business and economic models that underly the growth of cities. Land economics often dictates urbanization and low land prices at the periphery lead to urban sprawl. Can mechanisms such as transferable development rights (TDRs) lead to more even urban development? For long governments have been the primary providers of urban services. What role can Public Private Partnerships (PPPs) play in providing urban services? PPPs have been extensively used for developing infrastructure such as national highways but their role in developing cities remains nascent. What PPP models are likely to work best for urban

infrastructure? What other innovative business models can entrepreneurs come up with to decongest cities.

To make the cities of tomorrow function better, we need to promote policy coherence (policymakers), develop a better scientific understanding of how cities work (academics from the technological and social sciences) and develop new technologies and business models for how to deliver better services in cities (entrepreneurs). We therefore need policymakers, academics and entrepreneurs to join hands to build more vibrant cities.

Nucleus & Cell Information

Urbanisation & Housing

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri Rajesh Kumar Singh Director (WM) Dept of Land Resources dirwm-dolr@nic.in 80049 38186	Arun Menon arunmenon@iitm.ac.in 99629 34559	Madhup Shukla (Digas) madhup.iit@gmail.com 9884299387	Akhilesh DSN (Debrique) akhilesh.dsn@modulushousing.com 9566143232	Saha Hall - E Block Ground Floor	Raman Hall - E Block Ground floor	F1 to F12
2	Shri Thavaseelan K. DC & Mon Nagaland dcmon-ngl@gov.in 96157 04107	Sachin S Gunthe s.gunthe@iitm.ac.in 99626 04979	Deekshith V (AirOK) ceo@airoktech.com 9176086789	Gobi Krishnan (CareMe) gk@careme.health 9944387386	Saha Hall - E Block Ground Floor		
3	Smt.Hari Chandana Dasari Collector & DM Narayanpet, Telengana collector-nrpt@telengana.gov.in 91004 21386	NV Ravikumar nvrk@iitm.ac.in 94443 76359	Kavin Kumar Shanmugam (EPMCR) kavinkumar@epmcr.co.in 9444039796		Sarabhai - E Block Ground Floor		G1 to G13
4	Shri Ruchir Mittal Director, DOPPW Dept of Pension & Pensioners Welfare fs-dmn-dd@nic.in 94276 57720	Manikandan Mathur manims@iitm.ac.in 80563 33672	Gokul R (MGH) gokul@mghlabs.com 9840604186	Saravanan Panchatcharam (Thouway) psaro75@gmail.com 9962450022	Sarabhai - E Block Ground Floor		
COORDINATOR - Reema Saha | reema@respark.iitm.ac.in | 90927 05270							

8. Rural Development and Agriculture

Prof. Abhijit Deshpande

abhijith@iitm.ac.in

94448 02401

Ms. Jayalakshmi Umadikar

jaya@incubation.iitm.ac.in

91762 17205

Dr. Nagesh Kolagani

nagesh.kolagani@alumni.iitm.ac.in

94446 20292

Rural Development and Agriculture

Background: Today Rural India forms 65% of a total population of 1.38 billion people. Yet very little industry is flourishing here and the main source of livelihood continues to be agriculture. Therefore, there is huge migration to over-crowded cities, where migrants are forced to live in abysmal conditions. Typically, the youth tend to migrate outwards, leaving the elderly in rural areas. While it might be difficult to significantly reduce migration, the next 25 years should be used to create alternative sources of livelihood (non-agriculture means) which will help improve the quality of life in villages. This would result in the youth preferring to stay in the villages thereby rejuvenating the rural landscape. In addition, the village Panchayat should focus on better Governance to help grow the villages economically and socially.

This concept note lays out the current status in rural India in key areas such as Agriculture and Rural Development. Given the close linkages that Health & Family welfare and Education have, current status of these in rural context is also specified. For each of these areas, possible pointers to action are provided.

A. Agriculture: Current Status - Agri Value chain spans Machinery, Fertilizers, Irrigation, Marketing, Agri credit, and Insurance. Major Government schemes support only Agri-credit and insurance: PM-KISAN (55%), (ii) Modified Interest Subvention Scheme (MISS) (16%), and (iii) the crop insurance scheme, i.e., Pradhan Mantri Fasal Bima Yojana (13%).

- **Machinery:** Some challenges faced in farm mechanisation include: (i) different soil and climatic zones which require customised farm machinery, and (ii) dominance of small and marginal landholdings which makes investment in mechanisation challenging

- **Fertilizers:** Many of the fertilizer manufacturing companies use outdated machinery which increase cost of production thereby increasing government subsidy.

- **Irrigation:** As of 2020-21, 49% of the country's net sown area was under irrigation. The remaining agricultural area in the country depends on rainfall. As of 2016-17, major irrigation sources for agriculture include tubewells (48%) and other wells (16%), and canals (23%).

- **Marketing:** There continue to be challenges for farmers to sell at MSP – though majority are aware of MSP, only a fraction of procurement actually happens at MSP. Some other challenges include (i) most APMCs have a limited number of traders operating, which leads to cartelization and reduces competition, and (ii) Traders, commission agents, and other functionaries organise themselves into associations, which do not allow easy entry of new persons into market yards, stifling competition.

Rural Development and Agriculture

• **Government schemes:** Government schemes have to create true impact for the beneficiaries they were intended for. As an example, PM-KISAN scheme doesn't cover the landless labourers who form 55% of the agricultural workers. Some other issues are i) non-availability of proper land records in some states, (ii) incorrect bank accounts, and (iv) poor internet connectivity in rural areas hampering the uploading of data.

What can be done?

· Creating Agro Processing centre:
It could be a place where all the facilities for pre-treatment, processing, drying, packaging, storage and marketing are available. Without these centres, farmers sell their produce immediately after harvesting.

How should these centres be promoted?

· Can fertilizer subsidy be transferred directly to the beneficiaries account?

B. Rural Development: Current Status –

• **Government Expenditure:** In 2022-23, 54% of the Department's expenditure is estimated to be on MGNREGS. This is followed by the rural component of Pradhan Mantri Awaas Yojana – Gramin (PMAY-G) (15%), and Pradhan Mantri Gram Sadak Yojana (PMGSY) (14%).

• **Water:** Less than 50 percent of the population in India has access to safely managed drinking water. Chemical contamination through fluoride and arsenic is present in 1.96 million dwellings.

• **Unemployment:** According to a 2011 census survey, the unemployment rate in rural areas is 7.15%. There are various kinds of unemployment like Seasonal unemployment, Agricultural unemployment and cyclical unemployment.

• **Poor condition of rural road network:** India has one of the largest and densest rural road networks. However, 2.7 million kilometers of rural roads are in poor condition. Most of the roads are not all-weather roads and lack connectivity to remote areas.

What can be done?

· Can NREGA be further improved?
· Can new avenues of employment be explored? People who completed 100 days may be trained in construction of Rural houses, Sub Health centres, Primary Health centres?

Rural Development and Agriculture

- Promoting Non Agri Livelihoods.

Can a 100-200 seat BPO centre be established with all the necessary infrastructure in each cluster of villages? This would generate employment in villages, stop migration of educated youth and financially uplift families

Training of high school graduates in Geriatric care, Nursing, Manufacturing, Painting, welding, Construction sectors may be explored.

How can supplementary livelihoods like Animal Husbandry be developed? Can alternate livelihoods like Minor Forest Produce, Agro Forestry, can be leveraged

Tourism may also be explored as an option to for livelihood – separate hubs may be created

- Can water harvesting be done through community participation? Can research institutions and Government organisations collaborate on addressing these challenges?

C. Health and Family Welfare

- The physical infrastructure of health systems is still fairly poor, especially in rural areas. There is shortage of human resources (both doctors and support staff). People continue paying high amounts out of their own pocket implying that access to public health care, quality of public health care and overall insurance coverage needs to improve.

- The Standing Committee on Health (2021) had noted that there are shortfalls of 23% in SCs, 28% in PHCs, and 37% in CHCs. We are estimated to have 1.4 hospital beds per 1,000 people, which is half the global average of 2.9 beds (World Bank estimate in 2017). Health workers density is about 23 per 10,000 population (WHO recommendation44.5). There is one doctor per 1,511 people (WHO standard one doctor per 1,000 people). There is one nurse per 670 people (WHO standard one nurse per 300 people).

- About 33% ailments in rural areas were treated in government hospitals. As per the NSS Survey on Health in India (2018), in rural areas, 13.4% of the hospitalisation cases were financed by individuals through borrowings. About 60 million Indians are pushed into poverty each year due to out-of-pocket payments for health.

What can be done?

- What solutions can be prescribed to address shortage of about 30% in Rural SHCs, PHCs, also health workers and Doctors ? Telemedicine can be one of the solutions.
- How can Child and Maternal health be improved? Can auxillary nursemid wife and Anganwadi Karyakartha work together since Malnutrition and child mortality are interrelated?

Rural Development and Agriculture

- Understand what is working with current PHC setup and how it can be strengthened.

D. Education: current status in rural context

- GER (Gross Enrollment Ratio) is lower for certain socio-economically disadvantaged groups, based on: (i) gender identities (female, transgender persons), (ii) socio-cultural identities (scheduled castes, scheduled tribes), (iii) geographical identities (students from small villages and small towns), (iv) socio-economic identities (migrant communities and low-income households), and (v) disabilities.

- As per ministry, the most prominent reason for dropping out in 2015-16 was due to engagement in domestic activities (for girls), and engagement in economic activities (for boys). Other reasons for dropping out include loss of interest in studies, and financial constraints.

- The NEP observes that over 85% of a child's cumulative brain development happens before the age of six. To ensure healthy brain development and growth, it recommends universalising access to quality Early Childhood Care and Education (ECCE).

- Percentage of students who can do 1 digit numeracy in class 1 in Rural areas: Number recognition (74.1%), Oral addition (39.5%) Numeric addn(50.6%), Oral subtract (33.7%), Numeric subtract(39.4%). Percentage of Children in Std II & III who can do different tasks by age. (All rural districts ASER 2019): Reading: standard II (43.1%), Standard III (53.4%).

What can be done?

- Can teacher absenteeism and quality of teaching be addressed? Can focus be on basic language and numerical literacy?

- Topics which are relevant to locals like Agriculture, Water conservation, Energy, Waste management be taught as a supplementary education without affecting the current curriculum? Can many of these topics be taught as games?

E. Governance:

Key Challenges in Governance at a rural level remain –

- Implementation of various Government Schemes to provide true impact to beneficiaries.

- Improving decentralized planning with better participation from stakeholders.

Rural Development and Agriculture

- Transparency and accountability.

What can be done?

- Social audits for schemes like NREGA, PMAY, NSAP be conducted thoroughly.

- Participatory planning exercises like Gram Panchayat Development Plans may be done so as to transform rural folk from passive beneficiaries to active citizens.

Nucleus & Cell Information

Rural Development & Agriculture

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Dr.D.Sajith Babu Director, D/o Civil Supplies Sajithias2012@gmail.com 94470 00370	Santosh Kumar Sahu santosh@iitm.ac.in 97911 70431	Rajeev Kaimal (payAgri) rajeev.kaimal@payagri.com 9840930495	Anand A (Novatex) Kananand555@gmail.com 6369080563	Thalaiva Lounge - Room 2 - D Block 3rd Floor	Sports Lounge - C Block 6th Floor	G14 to G21
2	Dr.T.Prabhushankar DC, Karur 94441 73000	Pijush Ghosh pijush@iitm.ac.in 90032 24721	Vidyadhar Bhandare (Earthen Tunes) vidyadhar_b@outlook.com 9558251720	Aditya Srinivas (Roha) kas980425@gmail.com 9515940979	Thalaiva 3 - D Block 3rd Floor		
3	Shri Rahul Yadav DC, Kathua, Jammu and Kashmir 94190 55597	Dillip Kumar Satapathy dks@iitm.ac.in 94980 35838	Raghavan Sampathkumar (Samunnati) raghavan.s@samunnati.com 8355800501	Neena Mariam Phillip (Medisim) neenamariam@medisimvr.com 9790774224	Ceet 1 - E Block 3rd Floor		H14 to H22
4	Shubham Saxena, IAS Joint Secretary, Department of Agriculture and Farmers' Empowerment, Odisha 9439779005 mailtoshubh20@gmail.com	M. Jeganmohan mjeganmohan@iitm.ac.in 89031 59461	Guru Vignesh (Impensus) guruvignesh.v@impensuselectronics.com 96298 49981	Sakthivel K (RF Wave) sakthi@rfwavetek.com 9025443322	Ceet 2 - E Block 3rd Floor		
Coordinator - Jaya Umadikar | jaya@incubation.iitm.ac.in | 9176217205							

9. Fintech and Inclusion

Prof. Nandan Sudarsanam

nandan@iitm.ac.in

98409 82190

Mr. Puneet Gupta

puneet@kaleidofin.com

97908 66266

Mr. Bhuvan Dubey

bhuvan@respark.iitm.ac.in

96510 64635

1. Introduction : India is the fifth-largest economy in the world[1] with a GDP of over 2.66 Trillion USD (INR 135.6 lakh Crores[2] [3]). However, despite the economic growth during the past two decades, the informal economy in India still accounts for more than 80 percent of non-agricultural employment. Further, as per an ILO note, "Informality also has a gender bias. Women are somewhat more likely to be engaged in the informal economy but significantly more likely than men to be working as informal workers in the formal sector"[4].

The implication of this extremely large informal and unorganized sector is that a significantly large proportion of the Indian population is either self-employed or is dependent on small enterprises. To unlock the full potential of this segment access to finance becomes critical. The absence of a continued supply of working capital, underinvestment in enterprises, and lack of basic risk insurance has multiple consequences. It leads to low and erratic productivity resulting in lower risk-taking ability of entrepreneurs, which in-turn makes it harder for such enterprises to grow and scale.

Improving access to financial services through inclusion has always been an important aspect of State policy. Starting from the nationalization of banks to programs such as IRDP to targeted lending requirements and branch licensing policies to differentiated licenses offered by RBI, each of these initiatives has evolved, but the need for inclusion has always remained important and has continued to be behind the need.

It will be wrong to say that we have not made rapid strides in improving access to financial services. One of the big achievements has been universal access to a bank account. The Jan Dhan Scheme of the government sought to offer a bank account that could offer or send money on a real-time basis to anyone. What has been even more impressive has been the ability for users to be able to make use of this bank account. Aadhaar Enabled Payment System (AEPS) has made it extremely easy for users to make transactions without filling out forms, the need to sign or remember pins. Transactions can be authenticated by the use of a biometric finger print making payment systems easily accessible.

However, many low-income and informal sector users do not use their bank accounts other than for very limited involuntary transactions such as receiving loans in the bank accounts or receiving subsidies in their bank accounts. The percentage of the population aged 15+ with a Financial Institution account has increased to c80% from c53% in 2014, however, c48% of accounts remained inactive[5]. There continues to be a significant mistrust of the banking system, not related to the safety of the money, but largely due to excessive costs, opaque processes, no sense of timelines or predictability of outcome.

The introduction of UPI saw a significant increase in the usage of digital cash. While cash usage remains high, in most cities, including tier 3 and tier 4 cities, most hawkers, auto drivers, and shopkeepers have embraced QR-based digital transactions. The value of UPI-based transactions has increased from 0.57 billion in 2017 to 71.56 billion in 2021[6] . NPCI reported that about a third of Indian households are using UPIs – while 1 in 2 in the richest 20% households use digital payments, while 1 in 4 households in the poorest 40% use it[7]. At the launch of Account Aggregator, an important piece of financial infrastructure, that allows customers to aggregate their financial and potentially non-financial data for seeking better financial services, Dr Nandan Nilekeni suggested that the county has nearly 120 million unique customers that have made at least a single transaction using UPI. While this number compared to the potential 850 million customers looks small, the growth of users has been exciting. To our mind, it isn't obvious that the number of users will increase on their own very quickly. Specific steps will need to be taken to bring everyone in the fold of digital payments.

Less than 3 percent of adults have ever made a capital market transaction. The number of Demat accounts have increased to 7.4cr in October 2021, more than double of 3.6cr in March 2019, but still forms a small percentage of the population.

The use of informal savings has continued to remain high. The go-to savings products for most low-income households and informal sector households continue to be gold and chit funds.

Similarly on the credit side, barring simplistic low-value loans such as group loans, most customers do not have access to any good credit products such as working capital finance, business loans, affordable housing finance. Loans available are extremely expensive, largely on account of transaction costs and not necessarily expected loss rates. 200 million unique individuals are credit-active in India, credit products penetration in the rural segment is only 8%[9] .

Most households don't have any decent insurance coverage available to them. Health-related expenditure remains one of the most common reasons for households to slip back into poverty. Only 28.7% of households have at least one member covered by a health scheme or insurance[10]

2. Fintech Vision 2030 : Our vision for 2030 is not just a wish list. It provides a framework for what transforms finance into a human capacity just like health and education to become a fundamental human capacity. Most of the 17 goals as enlisted under the Sustainable Development Goals seem to depend on the availability of financial services.

2.1. Ubiquitous Financial services : Simply speaking, financial services need to be easily accessible to each individual in terms of geographical proximity. While geographical proximity is important, it may not be sufficient. Morduchand Rutherford (2003) identified, in the context of microfinance, that dimensions of reliability of access, it being available on a continuous basis, access being convenient and flexibility as important[12]. These dimensions hold true not only for microfinance but all financial services. The following are additional parts of our vision for ubiquity.

1. *Each adult member in each household has access to a smartphone with a working data connection*
2. *More than one cash-in-cash-out point available to each household within a distance of 0.5 km*
3. *Each customer has access to their credit score and their ability to understand their access to credit available through an app. It is also important to have a transparent system that helps the customer understand the reasons, if any, that make it hard for them to access credit.*

2.2. Data based design : When it comes to financial services, more is not always good. More credit could be detrimental and more than adequate insurance could be expensive and can eat into the surplus of the household. To our mind, in the next 10 years, the following will be the key elements

1. *Each household has access to data-based personalized advice and a personalized suite of financial services, offered with minimal fine print and in language that is best understood by the customer.*

2. *Each individual has access to their data and has full control over their ability to share their data for the creation of personalized financial solutions. Similarly, each customer also has the right to have access to their data removed in a seamless fashion.*

2.3. Access to multiple financial services : Financial products are imperfect substitutes to each other. For instance, while it is not uncommon for customers to finance health related expenses through sale of investments or by taking a new loan, however, this is extremely expensive for the customer. It is not incorrect to say that the distance between a middle-class household to poverty is a single medical bill. Our vision for access to financial services therefore is for all households to have access to multiple financial services and includes the following

1. *Each household has access to an honest bank account that has no charges levied to a customer without explicit customer consent.*

2. Each household has an emergency line of at least INR 10,000 (2 months expenses) available to them preferably through savings but in an extreme situation available through a liquidity line that can be drawn at a notice of 1-2 hours.

3. Each household has some life insurance available to them (even if it does not meet all their requirements). This needs to be purchased voluntarily.

4. Each household has tertiary health care available to them, either under state scheme, central scheme or under voluntary critical and catastrophic covers.

2.4 Digital payment access : Unless cash usage is reduced, access to financial services will continue to be an artificial plant on consumers. Our vision for digital payments will include the following

1.Each household is able to make digital payments (with assistance) to make payments from their bank account and is making at least one transaction a month for Bill payments

2. Each household is making at least 1 P2P payment a month and is making nearly all utility payments online

2.5 Access to high-quality service : Caveat emptor is often used in the context of the responsibility of customers to choose wisely. However, the information asymmetry in financial services makes it very hard for this to be a fair ask. Vision for high-quality service for financial services includes

1. Do no harm is embedded in every service provider's solution. A provider is responsible for solutions offered.

2. Financial services Portability: Customers are often locked in with their service providers either because of some benefit attached or on account of friction to switch. For instance, users often would struggle to shift from a poor bank account to a better serviced account, because of the challenges in making a change to all mandates that have been set up on the account. Customers may have monthly direct debits of loan EMIs, Savings SIPs and Monthly bills, etc on a particular bank account. Resetting such mandates is extremely taxing. We envision a world where a customer can carry their bank account along with its number to any other bank therefore reserving all such mandates. Some insurance policies are already portable (benefit of policy vintage that allows the customer to be covered for pre-existing illness cover). Making it mandatory for all financial services to be portable just like

the mobile number portability will improve customer service across the board.

3. One of the big roadblocks for households to access finance in a reliable and convenient manner comes from the parts where digital services meet physical on ground processes. The hurdle becomes insurmountable when it comes to records of movable and immovable property that is often offered as security. To unlock finance, it would greatly help if all assets of a household are digitized, including property records that allow for a quick verification of title and valuation that can allow simpler and faster access to credit for all individuals and enterprises.

3. Need for Advocacy

Indian Financial system prides itself on stability, unfortunately sometimes this stability comes at the cost of experimentation. We have three strong regulators in RBI, SEBI, and IRDA for a very small proportion of the population participating in financial services. Products such as investments are offered by entities regulated by each of these regulators and have very different regulations, cost structures, permitted margins and distribution margin. KYC requirements for even basic accounts being used by low income users are amongst the most stringent in the world even in terms of purchasing power parity. An ideal regulatory framework would offer the following :

1. Possibility for experimentation

2. Easier and digital KYC

3. Portability of KYC. In case the customer uses a full KYC bank account or Wallet for any other financial service such as a purchase of an investment or insurance policy in their own name, there needs to be no need for any further KYC.

4. Open banking norms to enable solutions without the need for license

5. Ability of banks to rely on third parties for core functions – no change in responsibility

6. Financial products portability

7. Automatic seeding of bank account with mobile numbers

8. PAN and Aadhaar numbers to be used interchangeably now that PAN and Aadhaar linkage deadline is close to being met.

4 . Need for government intervention – Public goods / Infrastructure

Financial services will need some support in the form of public funding. Private markets will always be plagued by the imperfect alignment between shareholder value and the customer well-being. At the same time, price caps and targeted services as an instrument to tackle this failure, can sometimes distort unit economics for the provider, that in turn leads to product designs that don't work well for the customers for whom such price caps were intended.

We note, for instance, that several banks at the time of opening bank accounts for low-income households, get customers to opt out of taking a debit card. The debit card allows merchant transactions and set up a UPI handle. The reason why a debit card is typically not issued comes from negative perceived unit economics which comes from an RBI directive to offer 4-5 free ATM transactions per month. Withdraws by a customer from a different bank's ATM leads to significant costs.

We believe that public funding to the user of the services in the form of a DBT to access digital financial service to offset the cost charged by providers starts to create positive unit economics for private providers. In most cases, the amounts were not large but such small funding could be catalytic. Increased used creates volumes which in turn eventually also obviates the need for such public funding.

We recommend the following as key areas for public funding.

1. Reimbursement of MDRs for certain customer categories. This has already been done for certain transaction values and we recommend that this continues

2. Reimbursement of cash-in / cash-out charges for low-income households via DBT credits

3. Income tax refund of 1% - 2% of the total tax payable by the household for all payments made to low-income households such as domestic help, drivers, hawkers, etc via bank accounts (subject to say a max of INR 5000 of tax refund per annum) to facilitate more incomes going to low-income households via bank accounts

4. Fraud insurance for customers

References :

https://data.worldbank.org/

india gdp: India Ratings pegs FY22 GDP growth at 8.6% on data revision, Auto News, ET Auto (indiatimes.com)

The amounts between USD and INR don't tally when multiplied with exchange rates largely due to estimation methodology differences

Informal economy in South Asia (ILO in India) - https://www.ilo.org/newdelhi/areasofwork/informal-economy/lang--en/index.htm

Source: https://globalfindex.worldbank.org/sites/globalfindex/files/countrybook/India.pdf, https://globalfindex.worldbank.org/

https://www.npci.org.in/what-we-do/upi/product-statistics

https://www.pymnts.com/digital-payments/2021/india-upi-platform-logs-record-100b-in-transactions/

https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1780999

https://www.business-standard.com/article/finance/half-of-india-s-working-population-of-400-mn-people-credit-active-report-121062900822_1.html

http://rchiips.org/nfhs/pdf/NFHS4/India.pdf)

Sustainable Development Goals | United Nations Development Programme (undp.org) - https://www.undp.org/sustainable-development-goals

Morduch, Jonathan and Stuart Rutherford (2003); "Microfinance: analytical issues for India", Essay for the World Bank, South Asia Region — Finance and Private Sector Development, April 2003.

Nucleus & Cell Information

Fintech & Inclusion

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2		NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri Prashant Sharma Special Secy, D/o MSME Govt of UP 80049 88000	Gaurav Raina g.raina@iitm.ac.in 97898 19714	Divyasree Krish (IITMIC) divyasree.krish@incubation.iitm.ac.in 9791024999	Jojo Joy N (Skillskapes) coo@skillskapes.com 8939526309		Discussion 1 - E block 1st Floor	Aryabhatta Hall- E Block - ground floor	F22 to F34
2	Varnali Deka DC & DM Kokrajhar, Assam 94350 43004	Richa Agarwal richa@iitm.ac.in 91760 10809	Rajesh Kumar (Aaum) rajesh.kumar@aaumanalytics.com 9789071463	Ramesh Kuruva (YNOS) ramesh@ynos.in 9703481048		Discussion 2 - E block 1st Floor		
3	Shri Amitabh Ranjan Registrar IIPA ranjanamitabh@iipa.education ranjanamitabh@ymail.com 98681 64013	Hema Chandra Kotamarthi hemachandra@iitm.ac.in 93603 31589	Anita Srinivasan (Kaleidofin) anita@kaleidofin.com 8778386801			Discussion 3 - E block 1st Floor		G22 to G34
4			Vipul Sekhsaria (Kaleidofin) vipul@kaleidofin.com 8754456196	Dhanaganapati (Samunnati) dhanaganapathy@samunnati.com 9500542138		Discussion 4 - E block 1st Floor		
Coordinator - Bhuvan Dubey | bhuvan@respark.iitm.ac.in | 9651064635								

10. Information Security and Defense

Prof. V Kamakoti

kama@iitm.ac.in

Prof. Sargunaraj Christopher

chris@iitm.ac.in

95996 63320

The Indian Defense service is the 4th largest in the world. India is linked to its neighbors by land, sea and air. Hence, Indian Defense has Army, Navy and Airforce apart from strategic command. We also have air defense command. The three services are headed by their Army, Navy and Air Chiefs with Chief of Defense Services (CDS) above all of them to take a holistic view of any situation that arises. There are two more departments under the same Defense minister for Defense R&D and Defense production. In addition, defense is supported by other services like Border Roads Organization and other paramilitary forces.

We are the third largest in defense expenditure with about 75 billion now. which is bound to increase in the years to come. Nearly 70% of this expenditure was for import, but now the policy of 'Atma Nirbar' and the condition that 65 % of the above expenditure should be within the country, has brought a remarkable change in the services procurement pattern. With the new policy the approach of the services has changed and they are encouraging indigenous R&D. The production of the defense equipment is also encouraged to be done in the private industries other than the public sectors. Even the 25% of the defense R&D budget is allotted for private sector and most of the activities of ISRO is getting privatized.

Our country is large, with difficult hilly terrains, and lengthy sea coasts area to be protected. Resources are limited and critical infrastructure are to be developed in parallel. Under these situations we must have a robust plan, both short and long term, to achieve our goals.

Under these circumstances what should India aim for in another 25 years?

Information Security: Over the years enough of information has been collected and they are available in the form of written records. Should it be digitized for easy decimation of knowledge or left in the paper form to keep the security high. Is our semiconductors are safe? Should we have our own secured chip set designed and fabricated within the country?

Conventional war: Though time tested, conventional war has its own disadvantages. Therefore, will it exist or or totally stopped? Or this will continue as long as physical territory to be conquered?

Cyber war: The cyber war seems to be more effective in attracting common man if the attack is on the civilian sector (like bank, railway booking, medical establishments, air bookings, telephone or internet interruption) which are easy and therefore vulnerable. On the other hand, if any military or strategic establishments are attacked then the implications may be significant but impact on the common people directly will be more of

propaganda than any direct effect. Therefore, will this be only for strategic strike to warn or for affecting all people? If it is an open attack on common people, then, what are the ramification of that?

Chemical war: Even though a widely prevalent weapon of the past years was chemicals, most of the countries discontinued using this because it had most cruel effect on the people who got affected. It is easy to produce and many countries have this weapon. It is known that now only antisocial elements use this weapon but will it be totally eliminated?

Nuclear war: This is a strategic weapon and only limited countries have them. The effect is huge and the impact will last longer. Not only the people but the entire environment gets affected and hence the affects inhabitance for years to come. Will this continue well beyond the cold war scenario? Will it be in the hands of antisocial elements too if not handled with care? Production and preserving will be a very costly affair. Maintenance of secured information about these weapons and passing the code when needed reliably and secretively is a tough task. Can be handled only by government organization?

Biological war: Unlike other weapons, for biological weapon there are no standards and regulations internationally. After experiencing a pandemic like corona, should this weapon be regulated. Can it be made to affect the targeted group without letting go uncontrollably. Every country is working at least to protect themselves from the biological weapons. Will this most devasting weapon to be continued? Is it possible to have the specific antidotes for the new and emerging biological weapons to contain the effect?

Technology as Driver: Irrespective of the size and manpower, the super power status given to those who are capable of having defense technology. Those countries who have mastered technologies like the nuclear bombs or hypersonic missiles are call the super powers.

Drones and unmanned vehicles: Currently drone and unmanned vehicles are in rage. Fighting from the drawing room is the concept. This requires several technologies to work together.

Under the sea manned and unmanned submarines: As human lives are precious, more difficult but strategically important tasks are done through unmanned systems. But giving command and control for an unmanned, under water vehicle in the sea is difficult. Hence research for long distance communication through ultra-low frequencies of optical means are to be tried. Powering these under water vehicles are another challenge to be

studied. It is possible to have under water cities to cater all these needs research done in these areas.

High altitude lab Changala pass: World's highest altitude lab (according to Guinness book of records) is in Chan gala pass built and operated by DRDO. Should this be enhanced and opened for academic research to exploit its potential?

Bio Fuel: Bio fuel developed by DRDO was used in some speed boats of navy for demonstration. But these are to made commercially viable by using bio waste and improving the process. Should this be given importance?

Fuel Cell: The modern submarines are of three category one using secondary cell which are to be charged on a daily basis which means the vessel has to surface every 24 hours which makes it vulnerable. On the other hand, fuel cells are nothing but primary cells which can hold under water for two weeks and then we have to fuel them. The last is to have a nuclear submarine can stay under water for even six months. Should we create under water station to fuel cells to extend the stay for longer?

Star Wars: Space is exploited for many things including wars. Will there be Star Wars? Is it a viable and right approach for humans? What should be our approach in this direction?

Photonics and Digital: With the onset of photonics and quantum will digital fade in defense? What will be contribution of QKD and photonic or quantum radars?

Managerial and decision Making: Should the decision for Capex be decided centrally at CDS or Chiefs level? What should be the role of bureaucracy in this decision and why there are many examples indicating policy paralysis and how do we overcome that? Should the decision-making process be purely left to the services as a collective decision involving academics and industry? Are we using the offset policy effectively? Can we promote export of defense goods with government control? What should be under government totally and what should be with private?

Goco Model: The defense projects and the infrastructure requirements cannot be funded privately but efficiency of private cannot be obtained in government set up. A via media approach of Government owned and company operated infrastructure be created?

Funding: The defense expenditure is huge and effective use is essence of

saving for the nation. While improving the effective spending by the concerned authorities, there is no assurance of continuous flow of funds. Year on year budget is allocated but flow of fund may not be as expected leaving uncertainty and consequent delays in decision making. Why not long term or overlapping funding be done for Capex at least?

Defense attachment for youth: Countries like Israel has a practice of attaching youth to the services for a short term of two to three years. This not only improves their ability but also improves their feel for the nation and awareness on defense matters. Will it be of any improvement if those who would want to be in services are selected only from the list of youth who have served the services for some years. By this process both sides will know each other better, before the commitment is made.

Academia Involvement in defense: It is known that the nations where the coupling between the academia and the defense is strong are able to be strong in technology thereby making them super power. What should be done to improve this relationship? Should all selected for services mandatorily spend time in an academic institution to learn technology as the wars are technology driven? Likewise, should there be incentive to academicians to come on sabbatical to defense establishments to discuss various defense technologies.

Conclusion: Any nation needs (defense) power to get peace! Therefore, innovation is a must. Israel's economy is flourishing by the defense technology that they have exhibited to the world so far. Israel though a small nation is able to show supremacy in defense technology merely by their innovation through the start-ups. The book entitled, 'Start up nation', on Israel vividly talks of their aggressive approach on innovation through start-ups. So, it is strongly felt that the innovation through start-ups may the only way for India to be a super power in defense! Unfortunately, the current system is such that we do not take chances with start-ups of this country, but go only with 'experienced', biggies of abroad!

Nucleus & Cell Information

Information Security & Defense

S.NO	IAS OFFICERS	FACULTY	ENTREPRENUER 1	ENTREPRENUER 2	NUCLEUS HALL	CELL HALL	AUDITORIUM SEATING
1	Shri Anshul Garg DC, Jammu 94192 64422	Bharath Govindarajan bharath@iitm.ac.in 96324 81266	Arjun Ravichandran (Gyan Data)	Suyash Singh (Galaxeye)	Nagarjuna Hall - E Block - 1st Floor	Nagarjuna E Block - 1st Floor	I13 to I22
2	Shri Abhishek Surana CEO Jhodpur ZP Rajasthan 86197 30624	Shweta Agrawal shwetaag@cse.iitm.ac.in 85273 45135	Sreehari Nagarajan (Chakra)		Charaka - E Block - 1st Floor		
3	Shri Ashish Shrivatsava Add Secy Information & Science Technology & Planning 86500 68111	Joe Thomas Karackattu joe@iitm.ac.in 99992 01207	Karthikeyan Thangaraj (Spheruler)	Prem Kumar SR (Inuaid)	Aryabhatta - E Block - Ground Floor		J13 to J21
4		Aishwarya Thiruvengadam aishwarya@cse.iitm.ac.in 72005 60221	Parvathy Sarath (Aaum)	Guru Shankar Sundaram (Spheruler)	Aryabhatta - E Block - Ground Floor		
Coordinator - Raj Subramanian | rajs@respark.iitm.ac.in | 98840 41682							

Speaker Profiles

Professor V Kamakoti

Prof. V Kamakoti is the current Director of IIT Madras and is also a faculty in the Department of Computer Science and Engineering at IIT Madras. He also held the position of Associate Dean for Industrial Consultancy and Sponsored Research (ICSR), IIT Madras. He holds numerous positions in various Government agencies and bodies including being a member of the National Security Advisory Board, Government of India. He has been honored with numerous awards and is a recipient of the Abdul Kalam Technology Innovation National Fellowship, 2020.

Professor Ashok Jhunjhunwala

Prof. Ashok Jhunjhunwala is an Institute Professor at IIT Madras, the founder board member and President of IIT Madras Research Park, IITM Incubation Cell and Rural Technology Business Incubator. He has been a faculty at IITM from 1981 and was faculty at Washington State University between 1979-81. Prof. Jhunjhunwala has been awarded Padmashree, Shanti Swarup Bhatnagar Award, Vikram Sarabhai Research Award, H K Firodia Award amongst many others. He was conferred title of "Dronacharya" by TIE, Chennai. He has made numerous technology contributions and founded India's first university-based Research Park. He is the board member of 50 public and private sector companies and has also been chairman of several government committees and educational institutions.

Professor Andrew Thanagaraj

Prof. Andrew Thanagaraj is a professor in Department of Electrical Engineering, IITM. He received his PhD in Electrical Engineering from Georgia Institute of Technology, Atlanta. Since Oct 2011, he has been serving as NPTEL coordinator at IIT Madras. He has played a key role in initiating and running NPTEL online courses and certification. He is currently a National MOOCs Coordinator for NPTEL in the SWAYAM project of the Ministry of Education, Government of India.

Dr Vignesh Muthuvijayan

Dr. Vignesh received his BTech in Chemical Engineering from A. C. Tech, Anna University. He went on to pursue his Masters degree in Chemical & Biochemical Engineering at the University of Maryland, Baltimore County, & his PhD in Chemical Engineering at Oklahoma State University. He has also worked as a post-doctoral fellow at Johns Hopkins University.

Professor Mohanasankar Sivaprakasam

Dr. Mohanasankar is a Professor in the Department of Electrical Engineering and heads IITM's Healthcare Technology Innovation Centre (HTIC). He set up HTIC in 2011 growing it into the leading med-tech innovation ecosystem in the country deploying affordable healthcare technologies and housing a medical technology incubator nurturing over 30 startups in this field. He received the Indian National Academy of Engineering (INAE) Young Engineer Award and IITM's Early Career R&D Award and has over 200 research publications in leading journals and conferences.

Professor Sujatha Srinivasan

Dr. Sujatha Srinivasan is Professor in the Department of Mechanical Engineering and heads the TTK Center for Rehabilitation Research and Device Development (R2D2) at IIT Madras. Her research focuses on applying mechanism design and movement biomechanics to develop functional and affordable assistive/rehabilitation devices for people with movement disability. Prof. Sujatha has nearly 30 years of experience in her field including 8 years in the US industry. She is an alumna of IIT Madras and joined its faculty in 2008. She has co-authored over 50 refereed journal and conference publications and is co-inventor of 30 patents (granted and pending). She is also co-founder of NeoMotion, a startup on assistive devices, incubated

Professor T Pradeep

Prof. Thalappil Pradeep is an Institute Professor, Deepak Parekh Institute Chair Professor, and Professor of Chemistry in IIT Madras. He has conceptualized and built the International Centre for Clean Water (ICCW) which is a new initiative of IIT Madras. In 2020, he received the Padma Shri award for his distinguished work in the field of Science and Technology honoring his pioneering work on material science and nanotechnology commercialization for affordable clean water. He is widely recognized for his work on Molecular and nanoscale materials, clean water, surfaces, instrumentation, business incubation.

Professor Krishna Balasubramaniam

Prof. Krishnan Balasubramanian is currently Chair Professor in the Department of Mechanical Engineering and serves as the Head of the Centre for Nondestructive Evaluation (CNDE) at IIT Madras. He has been involved in the field of Non-destructive evaluation for more than 25 years with applications in the fields of maintenance, quality assurance, manufacturing, and design. He has over 200 technical publications and has presented papers at several national and international meetings. For his contributions he was conferred with the prestigious Abdul Kalam Technology Innovation Fellowship and IIT Madras Lifetime Achievement Award in 2018.

Professor Radhakrishnan Ganti

Prof. Ganti completed B.Tech & M.Tech in Electrical Engineering from IIT Madras, Masters in Applied Mathematics & PhD from the University of Notre Dame(2009). He was a Postdoctoral researcher for Wireless Networking & Communications Group, UT Austin(2009-11) focusing on the spatial analysis of interference networks using tools from stochastic geometry. He heads the 5G testbed project, IITM responsible for building & demonstrating the 5G base station.

Professor R K Krishnakumar

Prof. R. Krishna Kumar is an Institute Professor at IIT Madras and is the founder and the first Head of the Department of Engineering Design. He is a well-known expert in automotive engineering. The Department, which is his vision, is the first in India to weave

theory and domain knowledge in biomedical and automotive engineering. He is the only researcher in this country in tyre mechanics and tyre design who has published outstanding research articles and implemented the knowledge to create products for the industry. Prof. Krishna Kumar has mentored one of the most successful start-ups in recent times - the two-wheeled electric vehicle company, Ather Energy which is today a Rs. 2000-core company.

Professor Ashwin Mahalingam

Dr. Ashwin Mahalingam joined the faculty in the Building Technology and Construction Management division of the Civil engineering department at IIT-Madras in 2006. Ashwin received his B.Tech in Civil engineering from IIT-Madras and then proceeded to Stanford University for a Masters in Construction Engineering and Management. He then helped start up an internet based company in the USA called All Star Fleet, aimed at providing asset management services for construction companies. Following this he returned to Stanford University to pursue a PhD in the area of Infrastructure Project Management. Ashwin's research interests are in the areas of Public Private Partnerships (PPP) in Infrastructure planning and management, the management and governance of large engineering projects and the use of technology in infrastructure development. Ashwin is also a co-founder of Okapi Advisory Services Pvt. Ltd and serves as a Director on the Board. He is the Editor of the Engineering Project Organization Journal (EPOJ) and has served on many national committees.

Dr. Abhijit P. Deshpande

Dr Abhijit P. Deshpande is a Professor of Chemical Engineering at IIT Madras. His focus is on obtaining the understanding of polymeric systems, more specifically their aggregation and gelation behavior. Rheology is used as a probing tool to investigate polymer blends, sulfonated polymers, crosslinked hydrogels, supramolecular/living polymers, and polymeric composites in his group. He teaching interests include specialized courses in fluid mechanics, rheology and continuum mechanics; and core chemical engineerings courses such as mass transfer and thermodynamics

Ms. Jayalakshmi Umaidkar

With Masters in Physics & Computer Applications, Ms Jaya has over 25 yrs of varied technology experience, from teaching & research to software development. Out of this, she has over 6 years of personal entrepreneurial experience, as a partner in a start-up venture in Israel. She has been associated with RTBI for 5 years. Leading the agriculture initiative in RTBI to develop and implement technologies for the benefit of farmers, she has published papers in reputed journals and contributed chapters to books on Usability Research.

Dr. Nagesh Kolagani

Prof. Nagesh obtained his B.Tech. from IIT Madras in 1988 and M.S. from USA in 1992. Subsequently, he worked for three years in the USA developing three Microsoft Windows based consumer software products. He has worked on several sponsored research projects for use by school children, farmers, and NGO field staff in various village development activities. Subsequently, he completed Ph.D. on PP-GIS and PM from IIT

Madras (2016). He worked as an Associate Professor at IIT Sri City, (2016-2019), and joined CUTM (Odisha) as a Professor in 2019.

Professor Nandan Sudarsanam

Nandan Sudarsanam is a faculty member in the Department of Management Studies and a core member of the Robert Bosch Center for Data Science and Artificial Intelligence (RBCDSAI) at IIT Madras. He earned his PhD from the Engineering Systems Division at MIT, following which, he worked as a quantitative researcher for five years at a high-frequency algorithmic trading firm in New York. His research and work experience focuses on applications of experimentation, machine learning and the abstraction of data to models and algorithms. This spans data and problems across different domains, including but not limited to finance, urban mobility, digital platforms, civic services, and criminology. He publishes in machine learning conferences as well as peer-reviewed journals in engineering and applied statistics.

Professor Sargunaraj Christopher

Prof. S Christopher is an Indian scientist who served as Chairman of the Defence Research and Development Organisation (DRDO). Formerly he was director of the Centre for Airborne Systems. He is also the author of various research publications. Currently working as professor in Electrical Science Department in India Institute Technology Madras (All India Ranked number one institute by NIRF). He obtained his BE (Hons) in Electronics & Communication Engineering from University of Madras and M.Tech in Microwaves and Radar Engineering from IIT, Kharagpur. He joined IIT Madras, as Project Associate in 1980, and carried out research in Microwave Antenna Design and Near-field Measurement Techniques. He then obtained PhD in Antennae and Measurement Techniques from IIT, Madras.

Faculty Profiles

Energy & Net-Zero	
Aravind Kumar Chandiran 80563 80100 / 044 - 2257 4154 aravindkumar@iitm.ac.in Assistant Professor at the Department of Chemical Engineering	Prof. Aravind holds a M.S in Materials for Energy Storage & Conversion from Paul Sabatier University, France. In 2010, he earned a PhD in Chemistry & Chemical Engineering from Swiss Federal Institute of Technology, Switzerland. He was also a post doctoral research fellow at UC Berkeley.
Rajnish Kumar 88053 40709/ 044 - 2257 4180 rajnish@iitm.ac.in Professor, Department Chemical Engineering, IIT Madras	Prof. Rajnish holds a PhD from University of British Columbia after his M.S in Chemical Engineering from Indian Institute of Science, Bangalore. Since 2016 he has been a faculty in IIT Madras in Dept of Chemical Engineering. Rajnish is a recipient of NASI – Scopus Young Scientist Award in Chemistry for the year 2016. He has been recognized as Highly Cited Researcher in 2018, and in 2020 he was awarded Dr. YBG Verma Award for Excellence in Chemical Engineering Teaching.
R. Kothandaraman 94442 31700/ 044 - 2257 4249 rkraman@iitm.ac.in Professor, Dept of Chemistry, IITM	Prof Kothandaraman completed B.Sc in Chemistry from Sri Vasavi College and a M.Sc in Applied Chemistry from Anna University. He holds a PhD in Solid State & Structural Chemistry Unit from IISc, Bangalore. After two successful postdoctoral stints at Michigan State University-East Lansing & National Research Council of Canada-Ottawa, he joined IITM.
Preeti Aghalayam 91766 59760/ 044 - 2257 4185 preeti@iitm.ac.in Professor, Dept of Chemical Engineering, IIT Madras	Prof Preeti Aghalayam holds a PhD in Chemical Engineering from University of Massachusetts, Amherst, MA. She also did her Post doctoral from Massachussets Institute of Technology, Cambridge. he is primarily involved in detailed kinetic modeling of complex chemical reactors and intricate catalytic chemistries. She is passionate about engaged teaching/learning methodologies, and the cause of women in STEM.

Education	
Shantanu Mukherjee 97482 19355/ 044 - 2257 4845 shantanu@iitm.ac.in shantanu@physics.iitm.ac.in Assistant Professor, Dept of Physics, IIT Madras	Prof. Shantanu completed his Masters in Physics from IIT Delhi. This was followed by a PhD from University of Wisconsin-Milwaukee in 2010 on theoretical studies of unconventional superconductors. He also worked as a post doctoral researcher at Niels Bohr institute, Copenhagen and at State University of New York in Binghamton.
Janakiraman Viraraghavan 94497 52143 / 044 - 2257 4485 janakiraman@ee.iitm.ac.in Assistant professor, Dpartment of Electrical Engineering, Indian Institute of Technology Madras	Prof. Janakiraman received his PhD in very large scale integration (VLSI) from the Electrical Communication Department, IISc, Bangalore(2010). He joined the Semiconductor Research & Development Center, IBM India Pvt. Ltd, Bangalore, where he was involved in the design of embedded DRAM in 14 nm for early technology qualification.
Vignesh Muthuvijayan 95000 46940/ 044 - 2257 4123 vigneshm@iitm.ac.in Associate Professor, Department of Biotechnology, Bhupat and Jyoti Mehta School of Biosciences, Coordinator, IIT Madras BSc Degree, Coordinator, NPTEL	Dr. Vignesh received his BTech in Chemical Engineering from A. C. Tech, Anna University. He went on to pursue his Masters degree in Chemical & Biochemical Engineering at the University of Maryland, Baltimore County, & his PhD in Chemical Engineering at Oklahoma State University. He has also worked as a post-doctoral fellow at Johns Hopkins University.
Kartik Chandra Mondal 73587 55811 / 044 - 2257 4228 csdkartik@iitm.ac.in Assistant professor, Department of Chemistry, IIT Madras	Prof. Kartik received his PhD(2011) from Karlsruhe Institute of Technology (KIT). He worked on mixed 3d – 4f ion based single molecule magnets. After a postdoctoral research position in the same group he moved to University of Göttingen (2011 – 2015). He has co-authored more than 50 peer – reviewed publications in leading scientific journals.

Health Care and Assistive Technologies	
Arun Kumar Thittai 76679 38200/ 044 - 2257 4053 akthittai@iitm.ac.in Professor, Department of Applied Mechanics, IIT Madras	Prof. Arun completed his BE in Electronics & Communication engineering from Shanmugha College of Engineering, TN and MS. & PhD degrees in electrical engineering from the University of Houston, Houston, TX, USA. He completed a Post-Doctoral Fellowship with the MD Anderson Cancer Center, Houston and his second Post-Doctoral Fellowship with the University of Texas Medical School, Houston, where he became an Assistant Professor in the Dept. of Diagnostic & Interventional Imaging.
Kavitha Arunachalam 97909 86993/ 044 - 2257 4740 akavitha@iitm.ac.in Professor, Department of Engineering Design, IIT Madras	Prof Kavitha received her bachelor's degree in Electronics & Communications engineering from College of Engineering, Guindy, Anna University(1998), and Ph.D. degree in electrical and computer engineering from Michigan State University, East Lansing, USA (2007). She also completed her post doctoral associate from Duke University Medical Centre, USA.

Smita Srivatsava 98843 14735/ 044 - 2257 4127 smita@iitm.ac.in Associate Professor, Dept. of Biotechnology, IIT Madras. Faculty-in-Charge, IITM Bioincubator, IIT Madras Research Park	Prof. Smita holds a BTech in Chemical Engineering followed by MS (Research) and PhD in Biochemical Engineering from IIT, Delhi. Her interest is in finding solutions for sustainable development via biotechnological interventions. Key experience ranges in the area of bio-manufacturing & bio-remediation via rational development of microbial & plant cell bio-factories for socio-economical impact.
P. Anbarasan 98401 22302/ 044 - 2257 4886 anbarasansp@iitm.ac.in Professor, Department of Chemistry, IIT Madras	Prof. Anbarasan holds a PhD in the enantioselective total synthesis of natural product from IISC, Bangalore. Subsequently, he also held a postdoctoral position at Leibniz Institute for Catalysis, Germany as Alexander von Humboldt fellow & University of California, Berkeley, USA.

Water	
Boby George 94454 85273/ 044 - 2257 4465 boby@iitm.ac.in Professor, Dept of Electrical Engineering, IITM	Prof. Boby holds a PhD from IIT Madras. He has extensively worked on various non-intrusive sensing techniques & electronic instrumentation for industry applications. He was a faculty head for the Center for Innovation for students at IIT M. He has received several awards from IEEE for being a productive author & reviewer and received the Young Faculty Recognition Award & Institute Research & Development Award from IIT Madras.
Tiju Thomas 80564 56442/ 044 - 2257 4757 tijuthomas@iitm.ac.in Associate professor, Department of Metallurgical and Materials Engineering, IIT Madras	Dr. Tiju holds a PhD from Cornell University, USA (2011). He was also a Post doctoral fellow at the University of Toronto working on sustainable, scalable, green material synthesis techniques. He has also worked more recently on the fundamental science of soft magnetic materials before joining IITM.
Jitendra S. Sangwai 98843 10593/ 044 - 2257 4825 jitendrasangwai@iitm.ac.in Professor, Department of Chemical Engineering, Indian Institute of Technology Madras	Prof Jitendra obtained M. Tech. (2001) and Ph. D. (2007) in Chemical Engineering from IIT Kharagpur & IIT Kanpur, respectively. He has published 135 peer reviewed journal publications and been recognized by IIT Madras with the Young Faculty Recognition Award, Institute Research and Development Award (Early Career & Mid Career).
Somnath Chandra Roy 80560 81266/ 044 - 2257 4886 somnath@iitm.ac.in Professor in the Dept of Physics, IIT Madras	Prof. Somnath Chandra Roy holds a PhD in Physics from IIT, Delhi. He completed his undergrad & post-grad in Physics from BHU, Varanasi. After a 4 year post-doctoral research at the Pennsylvania State University, USA, he returned to India in 2010 to join as a faculty at IITM.

Infrastructure & Communications	
Radhakrishna Ganti 98402 64563/ 044 - 2257 4467 rganti@iitm.ac.in Associate Professor, Dept. of Electrical Engineering, IITM ; Head of 5G Testbed Project, IITM	Prof. Ganti completed B.Tech & M.Tech in Electrical Engineering from IIT Madras, Masters in Applied Mathematics & PhD from the University of Notre Dame(2009). He was a Postdoctoral researcher for Wireless Networking & Communications Group, UT Austin(2009-11) focusing on the spatial analysis of interference networks using tools from stochastic geometry. He heads the 5G testbed project, IITM responsible for building & demonstrating the 5G base station.
Sheetal Kalyani 98841 48132/ 044 - 2257 4474 skalyani@ee.iitm.ac.in Professor, Dept of Electrical Engineering, IITM	Prof. Sheetal completed BE in Electronics & Communication engineering from Sardar Patel University, Gujarat(2002) and PhD in Electrical Engineering from IIT Madras, India(2008). She was a Senior Research Engineer in Centre of Excellence in Wireless Technology, Chennai, India (2008-12) before joining IIT Madras.
Devaprakash Muniraj 99004 57257/ 044 - 2257 4034 deva@iitm.ac.in Assistant Professor in the Department of Aerospace Engineering at IIT Madras	Prof. Devaprakash completed his Doctoral & Postdoctoral research at Virginia Tech, USA. His doctoral research focused on addressing challenges in making unmanned aircraft systems (UAS) secure & reliable. Prior to this, he worked as a scientist at the Aeronautical Development Agency, Bengaluru, where his work involved flight dynamic analysis & control law design for a high-performance fighter aircraft.
V Sriram 94455 56802/ 044 - 2257 4813 vsriram@iitm.ac.in Associate Professor, Department of Ocean Engineering, IIT Madras	Prof V Sriram holds a PhD from IIT, Madras in 2008. He has been a faculty in Dept of Ocean Engineering since 2018. He also has an industrial experience at HRWallingford, UK. He re-entered research through the Newton International fellowship with City University London as host. After completing this fellowship, he received the prestigious Alexander Von Humboldt Fellowship, Germany, with Franzius Institute (Presently, LuFi, LuH) as host.

Transport & Mobility	
Gitakrishnan Ramadurai 95000 90172/ 044 - 2257 4298 gitakrishnan@iitm.ac.in Associate Professor, Transportation Engineering Division, Department of Civil Engineering, IIT Madras, Core faculty member in the Robert Bosch Center for Data Science and AI at IIT Madras.	Prof. Gitakrishnan received his PhD in Transportation Engineering from Rensselaer Polytechnic Institute, Troy, NY (2009), MS in Civil Engineering from University of Texas at Austin(2003) & BTech in Civil Engineering from IIT Roorkee(2002). His goal is to develop technological & management solutions for a safe & sustainable transportation system.
CS Shankar Ram 94443 88122/ 044 - 2257 4705 shankarram@iitm.ac.in Professor and V. Ramamurti Faculty Fellow, Dept of Enginnering Design, IIT Madras	Prof. Shankar completed BE in Mechanical Engineering from Motilal Nehru Regional Engineering College, Allahabad, MS & PhD from Texas A&M University, USA. He aims to develop advanced active safety systems & driver assistance systems for heavy commercial road vehicles (critical for transporting people and commodities).
Srikanthan Sridharan 96209 38545/ 044 - 2257 4748 srikanthan@iitm.ac.in Assistant Professor, Department of Engineering Design, IIT Madras	Prof. Srikanthan received his undergraduate degree in Electrical & Electronics engineering from the College of Engineering, Guindy, Anna University, Chennai, Masters degree in Electrical Engineering from IIT Madras, and Doctoral degree in Electrical Engineering from the University of Illinois at Urbana–Champaign, USA (2006, 2009 & 2015 respectively).
Chaitanya Yamijala 88380 43462/ 044 - 2257 4214 yamijala@iitm.ac.in Assistant Professor, Dept of Chemistry, IIT Madras	Prof. Chaitanya completed his M.S. in Material Science and received a PhD in Computational Chemistry & Materials Science from JNCASR, Bangalore. He did his postdoctoral research in USA with Prof. Bryan Wong (Dept. of Chemical Engineering, University of California), and Prof. PengfeiHuo (Dept.of Chemistry, University of Rochester, New York).

Urbanisation & Housing	
Arun Menon 99629 34559/ 044 - 2257 4299 arunmenon@iitm.ac.in Associate Professor of Structural Engineering at IIT Madras	Prof. Arun holds a PhD in earthquake engineering from University of Pavia, Italy (ROSE School). He coordinates the activities of National Centre for Safety of Heritage Structures (NCSHS), a Ministry of Education (Govt. of India) -supported research centre at IIT Madras. He is an expert member of ISCARSAH & Bureau of Indian Standards Panel for Masonry, CED 46:P7 & Earthquake Engineering Sectional Committee CED 39.
Sachin S Gunthe 99626 04979 / 044 - 2257 4308 s.gunthe@iitm.ac.in Professor, Dept. of Civil Engineering, IIT Madras	Prof. Sachin holds a PhD in Physics from Indian Institute of Tropical Meteorology, Pune and MS from University of Pune(2001). He is involved in teaching diverse courses in the field of Environmental Engineering, and Earth System Science and Climate Change at undergraduate and graduate levels.
NV Ravikumar 94443 76359/ 044 - 2257 4777 nvrk@iitm.ac.in, Professor, Dept of Metallurgical and Materials Engineering, IIT Madras	Dr. rer. nat. Ravi Kumar obtained his doctorate in natural sciences from the Max Planck Institute for Metals Research, Stuttgart, Germany(2004). Subsequently, he continued in the same institute as a postdoctoral researcher and a guest scientist. He also heads the Central XRD Laboratory where he consults a large number of industries both in India and abroad.
Manikandan Mathur 80563 33672/ 044 - 2257 4025 manims@ae.iitm.ac.in Associate Professor, Dept of Aerospace Engineering, IIT Madras	Prof Manikandan Mathur holds a PhD in Mechanical Engineering from Masachussets Institute of Technology, Cambridge, USA. He also leads the prospective Centre of Excellence (pCoE) titled Geophysical Flows Lab, an international research initiative at IIT Madras. The research initiative includes climate modeling and environmental monitoring, and the use of drone technologies for the same.

Rural Development & Agriculture	
Santosh Kumar Sahu 97911 70431/ 044 - 2257 4512 santosh@iitm.ac.in Assistant Professor of Economics in the Department of Humanities and Social Sciences at IIT Madras	Prof. Santosh Kumar Sahu holds a PhD in Economics from IIT, Bombay post completing his M.A and MPhil from Berhampur, Odisha. He is a fellow at Initiative for Sustainable Energy Policy (ISEP) and an affiliated researcher at CTaP, IIT Madras.
Pijush Ghosh 90032 24721/ 044 - 2257 4060 pijush@iitm.ac.in Professor, Department of Applied Mechanics, IIT Madras	Prof. Pijush completed his PhD from North Dakota State University (USA), followed by Postdoctoral research at John Hopkins University. Besides working on materials & mechanics, he takes strong interest in Rural Education through his initiative 'Teach to Learn' at IIT Madras aiming to connect the premier institutes of India with the rural students through hands-on learning & mentoring.

Dr. Dillip Kumar Satapathy 94980 35838/ 044 - 2257 4899 dks@iitm.ac.in Professor, Department of Physics, IIT Madras	Dr. Dillip received his M.Tech. degree from IIT Delhi and Ph.D. from the Mathematics and Natural Sciences Faculty, Humboldt University, Germany. Subsequently, he continued his research at Swiss Light Source and then at the University of Fribourg, Switzerland as a postdoctoral scientist. He has been associated with IITM since 2012.
Dr. Masilamani Jeganmohan 89031 59461 / 044 - 2257 4211 mjeganmohan@iitm.ac.in Professor, Department of Chemistry at IIT Madras	Dr. Jeganmohan completed his bachelor degree from St. Joseph's College & master degree from the University of Madras (2001). He earned his PhD from National Tsing Hua University, Taiwan(2005) and pursued postdoctoral work in the same laboratory (Aug 2005 – July 2009). He then joined as an Alexander von Humboldt fellow in Ludwig – Maximilians – Universität, Germany (Sep 2009 – Oct 2010).

Fintech & Inclusion	
Gaurav Raina 97898 19714/ 044 - 2257 4453 g.raina@iitm.ac.in Professor, Dept of Electrical Engineering, IITM	Dr Raina holds a Phd in Mathematics from Trinity College, University of Cambridge, UK. Along with his association with IIT Madras, he is also a visiting research fellow in Mathematics at the University of Cambridge. He has recently been appointed as Chairman of the Mobile Payment Forum of India.
Dr. Richa Agrawal 9176010809 / 044 - 2257 4564 richa@iitm.ac.in Associate Professor, Department of Management Studies, IIT Madras	Dr. Richa holds an MBA in Marketing from Monirba Allahabad University and a PhD in Customers' Relational Behaviour in a Pseudo-Relationship Context from IIT, Bombay. She is an expert on Design Thinking & Insightful Marketing, actively involved in research concerning human engagement and interaction with Artificial Intelligence powered VA's.
Hema Chandra Kotamarthi 93603 31589/ 044 - 2257 4213 hemachandra@iitm.ac.in Assistant Professor, Department of Chemistry, IIT Madras	Professor Hema holds a PhD in Biophysical Chemistry from TIFR, Mumbai. He was a post-doctoral fellow at the Dept. of Biology, Massachusetts Institute of Technology, USA understanding mechano-biochemistry of ATP-dependent molecular motors involved in protein degradation. He received the Student Research Achievement Award & Education Committee Travel Award from the Biophysical Society, USA.

Information Security and Defense	
Bharath Govindarajan 96324 81266/ 044 - 2257 4030 bharath@iitm.ac.in Assistant professor, Department of aerospace engineering, IIT-Madras	Prof. Bharath after completing his BTech from IIT, Madras he did his MS & PhD from University of Maryland, College Park, USA. He works on creating conceptual design tools geared towards analyzing novel vertical take-off & landing configurations. He also works on developing hardware to test unmanned aerial vehicle configurations.
Shweta Agrawal 85273 45135/ 044 - 2257 4384 shwetaag@cse.iitm.ac.in Associate Professor, Computer Science and Engineering department, Indian Institute of Technology, Madras	Prof. Shweta earned her PhD from The University of Texas,Austin guided by Prof. Dan Boneh in Cryptography, Stanford University & Prof. Sriram Vishwanath in Information Theory. She also spent two years as a postdoctoral scholar at the University of California, Los Angeles with Prof. Amit Sahai. She is also working on the applications of blockchain technology to socially relevant issues.
Joe Thomas Karackattu 99992 01207 / 044 - 2257 4541 joe@iitm.ac.in Associate Professor, HSS Department, IIT Madras	Prof. Joe completed his MA in Politics & MPhil in Chinese Studies from JNU, Delhi. He also holds a PhD in Chinese Studies from JNU. He is a "Fox Fellow (2008-09)" at Yale. Besides his research publications, he has also made two non-fiction films on diplomatic history (China's connections with southern India).
Aishwarya Thiruvengadam 72005 60221/ 044 - 2257 4388 aishwarya@cse.iitm.ac.in Assistant Professor, Department of Computer Science, IIT Madras	Prof Aishwarya Thiruvengadam holds a PhD in Computer Science from the University of Maryland, College Park. She was also a postdoctoral scholar at the Department of Computer Science, TU Darmstadt and at the Department of Computer Science, University of California Santa Barbara.

Entrepreneurs Profiles

Energy & Net-zero	
STARTUP	**BIO**
Rohit Grover, CEO Aerostrovilos Energy Pvt Ltd rohit@aerostrovilos.com 9600067714	Rohit Grover is an Aerospace Engineer and a combustor enthusiast from IIT Madras. He completed Dual Degree (B.Tech+M.tech) in Aerospace Engineering. He is the CEO of Aerostrovilos Energy Pvt Ltd which is an IIT Madras incubated startup building India's first indigenous Gas Turbine for power generation.
Pradeep Thangappan, Co-founder & Director Aerostrovilos Energy Pvt Ltd pradeep@aerostrovilos.com 9750959770	Pradeep Thangappan is the Operations & Co-founder of Aerostrovilos Energy Pvt Ltd. a startup that is working on cutting edge gas turbine & Hydrogen Technology. Pradeep holds a Mechanical Engineering degree from Anna University with 14 Years of industrial experience in the field of Manufacturing, Welding, Optoelectronics, IoT & AI-ML systems.
Ankit Poddar, Founder & CEO Zedbee Technologies Pvt Ltd ankit@swadhaenergies.com 9884796960	Ankit Poddar completed his under graduation in Computer Science from West Bengal University in 2011. He, then joined Professor Ashok Jhunjhunwala at IIT Madras to work as a Research Associate on multiple engineering disciplines . He has been working on the research and development work of motor drivers & IoT since 2013. Currently he is the CEO of ZedBee Technologies (Formerly Swadha Energies) which was launched in 2015 with a sole objective of energy conservation.
Sirisha Sumanth VP Strategy & Planning Grinntech Motors and Services Pvt Ltd sirisha.sumanth@grinntech.com 9940411933	Sirisha Sumanth is the head of Production and Planning at Grinntech Pvt. Ltd., an investor backed startup in the Lithium ion battery space. Grinntech was founded with a vision to play a pivotal role in the electrification of mobility in India with a strong belief that "Make in India" will be essential to the country's future. Sirisha has 18 years of experience in the manufacturing sector. She is passionate about the role that technology based manufacturing will play in shaping the social and economic fabric of our country.
Keshav Vijay Business Head, Samudhyoga Waste Chakra Pvt Ltd keshavvijay.57@gmail.com 9790936504	Keshav Kumar is the Business Head of Samudhyoga Waste Chakra, a cleantech startup developing advanced technologies to derive value out of waste. Prior to Waste Chakra. Keshav worked as a business analyst in ZoomRx Analytics serving market insights to fortune 500 pharma clients. Keshav holds a Chemical Engineering degree from SSN College of Engineering.
Nallasivam Jeganathan CTO, X2Fuels and Energy Pvt Ltd nallasivamprpc@gmail.com 8072655194	Nallasivam Jeganathan is currently working as the Chief Technology Officer of X2Fuels and Energy Private Limited. He is involved in the development of commercial scale plants for treating municipal solid wastes, agricultural wastes, macroalgae and other feed stocks using hydrothermal liquefaction and pyrolysis processes. He has over 10 years of Industrial & R&D experience in Thermochemical processes, Chemical Process Design, High Pressure Reactors Design, Commissioning, Engineering and related fields.
Sreejith Swaminathan, Senior Product Manager sreejith@swadhaenergies.com Zedbee Technologies Pvt Ltd 8943021886	Sreejith S is a Solution Specialist in Zedbee technologies working in the domain of IoT based building automation solutions . He holds a Master degree with specialization in power electronics & electrical engineering and has been working in the industry for more than 7 years with domain expertise in energy and automation. His role includes implementation of operational strategy for product/ solutions improvements based on market and competitive trends.
SR Suseendiran Co-founder & CEO Elicius Energy Pvt Ltd suseendiran@eliciusenergy.com 94435 39219	Dr. Suseendiran obtained his B.Tech in Chemical and Electrochemical Engineering from Central Electrochemical Research Institute and completed his Ph.D. in Chemical Engineering from IIT Madras. During his Ph.D., he worked on developing tubular proton exchange membrane fuel cells. He has then co-founded Elicius Energy Private Limited along with his Ph.D. Advisor, Prof. Raghunathan Rengaswamy, to commercialize the tubular proton exchange membrane fuel cells.

Education	
STARTUP	**BIO**
Prasad Sukumaranunni Founder CEO Beebox Studios Pvt. Ltd prasad.s@beeboxstudios.com 8754483451	Prasad Sukumaranunni is the Founder & Director at Beebox Studios, an Augmented Reality, Virtual Reality, Web3D company incubated at IIT Madras Incubation Cell. He completed his BTech in Electronics & Communication from Calicut University, Kerala and has more than 22 years of industrial experience from various organisations such as Midas Communication Technologies, Motorola Solutions Malaysia etc.

Balamurugan Founder CEO GUVI Geek Network Pvt Ltd spbalamurugan@guvi.in	S.P. Balamurugan - Co-Founder, drives strategic priorities of GUVI, an online platform that focus on pedagogical tools which is least focused on by the skilling industry. Before Starting GUVI in 2014, Bala was a technologist at PayPal leading various tech teams in PayPal, CSC & Covansys during his 12+ years of working career in the tech industry. Bala holds a Master's in Computers from Anna University - CEG campus.
Arun Prakash Founder & CTO GUVI Geek Network Pvt Ltd 9176054456 arunprakash@guvi.in	Arun Prakash is the CEO and Founder of GUVI. As the head of engineering, Arun focuses on building products that bring out the creativity in the whole team. Arun holds a B. Tech in Information technology. With about 13 years of industry experience he focuses on the technology behind the GUVI platform. He shares technical knowledge through his Youtube channel (share4guvi & reach2arunprakash) which has reached more than 2 Million viewers and has been inspirational for many.
Rajani Seshadri Founder Director Indepenn Connections Pvt. Ltd. rajani@indepenn.com 9884915785	Rajani is the Co-founder of IndePenn Connections Pvt Ltd.The company provides women returning to work with a step-by-step, caring and professional pathway to a successful, rewarding new career, while managing a happy personal life. She is an electrical Engineer from NIT, Nagpur with post-graduation in Electronic Design from IISC, Bangalore.
Sujareetha Venkatanarayanan Co-founder & Director Beebox Studios Pvt. Ltd sujareetha@beeboxstudios.com 9940093249	Sujareetha Venkatanarayanan is the Co-founder & Director at Beebox Studios, an Augmented Reality, Virtual Reality, Web3D company incubated at IIT Madras Incubation Cell. She completed her Bachelor of Engg in Electronics & Communication from University of Madras, and has more than 15 years of industrial experience with the organisations - Midas Communication Technologies, Infosys Technologies and Motorola Solutions Malaysia.
Jagadeesh Kanna Founder and CEO Vaayusastra Aerospace Pvt Ltd jagadeeshkanna22@gmail.com 9360545176	Jagadeesh kanna is the Founder & CEO of Vaayusastra Aerospace, an Ed-Tech Startup in the Aeronautics and Aerospace domain. He has built a theatre based aeronautics curriculum to train children of age 5 to 14 and a hands-on curriculum for college students. He is passionate about building the future of the Space industry.
Karthik Pondugula Founder CEO Crion Technologies Pvt Ltd karthik@criontech.com 9940592917	Karthik Pondugula is the CEO and Co-founder of Crion Technologies Pvt. Ltd. a company working on Simulations development in 3D/VR/AR for the purpose of Education & Training, Marketing, etc., Karthik is a graduate of IIT Madras with a Dual Degree in Mechanical Engineering and Manufacturing Technology. Karthik is currently handling business development and leading a team of similar tech enthusiasts, designers, and programmers to work on projects in the areas of Training and Education using 3D, VR etc.
Kumaran Software Testing Lead Edsix Brainlab Pvt Ltd kumaran@skillangels.com 9566688250	Kumaran is the the Software Testing lead in Edsix Brainlab Pvt Ltd which is an emerging player in the edutainment industry. It is incubated by IIT Madras Rural Technology Business Incubator (RTBI). Kumaran has several years of experience in Games and Multi-Lingual testing across platforms. He has also done multiple Field Training and implementation.

Healthcare & Assistive Technology	
STARTUP	**BIO**
Dr. Steward Gracian Director SocioDent Pvt Ltd stuvia2j@gmail.com 9940787153	Dr. Steward Gracian, is the Founder & CEO of SocioDent, an early stage medtech startup focused on redefining oral care for dependent and disadvantaged individuals through their product and service innovations. Dr Steward is an experienced dentist, innovator and BIRAC BIG Grantee.
Siddarth Daga Co-founder & Head - Sales & Marketing Neomotion Assistive Solutions Pvt Ltd sdaga@neomotion.co.in 9445383599	Siddarth Daga is the Co Founder and Head of Sales and Marketing of Neomotion Assistive Solution Pvt Ltd, a company that focuses on providing innovative assistive technologies for people with disabilities. He completed his dual degree in Mechanical Engineering from IIT Madras.
Dr. Bhasi Sukumaran CEO BrainwaveS Neurorehab Solutions Pvt Ltd bhasis@srmist.edu.in 9383845040	Dr Bhasi Sukumaran is the Founder Director & CEO of BrainwaveS Neurorehab Solutions- working on developing a virtual reality enabled stroke rehabilitation program using bio/neurofeedback. He is also a Professor & Head, Department of Clinical Psychology, SRM Medical College Hospital & Research Centre, Chennai and a Consultant Clinical Neuropsychologist at the SIMS Hospitals, Vadapalani, Chennai.

Dr. Anirudh Ranganathan CEO Sekkei Bio Pvt Ltd anirudhranganathan@gmail.com 9884982855	Anirudh is part of the founding team at Sekkei Bio - a niche drug discovery company focused on the development of novel peptide therapeutics to address challenging metabolic and neurological disorders. Anirudh completed his PhD studies in Biochemistry from Stockholm University. He completed his undergraduate degree in Chemical engineering from India. He also has prior experience within the engineering industry and has consulted widely both within India and globally.
KV Pravin Kumar DextroWare Devices Pvt Ltd Co-founder & CEO pravinofficial14@gmail.com 9940579393	Pravin Kumar is the Founder and CEO of Dextroware Devices, an assistive tech start-up that aspires to be a one-stop point for the development of affordable assistive technologies. Pravin became a entrepreneur soon after he completed his bachelors in Elecronic Engineering. His strength lies in Design thinking along with an Engineering mindset to make sure the feasibility of innovation is achieved.
Sabarish RC CEO Medisim VR Pvt Ltd sabarishrc21@gmail.com 9444106666	Sabarish RC is the CEO and Founder of MediSim VR Pvt Limited focused on transforming medical training by harnessing the benefits of Virtual Reality & Haptics, to usher in a new era where technological advancements are fully utilized to deliver solutions to the medical fraternity. He completed his BE from Anna University and MBA from Illinois Institute of Technology, Chicago.
Sakthivel Thayappahn CEO Yali Mobility Pvt Ltd 6382191526 sivamsakthivel@gmail.com	Sakthivel Thayappahn is the Co-founder and Director of Yali Mobility that focuses on delivering affordable solutions for the person with locomotor disabilities. Shakthivel holds expertise in new product development in the fields of assistive technology and mechanical engineering. He headed several sponsored projects in IIT Madras and successfully demonstrated the ability to convert lab ideas to marketable products.
zMed Technologies Pvt Ltd Jayakanth S Kesan Co-founder & Director jay@zmed.tech 7358262047	Jayakanth is the Founder and CEO of zMed Healthcare Technologies, a Deep Tech company incubated at IIT Madras, with products for Healthcare IT. He has more than 20 years of experience in high technology, product development, and management. He holds a B.E from Madras University, an MS from the University of Texas, an MBA from Dartmouth the Tuck School of Business, and a Masters in Public Administration MPA from Harvard University.

Water	
STARTUP	**BIO**
Varun Sridharan Founder CEO Greenvironment Innovation and Marketing India Pvt Ltd varun@greenvironmentindia.com 9962663255	Varun Sridharan, a first-generation entrepreneur, is the Founder & CEO of Greenvironment Innovation & Marketing India (P) Ltd, an IoT Based Environmental Management Company. Greenvironment helps improve water and energy management in residential, commercial & industrial buildings through the use of IoT & Artificial Intelligence.
Kathirmani Sukumar CTO Greenvironment Innovation and Marketing India Pvt Ltd kathirmani@greenvironmentindia.com 9701344400	Kathirmani Sukumar is the CTO of Greenvironment Innovation and Marketing India (P) Ltd. an environmental engineering company focused towards providing sustainable solutions to wastewater management, smart technologies for water, air, energy & environmental management in commercial establishments, industries, IT parks, hospitals, hotels, large residential communities/apartments and institutions. Kathirmani has 12 years of experience in data science.
Bhavesh Narayani Solinas Integrity Pvt Ltd Co-founder, Product Head-Sanitation bhavesh@solinas.in 8838697838	Bhavesh Narayani is the Co Founder, Product Head-Sanitation at Solinas Integrity, a startup that creates robotic solutions for pipeline diagnostics and septic tank cleaning to reduce water losses and eliminate manual scavenging. He holds a master's degree in machine design specialization from IIT Madras and a Bachelor's degree in automobile engineering, along with prior experience with the Transport Corporation of India.
Moinak Banerjee Co-founder; Product Head-Water Solinas Integrity Pvt Ltd moinak@solinas.in 738762104	Moinak Banerjee is the Co Founder, Product Head-Water at Solinas Integrity, a startup that creates robotic solutions for pipeline diagnostics and septic tank cleaning to reduce water losses and eliminate manual scavenging. He holds a master's degree in Machine Design from KTH Stockholm. He has been involved in several projects from European Space Agency, Scania AB, and a few start-ups where he developed various innovative design solutions and filed patents for the same.
Ramesh Kumar Co-founder CEO Vayujal Technologies Pvt Ltd ramesh@vayujal.in 8939017761	Ramesh Kumar has completed his bachelors in Nanotechnology and has worked for over 8 years on development of technologies pertaining to drinking water solutions and converting the same into products to ensure their reach to the Field. He has started VayuJal Technologies and Aqueasy Innovations Pvt. Ltd. to ensure deployment of developed technologies ; (I) Atmospheric water generators to provide water from air, and (II) Metal and biological contamination free water solution for BoP segments.

Nishanth S Co-Founder & CTO Novatex Technology Pvt Ltd nishanthprime18@gmail.com 6383450870	Nishanth is the chief technical officer & co-founder of Novatex Technology Pvt Ltd. an IITM incubated startup working on Electric Cylinders for Mechanical Jacquard Machine. Nishanth is currently pursuing a Mechatronics Engineering degree in Sona college of technology. During his college days, he was awarded the Tamil Nadu Student innovation Award from the Tamil Nadu Government and also received a grant of 3 lakhs from the Innovation Voucher Program.
Dr. Bala Yeshwanth Ram CEO Inger Therapeutics yeshwanth.v@gmail.com 93447 47299	Dr. Bala Yeshwanth Ram is the CEO of Inger Therapeutics. He received his PhD from University of Zurich and completed his postdoctoral research from The Scripps research Institute and University of Geneva. Recognising the potential of the technology they developed in University of Geneva, he recently launched a startup - Inger therapeutics private Limited.
Abhishek Jose Head of Sales Earth Fokus Earthwise Pvt Ltd info@earthfokus.com 9487535673	Abhishek Jose is the Head of Sales of Earthfokus Earthwise private limited, an IITM incubated startup - a green startup that manufactures water-saving devices for plumbing fixtures that reduces water consumption by 50% to 98%. Abhishek is a graduate in the food technology domain.

Infrastructure & Communications	
STARTUP	**BIO**
Dr Nishanth Raja Co-founder & Director XYMA Analytics Pvt Ltd 9442949347 nishanthraja@xyma.in	Dr. Nishanth Raja is the Co-Founder and Director of XYMA Analytics Pvt Ltd that develops novel sensor products and solutions, installs in customer sites, maintains, and provides data analytics for life cycle management and influences operational efficiencies. His expertise includes Industrial automation, IoT, Hi-Temp Sensor, NDE, Data analysis and interpretation.
Rani Muralidharan Director Indepenn Connections Pvt. Ltd. rani@indepenn.com 9842413262	Rani Muralidharan is the founder director of indePenn Connections Pvt Ltd. The company provides women returning to work with a step-by-step, caring and professional pathway to a successful, rewarding new career, while managing a happy personal life. She is a Chartered Accountant from Mumbai and was an industrialist in the space of thermal power sector, fabricated structures, manufacture of valves & auto components and industrial infrastructure.
Chakkaravarthy Ramachandran CTO Theta90 Technologies Pvt Ltd + Agalsearch System Pvt Ltd charam@theta90tech.com 9566281749	Chakkaravarthy Ramachandran is the Co-founder of theta90 technologies. Theta90 is registered with Parvatak program for developing low cost automated quality check machine for local vendors. His idea is to bring more automation machines using computer vision at low cost (1 to 2lacs) for local vendors to speed up their production process and to improve their quality check. He completed his Bachelors in Engineering from the College of engineering, Guindy,Chennai. He is currently pursuing BSC -Online degree in Data science in IIT Madras.
Makesh Janakaraj COO Azeriri Pvt Ltd makesh@azeriri.com 9384098705	Makesh Janakaraj is the Chief Operating Officer of Azeriri Pvt Ltd. The company designs and fabricates innovative, transformative and sustainable sensors/actuators and systems to provide industries with improved automation, efficiency, zero-waste processes, leveraging state-of-the-art materials, manufacturing methods, embedded electronics and data science research. He completed his B.E in Instrumentation & Electronics from BMSCE, Bangalore University.
Pragyan Prasu Patnaik Director Aavrtti Technologies Pvt Ltd pragyan.online@gmail.com 9738848674	Pragya Prasu Patnaik is the Director of Avrtti Technologies Pvt. Ltd- a company focusing on developing radars to detect, locate, identify and inspect buried utilities and tunnels in the border areas. Pragya is an alumnus of IIT MADRAS (2013-MS) from the department of Engineering Design.
Sunil G D Sr. DM - Development Lead Detect Technologies Pvt Ltd 9176135603	Sunil G D is the lead of Robotics at Detect Technologies Private Limited, a company that develops and provides technologies to improve the safety and efficiency of industries and their processes. He has more than 5 years of experience in research and development of robotics related technologies and products, especially Unmanned Aerial Vehicles. He is an IIT Madras Alumnus with B.Tech and M.Tech in Aerospace Engineering.
Janani Suresh Software Developer Detect Technologies Pvt Ltd Janani.suresh@detecttechnologies.com 9043000705	Janani.S is working as a Computer Vision Software Developer in Detect Technologies, a company that develops and provides technologies to improve the safety and efficiency of industries and their processes. She holds a degree in Electrical and Electronics from Jeppiaar Engineering College. She is a tech enthusiast and loves to explore various fields that would help impact the lives of people.

Utkarsh Kulshrestha Jr.CV Operation Engineer Detect Technologies Pvt Ltd utkarsh@detecttechnologies.com 8446333683	Utkarsh Kulshrestha is working in Detect Technologies Private Limited as a Computer Vision Operations Engineer and has been a project manager for multiple deployments in North and West India. He is currently pursuing entreprenuership from IITM. Utkarsh holds 3+ years of experience in Data Science. He is an alumnus of Symbiosis Institute of Computer Studies and Research and is an experienced Information Technology Executive with a demonstrated history of working in the computer software industry.

Transport & Mobility	
STARTUP	**BIO**
Visakh Sasikumar Founder CEO Pi Beam Labs Pvt Ltd visakh@pibeam.com 7418449556	Visakh Sasikumar, an IIT Madras Alumnus, is the Founder and CEO of Pi Beam Electric a vertically integrated EV ecosystem platform for lastmile logistics and commute. He completed his masters in Entrepreneurial Studies from IIT, Madras. He has built electric vehicles from scratch followed by building innovative business models to convert it into a successful startup.
Rakesh Rajagopalan Head- Finance Grinntech Motors and Services Pvt Ltd rakesh.rajagopalan@grinntech.com 9791097983	Rakesh is the Head of Finance at Grinntech Motors and Services Private Limited, an investor backed startup in the Lithium ion battery space. Rakesh is a qualified Chartered Accountant with a Bachelor's degree in Commerce. He has held key strategic role experiences in the Material Sciences industry.
Deepak Mohan Co-founder & CEO Ozone Motors Pvt Ltd deepak@ozonemotors.in 8939040408	Deepak Mohan, the Founder & CEO of Ozone Motors Private Limited, an Electric Vehicle Start-up founded in 2016, with a mission to build affordable & sustainable transportation systems for the modern colonies of Earth. He is a Mechanical Engineer from Chennai, India. Deepak holds a vision to make world class products that are Designed & Made in India.
Arun Kumar Co-founder & Director Skyraptor India Pvt Ltd arunkumark@skyraptor.in 8056009778	Arunkumar K is the Founder & CEO of Skyraptor India pvt ltd, a startup working on new drive line technology(internal gearbox)for bicycles to increase the range of the bicycle along with pedal assistance to achieve nominal pedal effort for longer distance. Arunkumar holds a MS. DEGREE in Machine design from IIT Madras with 12+ years of industrial experience.
Vivek Co-founder & CEO Meras Plugins Pvt Ltd viveksam@merasplugins.com 9715378723	Vivek samynathan is the Co-Founder of MERAS Plugins Pvt Ltd, an electric vehicle charging infrastructure solution provider which addresses slow, fast and wireless charging technology. Vivek holds a master degree in Automotive service technology and processes at Ostfalia University, Germany. His startup is recognised by UNLEASH plus 2021 as part of the SDG program which gives an international recognition.
Jana Lakshman Head of new ventures Debrique Creative Labs Pvt Ltd janalakshman@modulushousing.com 8248624962	Jana Lakshman is the head of new ventures at Modulus Housing, a modular construction tech startup. Jana holds a Bachelor's degree from NIT Trichy in Metallurgical Engineering. An entrepreneur by heart, he quit his job from a corporate company after a year to startup on his own. After two years of unsuccessfully trying to get his startup up and running, he recently joined Modulus Housing to help digitalise construction.
Suseendar Marimuthu Founder CEO Blunav Technologies Pvt Ltd susee@blunav.in 9994482016	Suseendar Marimuthu is the Co-founder and CEO of Blunav Technologies - a company working on solutions for Air traffic management and Airport operations. Suseendar is an MEMS Engineering by education and is currently working along with Airports Authority of India in Chennai & Mumbai international airports for the roll out of their Flagship Airport Operations management solution.

Urbanization and Housing	
STARTUP	**BIO**
Deekshith V, Founder & CEO Air Ok Technologies Pvt Ltd ceo@airoktech.com 9176086789	Deekshith Vara Prasad is a civil engineering graduate from IIT Madras who is passionate about bringing innovative solutions for the rising pollution levels. He co-founded AirOk Technologies Pvt Ltd which develops industry-specific technologies to control pollution in small and medium scale industries.
Gokul R Co-founder & MD MGH Labs Pvt Ltd gokul@mghlabs.com 9840604186	Gokul R is an entrepreneur and industrial designer with 24 years of Industry experience in the field of Design, R&D and Manufacturing with leading brands like TATA Motors, Nissan, Renault, Tata Hitachi, Ashok Leyland, Tata Elxsi, Hero Motocorp, Honda. As the Founder of MGH Labs Pvt Ltd, incubated at IITMRP, he has successfully completed 6 years with 5 patents and 10 design registrations. He is also an Associate Professor- Adjunct at IIITDM in the Design Department.

Kavin Kumar Shanmugam, CEO Engineering Project Management Consultancy and Research Pvt Ltd kavinkumar@epmcr.co.in 9444039796	Kavin Kumar Shanmugam is the Founding Director of EPMCR (P) Ltd - an IIT Madras Incubated Construction Technology company offering services in Design, Construction Methods, and Project Management Services for Buildings, Factories, Industrial Warehouses, Water Infrastructure, Transport Infrastructure and Power Infrastructure Construction. The company adopt modern construction techniques powered by Digital Construction technologies and Lean Construction Management.
Madhup Shukla Founder, CEO DiGas Pvt Ltd madhup.iit@gmail.com 9884299387	Madhup is the Co-founder & CEO of DiGas Private Limited. He is one of the inventors of the World's first Battery-free Non-invasive FFD for gas stoves . He has patents and research papers in reputed journals. He did his MS in Microelectronics and VLSI from the Department of Electrical Engineering, IIT Madras. He also has 5 years of working experience as a nuclear scientist in Nuclear Power Corporation of India Limited under Department of Atomic Energy, Government of India.
Gobi Krishnan Co-founder CareMe Health Private Limited gk@careme.health 9944387386	Gobikrishnan (GK) Srinivasan is the Founder of CareMe Health — better mental health starts here, a modern digital healthcare organization that provides integrated care for people with chronic illnesses. After a brief stint at IBM, he followed his dream to found CareMe Health providing accessibility for better mental healthcare service.
Akhilesh DSN Chief Commercial Officer Debrique Creative Labs Pvt Ltd (Modulus Housing) akhilesh.dsn@modulushousing.com 9566143232	Akhilesh is the Chief Commercial Officer of Modulus Housing, an IIT Madras Incubated startup that builds construction automation technology to disrupt the way we construct. Akhilesh holds a Civil Engineering degree from IIT Madras. He has been with Modulus Housing from day one and also worked for a short stint at Flipkart Internet pvt ltd.
Saravanan Panchatcharam Co-founder Thouway Technologies Pvt Ltd psaro75@gmail.com 9962450022	Saravanan Panchatcharam is the Co-Founder of Thouway Technologies Pvt Ltd. He has around 20 years of experience in varied roles in the IT Industry in Software Development, Project Planning, Quality assurance , Product quality management and managing large teams. Few of the high profile customers they have managed delivery for are PayPal , Vodafone, Natwest(Royal Bank of Scotland), Citigroup and Ford.

Rural Development & Agriculture

STARTUP	BIO
Vidyadhar Bhandare Co-founder Earthen Tunes Pvt Ltd vidyadhar_b@outlook.com 9558251720	Vidyadhar Bhandare is the Co-founder of Earthen Tunes Designs Pvt. Ltd., a Social Enterprise designing and manufacturing shoes for Indian farmers.Through the company, he is trying to solve grassroot level problems with Design Thinking. Vidyadhar holds a Master's degree in Transportation and Automobile Design from NID, Ahmedabad and a bachelors in engineering degree in Automobile Engineering from Shivaji University.
Rajeev Kaimal Co-founder & MD payAgri Innovations Pvt Ltd rajeev.kaimal@payagri.com 9840930495	Rajeev Kaimal is the Co-Founder & MD of payAgri Innovations Pvt Ltd – An impactful start-up building a sustainable inclusive model in the Agri Value Chain. With over 18 years of experience in the Banking and Financial Services sector, he specializes in the field of Business & Rural Strategy, Agri Value Chain and Rural Financial Services.
Guru Vignesh Founder CEO Impensus Electronics Pvt Ltd guruvignesh.v@impensuselectronics.com 96298 49981	Guru Vignesh is the Founder and CEO of Impensus Electronics Pvt Ltd which strives to provide IoT enabled simplified and scalable solutions for post harvest management that will help in increasing their shelf life, quality of the harvest and also helps increase the income of the farmers. He is an Electronics and Electrical Engineer with 3 years of experience as a Subject Matter Expert in the electrical domain for a Philippines – based company.
Raghavan Sampathkumar Head of policy / advocacy and external affairs Samunnati raghavan.s@samunnati.com 8355800501	Raghavan Sampathkumar is the Head of Policy of Samunnati, India's largest agri-tech enterprise. Raghavan is a veteran in financial management with deep insights into Micro Finance Industry in India and has over 18 years of experience working across Asia Pacific in various sectors such as agri-inputs, protein (animal & plant), and biotechnology gaining holistic 360-degree understanding of the Animal-Agri-Food value chain.
Neena Mariam Phillip Marketing & BD Manager Medisim VR Pvt Ltd neenamariam@medisimvr.com 9790774224	Neena Mariam Philip is the Marketing and Business Development Manager at MediSim VR, a Med-tech company working in the field of healthcare simulation. The company's mission is to make comprehensive Medical training accessible & affordable across the world. MediSim VR marries the benefits of Virtual reality and Haptics, and elevates healthcare training to a new dimension.

Aditya Srinivas Founder & CTO Roha 369 Biotech Pvt Ltd kas980425@gmail.com 9515940979	Aditya Srinivas is the Founder and CTO of Roha369 Biotech, that develops secondary packaging made from mushroom mycelium and agricultural waste. This "Mycelium packaging" can potentially replace the need for polystyrene based secondary packaging in various consumer electronics (AC s, washing machines etc)and other products. He has hands-on experience in Biomimicry. He graduated as a chemical engineer in 2019 and while still in college, he founded his first company, which produced algae-based feed supplements.
Anand A Marketing head Novatex Technology Pvt Ltd Kananand555@gmail.com 6369080563	Anand is the Marketing Head of Novatex Technology Pvt Ltd, an IITM incubated startup that is working on Electric Cylinder for Mechanical Jacquard Machine. Anand is pursuing a B.E.Mechatronics Engineering degree in Sona college of technology. During his college days, he has been awarded the Tamil Nadu Student innovation Award from the Tamil Nadu Government and also received grant of 3 lakhs from Innovation Voucher Program.
Sakthivel K Co-founder & CEO RF Wave Technologies PVT Ltd sakthi@rfwavetek.com 9025443322	Sakthivelu Kathirvel is a new product developer in the area of agriculture production system monitoring. He is the Founder of RF wave Technologies Pvt. Ltd, a company incubated in IIT Madras that designs and develops high performance modules, for technically demanding radio frequency (RF), and microwave wave applications covering the frequency range of DC to 8.5 GHz. He holds a master degree from IIT Madras, Chennai.

Fintech & Inclusion	
STARTUP	**BIO**
Rajesh Kumar CEO, Founder & Managing Director Aaum Research and Analytics Pvt Ltd rajesh.kumar@aaumanalytics.com 9789071463	Rajesh Kumar is the CEO, Founder and Managing Director of Aaum Research and Analytics Pvt Ltd, that focuses on researching and devising the sophisticated analytical techniques to solve the pressing needs of the businesses. Rajesh holds rich consulting experience with Fortune 100 organizations. He holds a B.Tech in Mechanical Engineering from IIT Madras and a MBA from IIT Kanpur.
Vipul Sekhsaria Co-founder, Chief Networks Officer Kaleidofin Pvt Ltd vipul@kaleidofin.com 8754456196	Vipul Sekhasaria is the Co-founder and Chief Networks Officer at Kaleidofin,that provides a solutions approach that uses data science and technology to create customer-personas across informal segment and offers mass customized financial solutions that combine the power of savings, micro-investments, credit, and insurance instruments to solve customers real life goals.
Anita Srinivasan Senior Product Manager Kaleidofin Pvt Ltd anita@kaleidofin.com 8778386801	Anita Srinivasan is the Senior Product Manager Kaleidofin,that provides a solutions approach to using data science and technology to create customer-personas across informal segment and offers mass customized financial solutions that combine the power of savings, micro-investments, credit, and insurance instruments to solve customers real life goals. She has a dual degree in law and social sciences and is a gold medalist from National Law School of India University, Bangalore.
Ramesh KuruvaYNOS CEO Venture Engine CC Pvt Ltd ramesh@ynos.in 9703481048	Ramesh Kuruva is the CEO and a founding team member of YNOS Venture Engine, a startup incubated by the Indian Institute of Technology, Madras. YNOS is the India's largest early-stage Entrepreneurial ecosystem platform. His Doctoral thesis is on venture capital and private equity. He has published in leading journals like Journal of Alternative Investments. He was also a member of the research team for the 2016 and 2017 India Venture Capital and Private Equity Reports and a sub-editor for the 2018 Report.
Dhanaganapati Management Trainee Samunnati dhanaganapathy@samunnati.com 9500542138	Dhanaganapathy Madhavan is the Management Trainee at Samunnati, a leading Agri value chain enabler. He is working on various strategic projects including technological intervention at FPO & farmer level and a few sustainable value chain projects. Representing Samunnati, he also works with IIT Madras Research Park in diverse areas including Millets & 'Vision-2047'. An engineer by graduation, he did his MBA at the Indian Institute of Management, Ahmedabad.
Divyasree Krish Finance Associate IITM Incubation Cell divyasree.krish@incubation.iitm.ac.in 9791024999	Divyasree is a trained Chartered Accountant and a Company Secretary. She is a B.Com graduate from the University of Madras. She has 5+ yrs of experience in audit, taxation, management consulting, secretarial practices. She has collaborated with a wide range of startups in Chennai on crafting SOPs, financial models, devising pricing and GTM strategies and financial planning.
Jojo Joy N Co-founder COO Skillskapes Pvt Ltd coo@skillskapes.com 8939526309	Jojo is the Founder and COO of SkillSkapes Private Limited that focuses on providing End To End Content, Communication and Training Services. He has conducted several workshops on Experiential Learning/Soft Skills/Analytics training for industry and academia. He holds MA (CIEFL, Hyderabad), PGDM (XIMB), MS (SOAS, University of London) and (PhD candidate) at the London School of Economics (LSE).

Information Security & Defence	
STARTUP	**BIO**
Sreehari Nagarajan Founder CEO Chakra Network Solutions Pvt Ltd sree@chakranetwork.com 9841035766	S.Sree hari nagarajan is the Founder and CEO of Chakra Network Solutions Pvt. Ltd. He has a Masters Degree in Computer Science (M.S) from IIT-Madras and has over 22 years of experience in product development and design. He has been instrumental in designing the core engine of Chakra which is used in different verticals like Building Management System, 4G-Basestation Management System, Metro Railway Network's Telecom-SCADA and Fault Reporting System to name a few.
Karthikeyan Thangaraj Co-founder Spheruler Solutions Pvt Ltd karthikeyant1729@gmail.com 8144085983	Karthikeyan Thangaraj is the Co Founder of Spheruler Solutions Pvt Ltd. Alumnus of IIT Madras (B.Tech, 1997, Metallurgical Engineering) and Univ. of Madras (Ph.D, 2015). Spheruler Solutions' caters to specific Application needs of customers in Industrial and Defence sectors, such as Computer Vision Inspection, Accurate Mechanical Alignment Systems and 3D GIS Analysis Software
Guru Shankar Sundaram Co-founder Spheruler Solutions Pvt Ltd gurushankars@alumni.iitm.ac.in 9080837885	Guru Shankar Sundaram, B.Tech is the Founding Partner of Spheruler Solutions with 22+ Years of Global IT Consulting and Program Delivery. He is a Startup Founder, Investor and Passionate about Scaling Relationships / Engagements and holds a deep understanding of the technology ecosystem to solve business challenges.
Arjun Ravichandran Lead Data Architect & Business Development Gyan Data Pvt Ltd arjunr@gyandata.com 8446120199	Arjun Ravichandran is the Lead Data Architect and Manager, Business Development at GyanData, a data science consulting firm with a focus on the core engineering sectors. Arjun has developed and implemented data driven solutions for 25+ businesses and technical use cases across 8 sectors, utilizing techniques from system modeling, machine learning and optimization.
Suyash Singh Founder CEO GalaxEye Space Solutions Pvt. Ltd. suyashsingh91291@gmail.com 8329570640	Suyash Singh is the Co-founder and CEO at GalaxEye Space, a space technology company building a constellation of Edge computing based Earth imaging satellites. Suyash has a degree in Aerospace Engineering from the Indian Institute of Technology, Madras. Suyash holds 6+ years of Industry experience in Deep Learning & Big Data Analytics.
Parvathy Sarath Co-Founder & Chief Analytics Officer Aaum Research and Analytics Pvt Ltd parvathy.sarath@aaumgroup.com 9791122542	Parvathy Sarath is the CoFounder and Chief Analytics Officer of Aaum Research and Analytics Pvt Ltd that focuses on researching and devising sophisticated analytical techniques to solve the pressing needs of businesses. Parvathy topped her Masters in Econometrics from University of Madras.
Prem Kumar SR Founder CEO Inuaid Solutions Pvt Ltd prem@inuaid.com 9840764133	Prem Kumar entered the indian startup ecosystem in 2018 and has led two startups so far. The latest one is InuAid, in collaboration with 2 IIT-M professors and being incubated by IIT Madras. They were recognized by MeiTY and among the top 7 Startups by Startup TN in their recent innovative competition. They have also been selected for final pitch presentations to MeiTY, BIRAC and TDB in 4 competitions.

DELEGATE DETAILS

Energy and Net Zero
Shri Manoj Director Dept of Science and Technology
Shri Vijaykumar Siddappa Director Of Census Operation/Citizen Registration vijaykumarsb@gmail.com vijay.sb@nic.in 94492 09885
Shri S N Tripathi DG IIPA sntripathi@iipa.education sntripathi@gmail.com

Education
Shri Rai Mahimapat Ray Deputy Secy m.ray@ias.nic.in 99393 55555
Smt. Keerthi Jalli DC & Chair Person DDMA Cachar, Assam dc-cachar@nic.in 9435073737
Shri Vijay Rama Raju V Collector and District Majestrate YSR District Andhrapradesh collector_kdp@ap.gov.in 9849904109
Shri Naresh Bharadwaj Deputy Secy Dept of Pension and Pensioners Welfare 80101 01800

Healthcare and Assistive Technologies
Shri Vikram Singh Director vikramsingh-cea@gov.in 98688 93051
Dr.Sumit Garg Deputy Secy sumit.g@nic.in 88796 67547
Dr.Neha Garg Director NHM II nehagarg.irs@gov.in 99585 56080
Shri Jitendra Kumar Soni Mission Director (MD) National Health Mission Rajasthan rajnag@nic.in md-nrhm-rj@nic.in 91667 55000

Water
Shri S Majhl Deputy Secy Ministry Of Animal Husbandry & Fisheries sarbeswar.majhl@gov.in 92898 51880
SDr. Adeela Abdulla Director Dept of Fisheries Kerala fisheriesdirector@gmail.com 98955 05256 / 88486 78982
Dr.Piyush Singla DC Anantnag, South Kashmir anantnag@nic.in 94690 81000

Infrastructure and Communication
Dr.S Chitra Labour Commissioner Govt of Kerala lc.lc@kerala.gov.in lbrcommissioner@gmail.com 88489 32016/95622 31370
Shri Ravinder Singh Addl CEO YEIDA Uttar Pradesh aceo_rs@yamunaexpresswayauthority.com 99533 93892
Shri D Krishna Bhaskar Director Industries & Commerce - Commissionerate of Industries coi.inds@telangana.gov.in 95811 13222/73311 87595

Urbanization and Housing
Shri Rajesh Kumar Singh Director (WM) Dept of Land Resources dirwm-dolr@nic.in 80049 38186
Shri Thavaseelan K. DC & Mon Nagaland dcmon-ngl@gov.in 96157 04107
Smt.Hari Chandana Dasari Collector & DM Narayanpet, Telengana collector-nrpt@telengana.gov.in collector-nrpt@telangana.gov.in 91004 21386

Transport and Mobility
Shri Gaurav Hariom Gupta Director Ministry of Road Transport and Highways ghgupta155-cgo@gov.in 91082 85600
Shri Pronjol Chandra Director M/O Civil Aviation 83208 28090
Shri Vinay Kumar Prajapati Director Ministry of Ports,Shipping & Waterways vinay.prajapati@gov.in 84458 89991
Shri Vishesh Garhpale Director, MSME Dept MD, Laghu Udyog Nigam & M.P. Silk Federation Commissioner, Sericulture Department Bhopal vishesh@ias.nic.in 96692 66077

Rural Development and Agriculture
Dr.D.Sajith Babu Director, D/o Civil Supplies Sajithias2012@gmail.com 94470 00370
Shri Ruchir Mittal Director, DOPPW Dept of Pension & Pensioners Welfare fs-dmn-dd@nic.in 94276 57720
Shri Rahul Yadav DC, Kathua, Jammu and Kashmir 94190 55597 dckth-jk@nic.in
Shubham Saxena, IAS Joint Secretary, Department of Agriculture and Farmers' Empowerment, Odisha 9439779005 mailtoshubh20@gmail.com

FinTech and Inclusion	Information Security and Defense
Shri Prashant Sharma Special Secy, D/o MSME Govt of UP sharma.prashant@ias.nic.in 80049 88000	Shri Anshul Garg DC, Jammu anshul.garg@ias.nic.in 94192 64422
Varnali Deka DC & DM Kokrajhar, Assam dc-goalpara@nic.in varnali.deka@gmail.com 94350 43004	Shri Abhishek Surana CEO Jhodpur ZP Rajasthan surana90@gmail.com 86197 30624
Shri Amitabh Ranjan Registrar IIPA ranjanamitabh@iipa.education ranjanamitabh@ymail.com 98681 64013	Shri Ashish Shrivatsava Add Secy Information & Science Technology & Planning 86500 68111

Video Conference Link

Symposium on Imagining India@2047 through Innovation - Inaugural Programme - Hosted by DARPG

https://darpg.webex.com/darpg/j.php?MTID=m4969b22e5078d439ef005458cd3692be

Tuesday, **Mar 8, 2022 1:30 pm** |
3 hours | (UTC+05:30) Chennai, Kolkata, Mumbai, New Delhi

Meeting number: 2513 740 4756
Password: IITM@8322

Join by video system.
Dial: 25137404756@darpg.webex.com
You can also dial 210.4.202.4 and enter your meeting number.

Join by phone+65-6670-9679 Singapore
Toll Access code: 251 374 04756

Symposium on Imagining India@2047 through Innovation - Inaugural Programme - Hosted by DARPG

https://darpg.webex.com/darpg/j.php?MTID=m9221dc0e43f3ff4297b6954d686225b7

Wednesday, **Mar 9, 2022 11:30 am** |
6 hours | (UTC+05:30) Chennai, Kolkata, Mumbai, New Delhi

Meeting number: 2516 907 5102
Password: IITM@090322

Join by video system.
Dial: 25137404756@darpg.webex.com

Join by phone +65-6670-9679 Singapore
Toll Access code: 251 690 75102

Contact Details

Airport Helpdesk	Nagaraj – 97909 64149
Hotel Coordinator	Karthick – 99417 67146
Internal Coordinator	Sheeba Jesse – 98845 52774
Head of Coordination	Raji Soni – 99622 82952

Event Schedule

7th March 2022

Session	Programme	Duration	Start	End	Venue
S1	Welcome by Prof. V. Kamakoti, Director - IITM Prof Ashok Jhunjhunwala - President - IITMRP | IITMIC Mr. S N Tripathi, DG - IIPA.	20	09:00	09:20	RP Auditorium
	Thematic presentations by Faculty and Entrepreneurs	85	09:20	10:45	RP Auditorium
S1.1	Water @ 2047 : A Glimpse into the Challenges and Opportunities by Prof. T Pradeep				
S1.2	How can we make India the leading example of large scale affordable Healthcare by 2047? By Prof. Mohanasankar S				
S1.3	Telecommunications in 2047: Is It Possible To Forecast? By Prof. Bhaskar Ramamurthi				
S1.4	Disability and Assistive Technologies: Challenges and Opportunities by Prof. Sujatha Srinvasan				
S1.5	Digitising Transactions by Prof. Gaurav Raina				
	Announcement of NUCLEUS (4) & CELL (17) Teams	15	10:45	11:00	RP Auditorium - D7
	Tea Break	30	11:00	11:30	RP Pre Function Area - D7
S2	Thematic Presentations by Faculty, Entrepreneurs & IAS officers	105	11:30	13:15	RP Auditorium
S2.1	How soon can India get to Net-Zero? by Prof. Ashok Jhunjhunwala				
S2.2	Updation of Regulations for Accommodating Innovations in Housing and Construction by Prof. Ravindra Gettu				
S2.3	Asset Integrity Monitoring of Physical Infrastructure by Prof. Krishanan Balasubramanian				
S2.4	A 25-year Roadmap for Universal Higher Education by Mr. Andrew Thanagaraj				
S2.5	From Creating Financial Inclusion to Ensuring Financial Freedom by Mr Puneet Gupta				
S2.6	Ms Varnali Dekha (IAS)				
	Lunch Break	60	13:15	14:15	RP Pre Function Area
S3	IITM Research Park - Visit	165	14:15	17:00	
S4	Break out for NUCLEUS Teams	120	17:00	19:00	RP - 40 Rooms
S5	Dinner and discussion amongst NUCLEUS	120	19:45	21:45	Holiday Inn

8th March 2022

Session	Programme	Duration	Start	End	Venue
S6	Visit to IITM Lab	165	09:00	11:45	IITM Campus
S7	CELL Teams Meeting	75	11:45	13:00	RP - 10 Rooms
	Lunch Break	60	13:00	14:00	RP Pre Function Area
S8	Inaugration - Hon' Minister Dr. Jitendra Singh, Prof V Kamakoti Director- IITM, Mr V Srinivas Secretary ARPG, Prof. Ashok Jhunjhunwala, President IITMRP | IIITMIC	90	14:00	15:30	RP Auditorium
	Lamp Lighting Ceremony & Tamil Thai Vazhthu				
	Welcome note by Prof V. Kamakoti				
	Address by Mr. V. Srinivas (Secretary, ARPG)				
	Film on e-GOV				
	Address by Hon' Minister Dr. Jitendra Singh				
	Vote of Thanks, Prof. Ashok Jhunjhunwala				
	National Anthem				
	Tea Break	30	15:30	16:00	RP Pre Function Area
S9	CELL Teams Meeting	120	16:00	18:00	RP - 10 Rooms
S10	Dinner and Programme	135	18:30	20:45	RP Pre Function Area

9th March 2022

Session	Programme	Duration	Start	End	Venue
S11	Thematic presentations by Faculty, Entrepreneurs & IAS officers	85	09:00	10:25	RP Auditorium
S11.1	Innovation - Does it have a structure: Case studies from Automotive Engineering by Prof. R Krishna Kumar				
S11.2	Inclusive Growth in Indian Agri Value Chain by Mr. Anil S. G., Samunnati				
S11.3	Evolution of AI in enhancing Information and Security for Industries by Tarun Mishra, Detect				
S11.4	Why Design-In-India is as important as Make-In-India for being AatmaNirbhar? By Mr R. Srinath, Agnikul				
S11.5	Mr Jitendra Kumar Soni (IAS)				
	Tea Break	20	10:25	10:45	RP Pre Function Area
S12	Thematic presentations by Faculty and Entrepreneurs	50	10:45	11:35	RP Auditorium
S12.1	Biomicrofluidics - Why Biomedical Research must change by Prof. Sarit Das				
S12.2	Unlocking value for Dairy Farmers through Digitization by Mr Ranjith Mukundan				
S12.3	The Electric Future of Mobility by Prof. L. Kannan				
S13	Presentation by Cell Teams (5): (10 min presentation 5 min disc)	75	11:35	12:50	RP Auditorium
	Lunch Break	45	12:50	13:35	RP Pre Function Area
S14	Presentation by Cell Teams (5)	75	13:35	14:50	RP Auditorium
	Tea Break	20	14:50	15:10	RP Pre Function Area
S15	Concluding session: General discussions on Innovation and Governance in Vision 2047, other feedback to cells, reiterating time-line for future, re-emphaissing nucleus and cell connects; closing remarks; vote of thanks, Momentos, National Anthem	80	15:10	16:30	RP Auditorium