Office of the Principal Scientific Adviser
to the Government of India

SCIENCE & TECHNOLOGY CLUSTER

Compendium for NorthEast & Industry 4.0

ALL CLUSTER MEETING RECOMMENDATIONS

Clusters Participating

BCKIC
Bhubaneswar City
Knowledge Innovation
Cluster Foundation

BeST
CLUSTER

Acknowledgments

In this nationally important endeavor, all Science and Technology (S&T) Clusters of India owe their deepest gratitude to the leadership of the Office of the PSA to GoI, Prof. Ajay Sood, Principal Scientific Adviser to the Government of India, and Dr. (Mrs.) Parvinder Maini, Scientific Secretary, Office of the Principal Scientific Adviser to the Government of India for their unwavering support and visionary guidance throughout the entire process, from the initial conception to providing critical insights for developing the Compendium.

This compendium is a result of the equal contribution and hard work of all seven S&T clusters, especially Delhi (DRIIV), Pune (PKC), Jodhpur (JCKIF), and Bhubaneswar (BCKIC Foundation). The report delves into the Northeast Ecosystem and the transformative potential of Industry 4.0 digitalization for New India, showcasing the clusters' efforts to strengthen the Northeastern region, empower the innovation and startup ecosystem, establish innovation hubs, and introduce cluster initiatives under Industry 4.0. These initiatives leverage digitalization to address challenges related to climate change, improve smart city operations, and promote biodiversity conservation.

The insights in this report stem from the fruitful discussions and collaborations from the first joint Science and Technology (S&T) Clusters' Meet held on October 26-27, 2023, in Jodhpur, Rajasthan.

Furthermore, we acknowledge the relentless efforts of all stakeholders, including individual researchers, industry partners, academia, funding agencies, and policymakers, for their contributions of time, knowledge, and valuable resources.

By harnessing the diverse resources of the Northeast Ecosystem and the power of Industry 4.0, working hand in hand under the cluster ecosystem we are confident that India can unlock new opportunities, enhance productivity, and create a more prosperous future with sustainable growth and a world filled with innovative solutions.

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INTRODUCTION

About O/o PSA

The Government of India established the Office of the Principal Scientific Adviser (PSA) in November 1999. The PSA's office aims to provide pragmatic and objective advice to the Prime Minister and the cabinet in matters of Science and Technology. The Office of PSA was placed under the Cabinet Secretariat in August, 2018.

The Office of the Principal Scientific Adviser (PSA) serves as a high-level advisory body providing strategic guidance and scientific advice to the government on matters of science, technology, and innovation. The primary objective is to align scientific advancements with national development goals and address complex challenges across different sectors. The PSAs office coordinates and facilitates scientific efforts across ministries and departments. It plays a pivotal role in formulating science and technology policies, fostering collaboration between academia, research institutions, and industry, and promoting innovation-driven solutions. The 0/o PSA acts as a bridge between the scientific community and the government, advising policymakers on the integration of cutting-edge research into governance strategies. This includes recommendations on harnessing technology for sustainable development, promoting scientific temper, and addressing critical issues such as climate change, healthcare, and national security.

The Office of the Principal Scientific Adviser plays a pivotal role in shaping a nation's scientific and technological landscape, ensuring that advancements in science contribute meaningfully to societal progress and addressing contemporary challenges.

About the Science & Technology Clusters

Science and Technology Clusters (S&T Clusters), a flagship initiative of the Office of the Principal Scientific Adviser (PSA) to the Government of India (GoI), were established after the recommendation of the Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC). Presently, seven S&T Clusters—in Bengaluru, Bhubaneshwar, Delhi-NCR, Hyderabad, Jodhpur, Northern Region and Pune—are striving to solve local problems in a consortium mode. This initiative brings together academia, R&D institutions, industries, and local governments to tackle regional problems through S&T interventions.

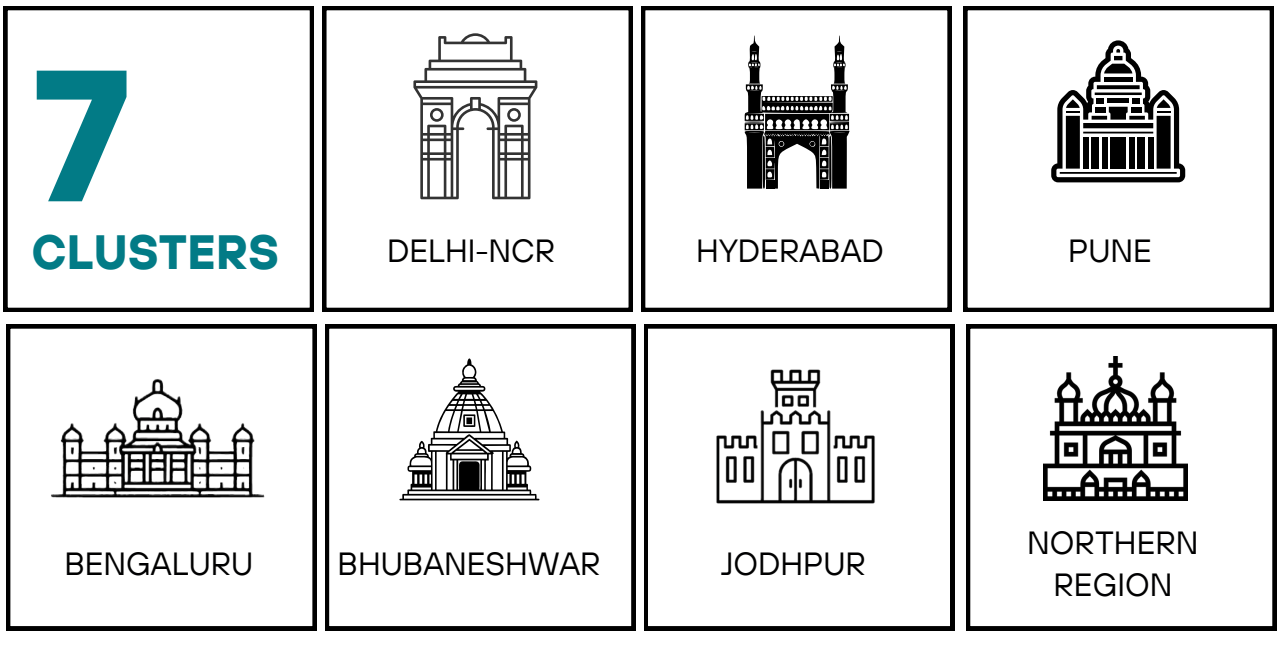
These clusters are pivotal for facilitating collaborative research to solve local and global challenges and realise the vision of 'Atmanirbhar Bharat'.

To achieve this goal, each S&T Cluster brings together a group of institutions, including academia, research laboratories, industry partners, start-ups, ministries of micro, small, and medium enterprises (MSMEs), state governments, philanthropic foundations, & international organisations. The clusters operate under a formal umbrella structure while retaining their internal autonomy, thus creating a shared ecosystem that fosters collaboration among stakeholders.

The S&T Clusters operate in a three-tiered pyramid approach. The bottom tier involves creating a shared ecosystem among the institutions, the second-tier places focus on becoming a regional solution provider, and the topmost tier is aimed at the clusters becoming nationally and globally competitive. By working together and leveraging their collective strengths, the clusters aim to bring positive impacts on the economy and society at large.

Each Cluster has a unique area of focus, R&D activities, and collaborations with industry partners, academic institutions, and government agencies.

The report shall delve further into the work, focus areas, success stories, and future outlooks of individual S&T Clusters, specifically in the sector of Northeast region and Industry 4.0 in India.



EXECUTIVE SUMMARY

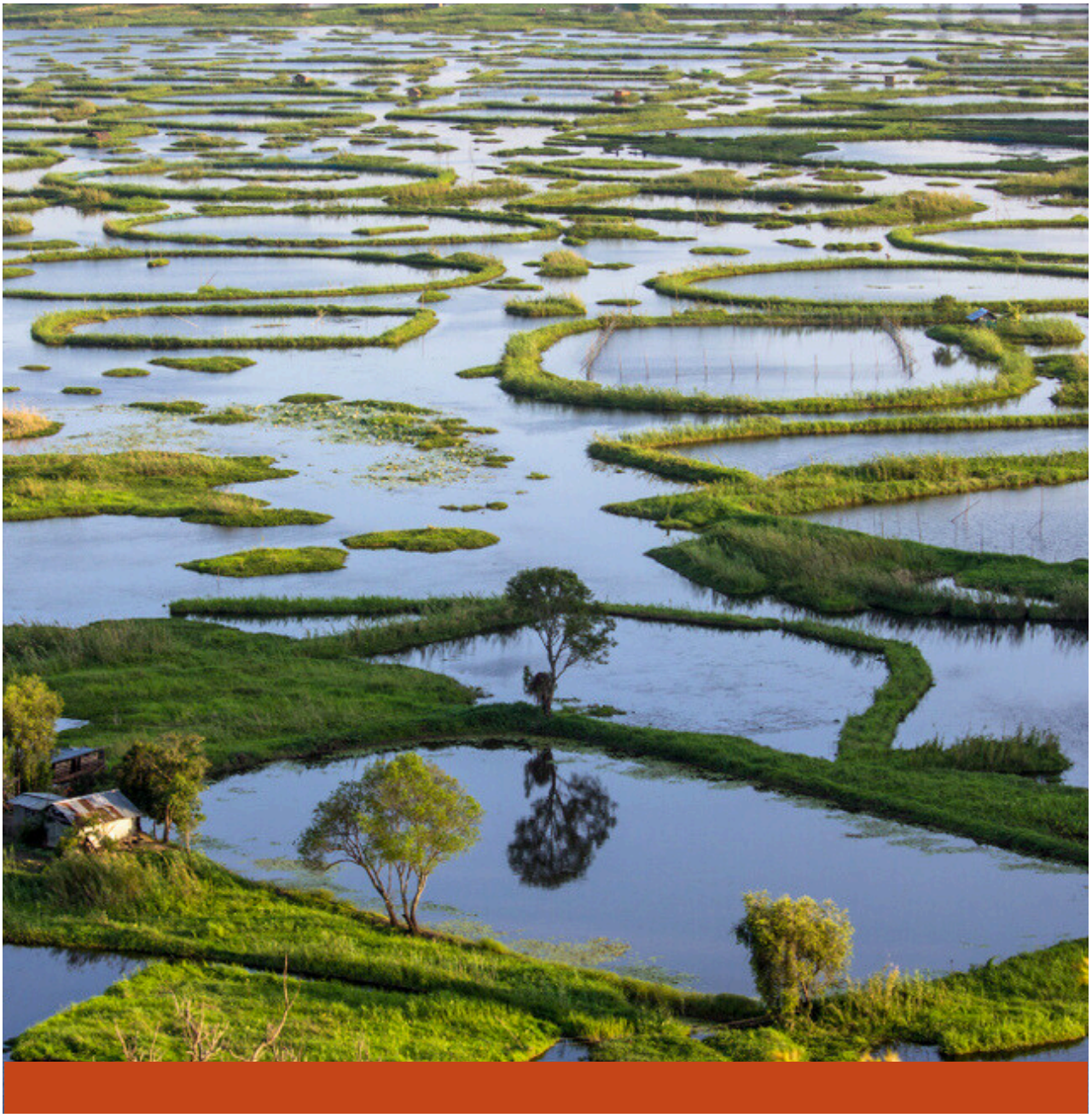
Principal Scientific Adviser to the Government of India Professor Ajay Kumar Sood Chaired the first joint Science and Technology (S&T) Clusters' Meet held on October 26-27, 2023 in Jodhpur, Rajasthan. The two-day meeting witnessed in-depth discussions on identified themes and opportunities for interdisciplinary collaboration among clusters. The themes included: Healthcare, Energy and Environment, Agritech and Nutrition, STEM Education, Livelihood through S&T, and Northeast Impact & Industry 4.0.

This thematic report on "Northeast Ecosystem and Industry 4.0 Digitalization has been developed and designed by BCKIC Foundation in close collaboration with the Office of PSA and all the clusters involved. The report showcases the activities and milestones across all clusters under the aforementioned areas. Realizing that the Northeastern Region, comprising 8 of India's 28 states, plays a decisive role in India's journey towards achieving the Agenda 2045, and given its close geographic proximity to the region, BCKIC Foundation from the very beginning has been committed to upholding the core SDG principle of "Leaving No One Behind." The goal is to progress the SDGs from a global to national to local context.

Additionally, this report also summarizes the clusters' efforts in harnessing Industry 4.0 for India's holistic development, where digitalization plays a crucial role, whether in addressing climate change, mobility or biodiversity.

For instance, the Bangalore Cluster (BeST) and MetEarth Technologies are integrating artificial intelligence (AI) for weather data analysis, significantly improving productivity and disaster preparedness. The Pune Cluster (PKC) is extensively working on sustainable mobility programs for both public and private transport, which can revolutionize urban mobility, reduce traffic congestion, and lower carbon emissions. The Delhi cluster (DRIIV) has developed the "One Delhi App," which is set to revolutionize public transport in Delhi through digitization, making it more efficient and user-friendly. In Jodhpur, the cluster (JCKIF) is developing, a traffic modeling, management, and rule enforcement framework using surveillance videos and computer vision techniques, which promises to enhance traffic management and rule enforcement. Additionally, the "Desert Ecosystem Innovations Guided by Nature & Selection" (THAR - DESIGNS) initiative focuses on the integrated study of the desert ecosystem to drive discoveries, inventions, and innovations. This initiative aims to address water and health challenges while promoting industry and agriculture growth, thereby sustaining livelihoods in the harsh desert environment. These efforts collectively highlight the transformative impact of Industry 4.0 technologies across various sectors in India.

By focusing on Industry 4.0, the aim is to highlight how these technologies can drive inclusive economic growth and foster a more resilient, holistic, and sustainable future. As India aspires to be at the forefront of the global industrial transformation, understanding, adopting Industry 4.0 principles, and equipping India's workforce with the necessary skills is crucial in ensuring the nation's long-term industrial and economic success.



STRENGTHENING THE NORTHEAST ECOSYSTEM

Northeast (NE) India and its Ecosystem

Northeast India, a region known for its rich cultural heritage and ecological diversity which is slowly but strongly carving its niche in the innovation & startup ecosystem. Today startups are no longer just buzzwords in bigger cities, east and northeast is positioning itself as a conducive ecosystem for innovation and startups to flourish. However, when we talk about missions like 'Atmanirbhar Bharat' or 'Reaching the Unreached' it can't be the effort of a single institution or an individual. It demands collective action involving academia, industry, policy makers, government bodies, and startups all working hand in hand in a cluster approach. Following this principle, BCKIC Foundation in close collaboration with KIIT TBI, BIRAC BRTC, BIRAC East & Northeast Cluster, and Incubators from the region serves as small ignition to create momentum and bring together on one platform for "creating a vibrant innovation & startup ecosystem in east and northeast" which is translating into tangible impacts in terms of skilling, employment, IP or follow-funding. Today there are more than 100 startups from east and northeast supported in every possible way. A valuable compendium of 100+ technologies at different TRL levels sourced from northeastern startups and academia has been compiled. Majority of them have been supported across BIRAC and other ministries including DST, MeitY, Startup India and other government agencies.

These are tangible; however, we believe equally important are the intangibles that BCKIC cluster has achieved in terms of the new ways of doing things and the community of local entrepreneurs that have been built in the northeast and east region through networks and cluster building approach.

NE-Region: The Evolving Back Drop

Landscaping & Ground Level Assessment

110 Tech Innovations Mined in NE	**21** NE Institution in "Hub & Spoke"	**2** NE Technologies Licensed	**44** Startups Mentored & Supported	**34** NE Mentors Onboarded	**27** IPs filed from North East

Capacity Building

NORTHEAST REGION INITIATIVES

Genesis of Manipur Technology Innovation Hub (MTI-Hub)

One of the significant milestones is the establishment of the **Manipur Technology Innovation Hub (MTI-Hub)** in a Public-Private Partnership (PPP) Model, supported by the Department of Information Technology, Government of Manipur, in collaboration with KIIT-TBI as an incubation partner. While one year may be too short to draw definitive conclusions, our experience in Manipur has deepened our understanding of the current developmental challenges faced by the state. It has also helped us chart a path forward towards achieving SDG targets and fostering inclusivity in all our initiatives.

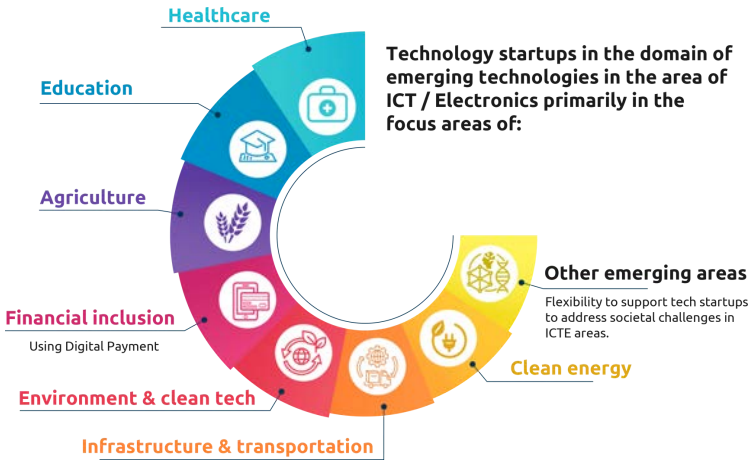
Department of Information Technology (DIT), Govt. of Manipur signed an agreement with BCKIC on 5th January 2022 to establish **Manipur Technology Innovation Hub (MTI-Hub).**

Shri Amit Shah, Hon'ble Union Minister for Home Affairs and Minister of Cooperation virtually inaugurated the Manipur Technology Innovation Hub (MTI-HUB) on 6th January, 2022.

Shri N. Biren Singh, Hon'ble Chief Minister of Manipur along with Shri Rajesh Kumar, Chief Secretary, Manipur visited and interacted with representatives of the Manipur Technology Innovation Hub (MTI-HUB) on 12th November 2022.

Facilities Offers

Focus Areas



IMPACT SO FAR

	INR 1.5 Cr. fund raised by 3 Startups from Manipur in BIG NER	**INR 1.8 Cr.** fund raised by 6 Startups from manipur under ASIIM scheme	**INR 10 Lakhs** fund raised by 2 Startups from Manipur under Nidhi EIR	
1000+ Innovators Reached	**Hosted G20-DIA** National Roadshow at NIELIT, Imphal	**20+** Total Programs conducted	**100+** Start-ups Connected	**25+** Innovation Idea Pitch
10 Physical Roadshows Conducted	**10+** Mentors Identified	**4** MoU Singed with Institutes	**10+** Startup handholding and mentoring	**2** Start-up Product from Manipur launched by DoNER secretary
27 Start-ups signed MoU for incubation at MTI Hub and KIIT-TBI	**3** To promote MTI-Hub, attended events organized by various org	**40+** Startups Identified	**9** Start-ups from Manipur Attended Innovation Conclave	

THE IMPACT CONTINUES

Manipur Technology Innovation Hub (MTI-Hub)

- Signed MoU Between DIT, Govt. of Manipur and BCKIC on 5th January, 2022.
- Shri Amit Shah, Hon'ble Union Minister virtually inaugurated MTI- HUB on 6th January, 2022.
- Officially opened office in Manipur Information Technology Park on 7th November, 2022.
- Startup Innovation Conclave, 9th & 10th December, 2022, Bhubaneshwa.
- North East Startup Showcase Summit 1.0 (Ness Summit), 1st & 2nd February, 2023.
- Roadshows 16th Nov 2022-10 April 2023.
- MTI-Hub Start-up Meet: Interaction with Start-up Founders, 26th September, 2023.
- Interactive session on Internet Ban : Issues & Challenges faced by the Startups, 9th June, 2023.
- Meet the Startups: Exploring Innovation and Empowering Entrepreneurs in Manipur starting from 19th May, 2023 onwards.
- G20 DIA National Program "Digitalization: Enabling India's Tech Growth", 24th March, 2023.
- BIRAC Biotechnology Ignition Grant (BIG) Technical Evaluation Panel (TEP), 21-24h March, 2023.
- North East India Launchpad 2.0 10th & 11th March, 2023.
- Building Sustainable Incubator Ecosystem in North East Region (BINER) 2.0, 3rd & 4th February, 2023.
- One-Day Stakeholders Consultative Meeting on the Loktak Lake 17th April, 2023 at Loktak Lake, Manipur.
- Nuts & Bolts of MSME SFURTI Scheme, 28th April, 2023, Virtual.
- Regional Startup Network, 5m 6th October, 2023.
- People's Festival of Innovations 28th Nov 2nd Dec, 2023.

Roadshow on MTI-Hub Conducted

Roadshow # 1
Venue: Manipur Institute of Technology, Imphal
Date: 16th November, 2022

Roadshow # 2
Venue: Manipur Technical University, Imphal
Date: 17th November, 2022

Roadshow # 3
Venue: NIELIT, Imphal,
Date: 22nd November, 2022

Roadshow # 4
Venue: CIPET, Imphal
Date: 23rd November, 2022

Roadshow # 5
Venue: National Institute of Technology, Manipur
Date: 24th November, 2022

Roadshow # 6
Venue: Manipur International University, Imphal
Date: 26th November, 2022

Roadshow # 7
Venue: Indian Institute of Information Technology, Manipur
Date: 6th December, 2022

Roadshow # 8
Venue: Dhanamanjuri University, Manipur
Date: 16th December, 2022

Roadshow # 9
Venue: Modern College, Manipur
Date: 29th March, 2023

Roadshow # 10
Venue: SAIRAM, Imphal
Date: 10th April, 2023

- **1000+ people attended** and get benefitted about the various support system provided by MTI-HUB.
- **4-5 Innovative Ideas** have been selected from each roadshows for further refining.
- **1 participant** of the roadshow was finalist of the **BOEING BUILD 2.0 program**.
- Provided the **12 problem statement** given by DONER Ministry to come up with the solution.
- Motivated the youths with the success story sharing by BIG grant winners from Manipur.
- MTI-HUB office is becoming a centre of attraction for the youths of Manipur venturing into the startup ecosystem.

Northeast Startup Showcase (NESS) Summit

The first NESS Summit (North East Startup Showcase Summit 1.0@ Manipur) was being organized by BRTC a BIRAC-KIIT-TBI Initiative (BIRAC Regional Techno Entrepreneurship Centre) at KIIT-TBI and the Department of Information Technology, Government of Manipur in association with Manipur Technology Innovation Hub and BCKIC Foundation on 1st & 2nd February 2023.

The objective was to accelerate the cross-talks among startups across the inter-state and aimed, at offering a platform to promising start-ups from outside NE and aspiring entrepreneurs across NER to showcase their technology/ product demonstration to understand the best practices and encourage the seeding of enterprises in NER.

Program Attendees

Innovators	Startups from PAN India	Faculty, Students, Scientists	NE Entrepreneurs and Startups

NESS Summit Objective

NESS Major Elements

1. Confluence of start-ups outside NE and from NER to understand the best practices
2. Focused discussions for Start-ups, Enablers, and related stakeholders for peer-to-peer learning
3. Networking with various stakeholders for technology Deployment
4. Exhibition of innovative products and technologies by Start-ups
5. Guidance on how to form a start-up, and how to avail the enabling opportunities
6. Seeding of enterprises in NER

Achievements

- Inaugurated the summit by Dr. Sapam Ranjan Singh, Hon'bleMinister of Medical, Health and Family Welfare & Publicity and Information, Govt. of Manipur.
- 40 startups showcase their product, including 35 from Manipur and 5 from outside Manipur.
- 35 startups from Manipur Pitched their idea on day 2.
- 16 Startups signed MOU with MTI-Hub for incubation and mentoring support.

Geographic Distribution of Startups

33	6
Startups from NE	Startups from Outside NE

40 Startups who showcase their products and ideas during NESS Summit

Sintha Automobile

LEAVING NO ONE BEHIND: WAY FORWARD

Working in the Northeast for the past two years has provided us with insights into the tremendous potential of this region, as well as the challenges that require concerted efforts. As we move forward, we aim to examine the impact in a more granular manner, initiate state-level SDG monitoring, and bring about welcome change.

Strengthening Translational Research and SDG Localization

- Deepen district-level SDG monitoring for a more significant impact.
- Employ a tightly coordinated, multi-prolonged approach to achieve the SDGs.
- Create a unified platform for startups to build a collaborative community that will solve many challenges faced by startups while working in silos and will facilitate logistics, market connects, etc.

Capacity Building and Collaboration

- Conduct more intensive capacity-building programs for incubator managers.
- Accelerate cross-talk among startups across inter-state, intra-state, and outside the region.

Quality Control and Biotechnological Interventions

- Enhance local indigenous products' shelf life to meet global standards.
- Systematically map state-wise bio resources to empower local biotech entrepreneurs.

Supporting Startups & Monitoring Progress

- Implement an indicator framework for rigorous startup progress monitoring.

Technology Evaluation & Strategic Linkages

- Forge crucial connections with local government for tech development and industries for tech transfer and licensing.

PRINT, ELECTRONICS & MEDIA COVERAGES

INDUSTRY 4.0
DIGITALIZATION FOR NEW INDIA

Introduction: Industry 4.0

Industry 4.0 represents a new era of technological advancement, characterized by integrating advanced digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), machine learning, big data, and automation. This new era of technological advancement promises to revolutionize traditional methods and service sectors by enhancing productivity, fostering innovation, and creating more resilient economies. In India, adopting Industry 4.0 technologies offers a unique opportunity to transition to a knowledge-based economy, develop smarter cities, and address pressing socio-economic challenges in the field of healthcare, agriculture & biomanufacturing and other allied fields. By harnessing these advanced technologies, India can enhance operational efficiencies, drive sustainable development, and establish itself as a global leader in the new industrial era.

INDUSTRY 4.0 FOR SMART CITIES OPERATIONS

Behaviour Nudges for Sustainable Transportation

Background

The Pune metro region has seen several policy and infrastructure improvements in the last decade. Pune Mahanagar Parivahan Mahamandal Limited (PMPML) which operates a large fleet covering the Pune Metro Region, has introduced Cleaner fuels (CNG) as well as electric buses. Significant investment and planning have gone into the metro rail project which has two corridors that will be fully operational in 2024. There are other enhancements to public transit systems such as increasing its reach and last/first-mile connectivity. Roads are being built with wider footpaths and dedicated lanes for bicycles. A public bicycle sharing system can serve as an alternate mode for short trips and provide last/first-mile connectivity to commuters. While initiatives from the government are the first step, it is also imperative for the citizens to play their part in contributing towards the sustainable development goals by adopting sustainable practices of living.

About the Program

Pune Cluster in cooperation with government bodies, academia, R&D, and NGOs is working on a large scale to solve the mobility requirements of the city. The Pune metro region has seen several policy and infrastructure improvements in the last decade. Pune Mahanagar Parivahan Mahamandal Limited (PMPML) which operates a large fleet covering the Pune Metro Region, has introduced Cleaner fuels (CNG) as well as electric buses. Significant investment and planning have gone into the metro rail project which has two corridors that will be fully operational in 2024. There are other enhancements to public transit systems such as increasing its reach and last/first-mile connectivity. Roads are being built with wider footpaths and dedicated lanes for bicycles. A public bicycle sharing system can serve as an alternate mode for short trips and provide last/first-mile connectivity to commuters. While initiatives from the government are the first step, it is also imperative for the citizens to play their part in contributing towards the sustainable development goals by adopting sustainable practices of living.

Program Goals

- Improve the ridership for designated routes of PMPML and the Metros – Maha metro and Pune Metro
- Quantify the impact of various 'nudges' or 'service improvements' through a data-driven approach
- Enable the transport providers to make an informed decision about the service improvements that need to be made
- Provide learnings and best practices for public transport providers for smart cities

The first phase of the program is focused on improving ridership for PMPML buses by introducing behavioural interventions through awareness campaigns.

Operating Model

Impact

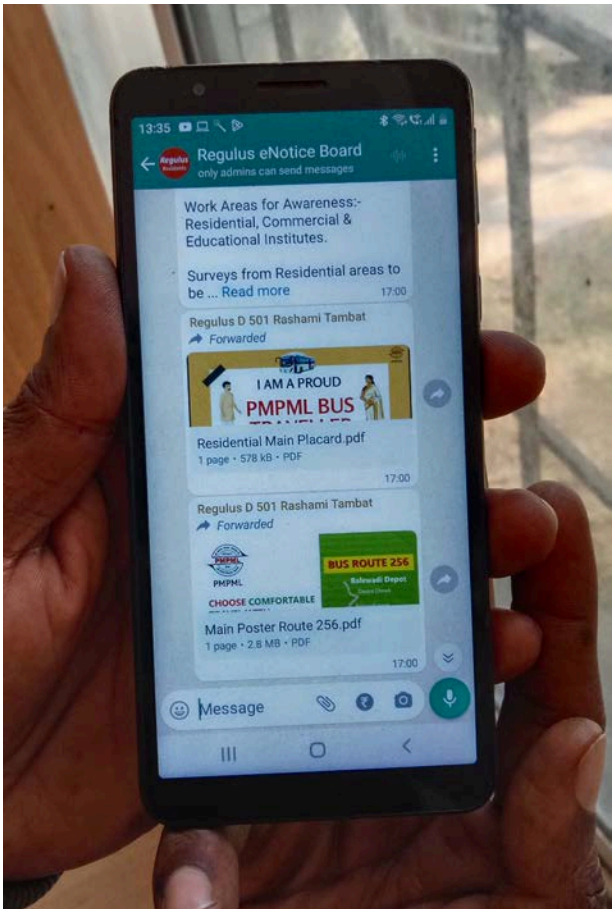
Studies and surveys were conducted to identify specific PMPML bus routes where the pilot nudges could be designed and one route- the bus route-256, operating from Balewadi region to Mahanagar Palika (MaNaPa) was further chosen for implementation.

Fig. 1: Routes surveyed

Fig.2: reach of awareness campaigns on bus route 256

Bus Stops Surveyed	Citizens Surveyed	Institutions for Outreach	Awareness Campaigns
300	800+	20	12
Stop Indication, encroachment, accessibility etc	Travel Behaviour & PMPML Service experience	Companies, Housing Complexes, Colleges	Commercial Areas (4), Colleges (2), Housing Societies (6)

Indirect Beneficiaries: 9000+



Partners

Govt Bodies

R&D, Academia

Funding

NGOs

International

INDUSTRY 4.0 FOR SMART CITIES OPERATIONS

Traffic Modeling, Management, and Rule Enforcement in Jodhpur from Surveillance Videos Using Computer Vision Techniques

Background

Jodhpur, popularly known as the Sun City, is the second-largest city in Rajasthan and one of India's most popular tourist destinations. However, the city faces significant traffic challenges due to its radial road network, which lacks a complementary circumferential network. This results in centralized intercity trips through the Central Business District (CBD), leading to frequent traffic snarls. Contributing factors such as roadside parking, increased vehicle ownership, indiscipline driving, and the lack of parking and non-motorized transport infrastructure exacerbate these issues. Consequently, Jodhpur has seen a rise in fatal accidents, highlighting the urgent need for effective travel demand management measures to address traffic-related externalities and road safety concerns.

Against this backdrop, JCKIF implemented an AI-driven initiative to enhance the efficiency of Jodhpur's traffic management system. Leveraging big data and advanced AI and data analytics, the initiative seeks to improve planning and decision-making processes, paving the way for a smart and intelligent city through I-Governance. From a traffic control perspective, it is crucial to analyze traffic demand fluctuations by location and time. AI/ML-based advanced technologies will be employed to achieve this, offering solutions to identify traffic rule violations and optimize traffic flow in the city.

Objective and Technology

The primary objective of this mission project is to utilize advanced artificial intelligence technology to significantly enhance the TRAZER product, a comprehensive traffic surveillance system developed by KritiKal Solutions Pvt. Ltd. In collaboration with JCKIF, the aim is to expand TRAZER's capabilities to better meet the dynamic demands of urban traffic management and safety.

Further, the Jodhpur cluster, along with the Jodhpur Traffic Police, City Development Authority, and Jodhpur Nagar Nigam, is developing a Traffic Modeling and Management Framework, and the app has already been tested in real-time environments in multiple locations in Jodhpur. Jodhpur Traffic Police, City Development Authority, Jodhpur will be the end users for the technology.

Methodology

- Improvising the vehicle detection and classification accuracy.
- Model Training and Optimization.
- Upgrading Tracker SORT to BYTESORT.
- Report refinement.
- Multi- stream processing.
- Speed Estimation.
- Zebra crossing violation.
- Congestion Estimation.
- Helmet and Triple Riding Detection.
- Triple Riding.
- Vehicle colour Detection.
- Parked vehicles.

Some examples

Classification of vehicles

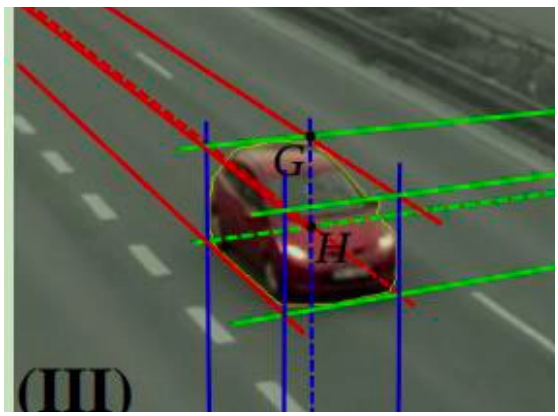
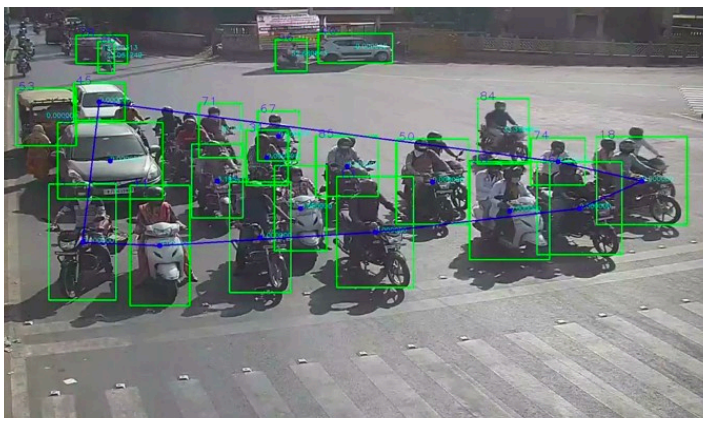
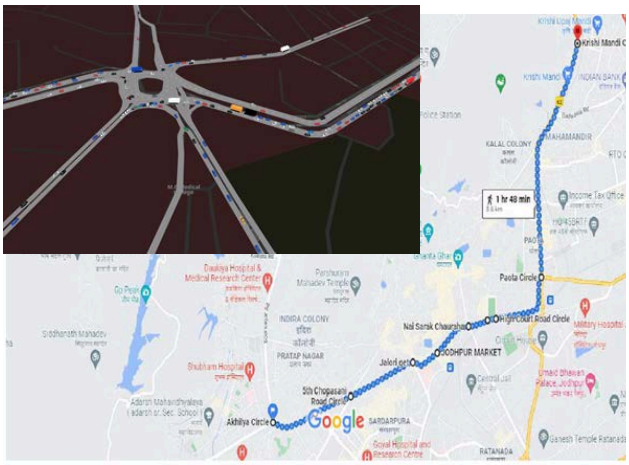


Image along with measurements



Detecting multiple vehicles in a region



Traffic simulation model from Akhaliya Circle to Krishi Mandi, Jodhpur

Estimation of Traffic Conflict Technique (TCT) indicators for Paota Circle, Krishi mandi and Police line Circle, Jodhpur

Outcomes

Multistream Processing:

- Processing multiple videos simultaneously.

Speed Estimation:

- Speed estimation of each vehicle.
- Average, minimum and maximum speed of vehicles in the scenery.

Zebra Cross violation:

- Identifying vehicles violating the zebra crossing while waiting at traffic signal.

Congestion Estimation:

- Congestion identification on scene.

Helmet Detection:

- Detects whether motor rider is wearing helmet or not.

Triple Riding:

- Identifying the two wheelers with more than two people.

Parked Vehicles:

- Identifying parking vehicles in the camera view.

Vehicle Color Detection:

- Estimating color of each vehicle.

Impact

Development of a city-level integrated travel demand and traffic flow model, resulting in better travel management and increased traffic safety.

Future Prospectives

Currently, the modules are used for extracting traffic counts for 16 locations in the Jodhpur North network. The counts will be used for simulating traffic flow of the network for better travel management in the city. Also, using the developed modules for traffic rule violation detection, the possibility of automatic challan generation could be explored soon.

INDUSTRY 4.0 FOR SMART CITIES OPERATIONS

One Delhi App: Revolutionizing Public Transport in Delhi through Digitization (Developed by DRIIV)

Background

The Importance of Efficient Public Transportation:

In a major metropolitan area like Delhi, with its large and ever-growing population, a well-functioning public transportation system is essential. It serves as the backbone of urban mobility, facilitating the movement of people and goods, promoting economic activity, and contributing to a sustainable urban environment.

The Need for a Solution and the Role of DRIIV:

Recognizing the urgency for innovation to address these challenges, the Delhi Research Implementation and Innovation (DRIIV) emerged as a key player in leveraging technology and bridge the information gap plaguing Delhi's public transport system. DRIIV's vision centered on creating a more seamless, efficient, and accessible public transport experience for all Delhi residents. This vision became the driving force behind the development of the One Delhi App, a revolutionary tool destined to transform public transportation in Delhi

Challenges Faced by Delhi's Public Transport System:

However, Delhi's public transport system faced significant challenges that hindered its effectiveness and user experience. These challenges included:

- **Fragmented Information:** Commuters lacked access to real-time information on bus arrival times, leading to long wait times and inefficient travel planning.
- **Lack of Integration:** A disconnect existed between different modes of transportation, particularly the Delhi Metro and the city bus network. This resulted in a disjointed user experience for those who relied on a combination of services for their commutes.
- **Inefficient Fleet Management:** Public transport authorities lacked a centralized system for tracking buses and monitoring ridership patterns, hindering efforts to optimize fleet management and resource allocation.

Partners

About the Technology

DRIIV conceptualized the One Delhi App, a game-changer in digitizing Delhi's public transport. This innovative app boasts several features:

- **Real-time Arrival Tracking:** Passengers can ditch the guesswork and track buses in real-time, optimizing their commutes.
- **E-Ticketing:** Gone are the days of scrambling for cash. The app facilitates seamless e-ticketing, ensuring a hassle-free travel experience for both buses and the Delhi Metro.
- **Fleet Management System:** Depot managers gain a powerful tool to track and manage over 7,000 buses across 2,000+ routes, optimizing efficiency and resource allocation.
- **Open Data Platform:** First and only in India, DRIIV provides open access to public transport data. This empowers researchers, developers, and entrepreneurs to create innovative solutions for a more robust public transport ecosystem.
- **Integrated Trip Planning:** This innovative feature allows users to enter their origin and destination, and the app generates the most efficient route combining both buses and metro, eliminating the need for juggling multiple apps or schedules.

As per the DMRC latest report,

- Cumulative Passenger Journey for the current FY up to previous month **(May'24) – 36,62,42,699**
- Avg. Daily Passenger Journey for the current FY up to previous month **(May'24) – 60,03,979**

Status of the Technology

The One Delhi App has been successfully adopted by the Delhi Government, marking a significant milestone. It is now a central component of Delhi's public transport infrastructure, further enhanced by its recent integration with the Delhi Metro Rail Corporation (DMRC).

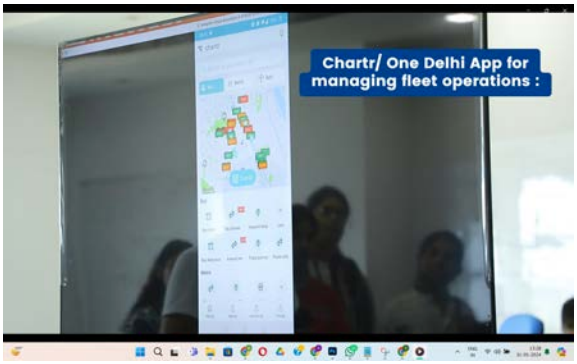
Impact

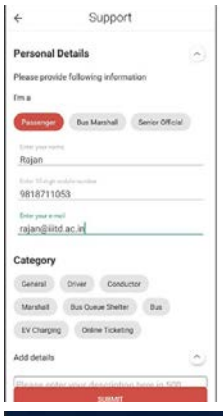
The One Delhi App has yielded impactful results:

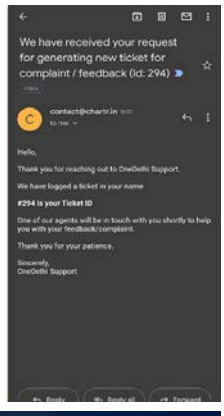
- **Increased Efficiency:** The app streamlines operations, leading to cost savings for both authorities and passengers.
- **Enhanced Ridership:** Real-time information, e-ticketing, and integrated trip planning encourage ridership, making public transport a more attractive option.
- **Transparency and Collaboration:** Open data fosters transparency and collaboration, paving the way for a more inclusive and future-proof public transport system.
- **Seamless Multi-Modal Travel:** The integration with DMRC allows for seamless ticketing and trip planning across buses and metro, offering a unified travel experience.
- **Convenience and Flexibility:** With approximately 300,000 active users and 150,000 daily tickets sales for DTC buses.
- The app now caters to **Delhi Metro** travellers as well. Commuters can enjoy the convenience of using a single app for all their public transport needs, including digital QR ticketing for both modes.

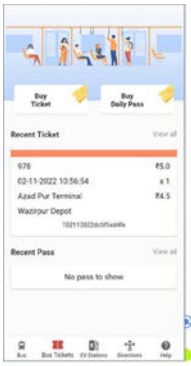
Future Prospective

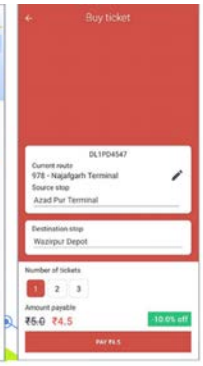
DRIIV's vision extends beyond Delhi. The app's success has garnered national interest, with collaborations underway with transport corporations in Odisha and Hyderabad. The One Delhi App stands as a testament to DRIIV's innovative spirit and commitment to transforming public transport in India. With its continued development and deployment across the country, DRIIV is poised to revolutionize urban mobility, making public transport a smarter, smoother, and more sustainable choice for all.











INDUSTRY 4.0 FOR COMBATING CLIMATE CHANGE

A collaborative effort between BeST Cluster and MetEarth Technologies to harness high-quality weather data & AI

Background

Weather forecasting has always been one of science's most important yet challenging services. The importance and dependency on weather forecasts are increasing with the paradigm shift towards green and sustainable technologies. As the second most populous country, India is poised to face the impacts of weather and climate change more significantly than the global average. This is largely due to the challenging demography, lack of quality observations, and limited weather awareness. Despite massive improvements in forecast quality from Indian agencies, there is still considerable room to deliver this information effectively to end users and to educate them on how best to utilize it.

Partner

MetEarth

The Microsoft Planetary Computer is an exemplary initiative aiming to bridge this gap by making complex weather-related datasets accessible to the general public straightforwardly. While it has integrated multiple datasets from around the globe, it still requires enhancements to fully incorporate the Indian subcontinent. Additionally, incorporating only weather data may not suffice for end users to accurately estimate risks and plan mitigations. They need information about the target sector as well. For instance, an engineer from an electricity load dispatch centre might find weather forecasts extremely useful, but his understanding would be complete only when he can compare the impact of weather changes on electricity load in the past. Extending this concept, multiple sectors such as renewable energy, agriculture, and logistics, which are highly vulnerable to weather and climate change, can greatly benefit from this integrated approach. Empowering these sectors could mitigate short- and long-term risks in areas responsible for about one-third of the national GDP.

About the Technology

Combining the high-quality weather data with AI, BeST Cluster & MetEarth Technologies have built platforms capable of forecasting renewable energy generation, electricity/load demand, rainfall, soil moisture forecasting, and cyclones wind field.

1.Rainfall and Soil Moisture Forecasting

- This product is designed for Insurance and reinsurance organizations.

- Insurance companies are using it to compute the premium of crop insurance.

- We also assist them in determining the damage of crops due to extreme weather events such as heavy rain, flood, and drought.

3. Electricity Demand/ Load Forecast

- This product is built to analyze and forecast short, medium and long-term electricity demand.

- The model considers various socio-economic parameters including per-capita income, GDP, population growth and policy changes.

- Upcoming Products Cloud Tracking System. This product will be developed mainly to cater to solar plants.

- MetEarth will use the real time satellite data to identify the cloud and then will use the NWP wind data.

2. Risk Modelling

- MetEarth has a plan to build a detailed and comprehensive risk map covering the complete India.

- The map will be prepared based on high resolution weather simulation & generating ensembles for these events.

- The map will consider the financial and economical aspects of different land use and land covers and will make policymakers and stakeholders help designing policies at national as well as local level.

4. Cyclone Wind Field and Gust

- Biggest challenge that is faced by the Re/Insurance sector is to estimate their potential risk and loss exposure.

- We are planning to use local observations and regional weather models to generate wind fields of cyclones.

- This product can be used by the insurance industry for assessment of loss and later they release the pay out too.

Machine Learning-based localized Decision Support System App for Farmers

Aim

- A decision support tool for agriculture that provides real-time weather information and forecasts at the farm level based on machine-learning systems.

- Utilize cutting-edge research from machine learning and climate science to provide end-to-end system that can do probabilistic forecasts of relevant weather variables at different time horizons, quantify the uncertainties involved, and translate these into useful information, that can be tailored to a wide variety of farmers.

About the Technology

- Platform will ingest relevant climatic information from a wide variety sources including remote sensing, forecasts and in-situ observations. It will use state-of-the art machine learning models, coupled with domain knowledge from climate science, hydrology etc. to create probabilistic forecasts of the relevant parameters.

- Deep Learning models to make predictions at high spatial resolutions, local spatial patterns of different variables, and inter-variable relations can be represented by convolutions, temporal patterns will be captured through recurrent components.

Drawback

- Although Indian agencies like IMD are working on medium-range weather forecasts using dynamical models, they are yet to achieve significant success at very high spatial resolutions. Moreover, currently available weather forecast products are not tailored for decision-making, especially at specific locations (like a farm).

Impact Envisaged

- Predicting direct/indirect & short/long-term impacts of changing water cycle.

- Understanding onset & organisation of monsoon convection, including mesoscale (~ 10-100 km) systems and severe weather.

- Basic Science: Novel research in diverse areas related to monsoon variability on intra-day to decadal scales, , climate change, clouds, water cycle and air-sea-land interactions.

- Applications: Model-data blends for changing water cycle, city-scale and regional forecasts (esp. for benefit of Govt/municipal agencies, energy sector).

Partners

INDUSTRY 4.0 FOR BIODIVERSITY CONSERVATION

Desert Ecosystem Innovations Guided by Nature & Selection (THAR - DESIGNS)

Background

The Thar Desert, the most densely populated hot desert in the world, is characterized by extreme environmental conditions including high maximum temperatures with significant diurnal variations, scanty rainfall, severe aridity, and intense UV radiation. These harsh conditions push nearly all forms of life to their physiological limits, posing serious threats to their survival. In response, both genetic adaptations and cultural practices have co-evolved among the native inhabitants to enable harmonious co-existence in this challenging environment.

The Thar serves as a vast natural laboratory for the development of innovative adaptations that ensure the survival of its diverse species, their interdependencies, and the conservation of the entire ecosystem. Today, the Thar Desert is not only a repository of natural history but also boasts a rich diversity of flora, fauna, and native human populations who maintain ancient cultural systems and traditions. This unique environment is full of indigenous knowledge and shows the resilience and resourcefulness of its people.

Therefore, an integrated study of the desert ecosystem is essential to drive discoveries, inventions, and innovations that address water and health challenges, and to promote the growth of industry and agriculture for sustaining livelihoods.

Broad Objectives

1. To carry out an integrated study of the desert ecosystem.

2.To propel discoveries, inventions and innovation for mitigating water and health challenges.

3.To catalyze the growth of industry and agriculture for sustenance and livelihood

Partners

SOME OF THE PROJECTS UNDER THIS INITIATIVE

1.Ecosystem phenomics-inspired solutions for One Health

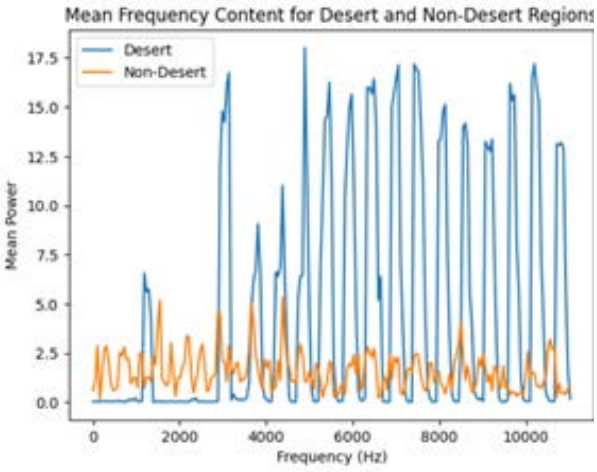
About the Technology:

This study used crowdsourced bird data to identify four distinct ecoregions in the Thar Desert, using birds as ecological indicators. It highlighted the impact of human activities on biodiversity and proposed exploring other bird behaviors as indicators. The study identified vulnerable ecoregions and their vulnerability to agriculture, benefiting environmentalists and policymakers

Achievements:

-The work was published in "Global Ecology and Conservation."

-Ongoing work with ZSI and other organizations to further explore ecoregions in Thar based on various forms of biota.



Differences in call frequency of birds from desert and non-desert regions.

2.Camel & Bat Phenomics-Guided Bioengineering: Design Prospecting & Bioinspired Solutions

About the Technology:

This project studies the adaptive features of desert fauna in the Thar Desert, focusing on camels and bats as model animals, to understand their environment and adaptive signatures. Tiny GPS trackers and sensors were developed to analyze the mobility and adaptive mechanisms of these animals in geo-spatio-temporal dimensions for bioinspired solutions.

Achievements:

-Modified GPS trackers to suit the size and weight of the model organisms.

-Ongoing trials on bats in Nawalgarh, Jhunjhunu district by Dr. DauLal Bohra to understand their locomotion routes and behaviors across various species in the Thar Desert.

GPS tracker on model animals

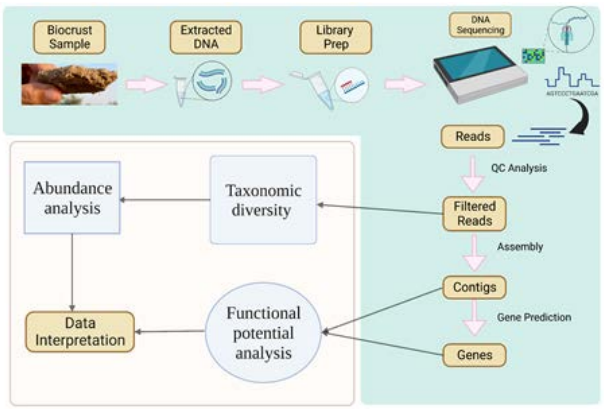
3.Investigating Biological Soil Crusts (BCSs) in the Thar Desert

About the Technology:

The Thar Desert, covering about 12% of India's arid and semi-arid zones, is home to diverse flora and fauna. However, the microscopic organisms in Biological Soil Crusts (BSCs) have been overlooked. These crusts, formed by soil-dwelling microbes, play vital roles in stabilizing soil, fixing nitrogen, cycling nutrients, and enhancing water retention. Our study, using culture-based and culture-independent methods, explores the diversity of BSC microbes and their functions. We have built a biorepository of fungi, actinomycetes, and cyanobacteria with unique adaptations for survival, offering potential for bioprospecting and antimicrobial discovery.

Achievement:

A collaborative proposal was submitted to the Ignite Life Science Foundation for funding to bioprospect antimicrobial agents from Thar biocrusts (INR 15,00,000).



Overview of the metagenomic surveys of the Thar biocrusts conducted using Oxford Nanopore MinION sequencing technology.

4.Ethnogenetic Mapping of Crafts of Rajasthan Desert

About the Technology:

The Thar Desert, known for its cultural diversity, houses artisan communities practicing traditional crafts. However, these communities face challenges like limited market access and health hazards. This study aims to create sustainable livelihoods for artisans by documenting their crafts and genetic landscape. Blood samples were collected from 185 individuals for genotyping, providing insights into their genetic adaptations and health status. This research will promote their crafts in national and international markets, improving their economic conditions.

Achievements:

-Established social connections between craftsmen and technical institutions.

-Genotyping to reveal the genetic landscape of the Thar region and genetic adaptations of craftsmen to extreme conditions.

Community engagement with native craft communities of Rajasthan: Interview and health assessment by the Project team

CHALLENGES

- Inadequate R&D investment, particularly from the private sector.
- Lack of scientific mindset, especially in early education. Limited career prospects in basic sciences divert potential researchers to other sectors.
- Indian Industry shows limited interest in adopting indigenous innovations from startups.
- Publicly funded R&D and Technology Institutions suffer from poor marketing skills and information dissemination.
- The connection between research, higher education, and industry is underdeveloped and requires strengthening.
- The "Lab to Land" transition has long gestation period, with a low rate of technology transfer to industry for societal benefit.
- The public procurement system strongly favors established products and technologies, which hinders the support for innovative start-ups.

WAY FORWARD:

ALL CLUSTER-ONE FAMILY-ONE VISION

Realizing these challenges, we as ONE FAMILY of clusters are committed to enhance the Science and Technology Ecosystem pan India. Working ahead, some of the key action points include:

- Establish value addition centers in institutions for up-scaling technologies, improving from TRL 4 to TRL 6/7, with Co investment and co development approach.
- Develop self-sufficient manufacturing clusters with local branding and e-commerce distribution.
- Create a central database for ready-to-deploy or under-development technologies (sector wise).
- Focus on initiatives for startups to Align Indian quality standards with global standards in multiple sectors.
- Conduct quarterly workshops to raise awareness about the DIPP's Public Procurement Order 2017 for promoting Make in India.
- Launch challenges to create products from technologies in areas of national importance, like waste management and water management.

PRINT, ELECTRONICS & MEDIA COVERAGES

Office of the Principal Scientific Adviser
to the Government of India

SCIENCE & TECHNOLOGY CLUSTER

Office of the Principal Scientific Adviser to the Government of India

The Government of India established the Office of the Principal Scientific Adviser (PSA) in November 1999. The PSA's office aims to provide pragmatic and objective advice to the Prime Minister and the cabinet in matters of Science and Technology.

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