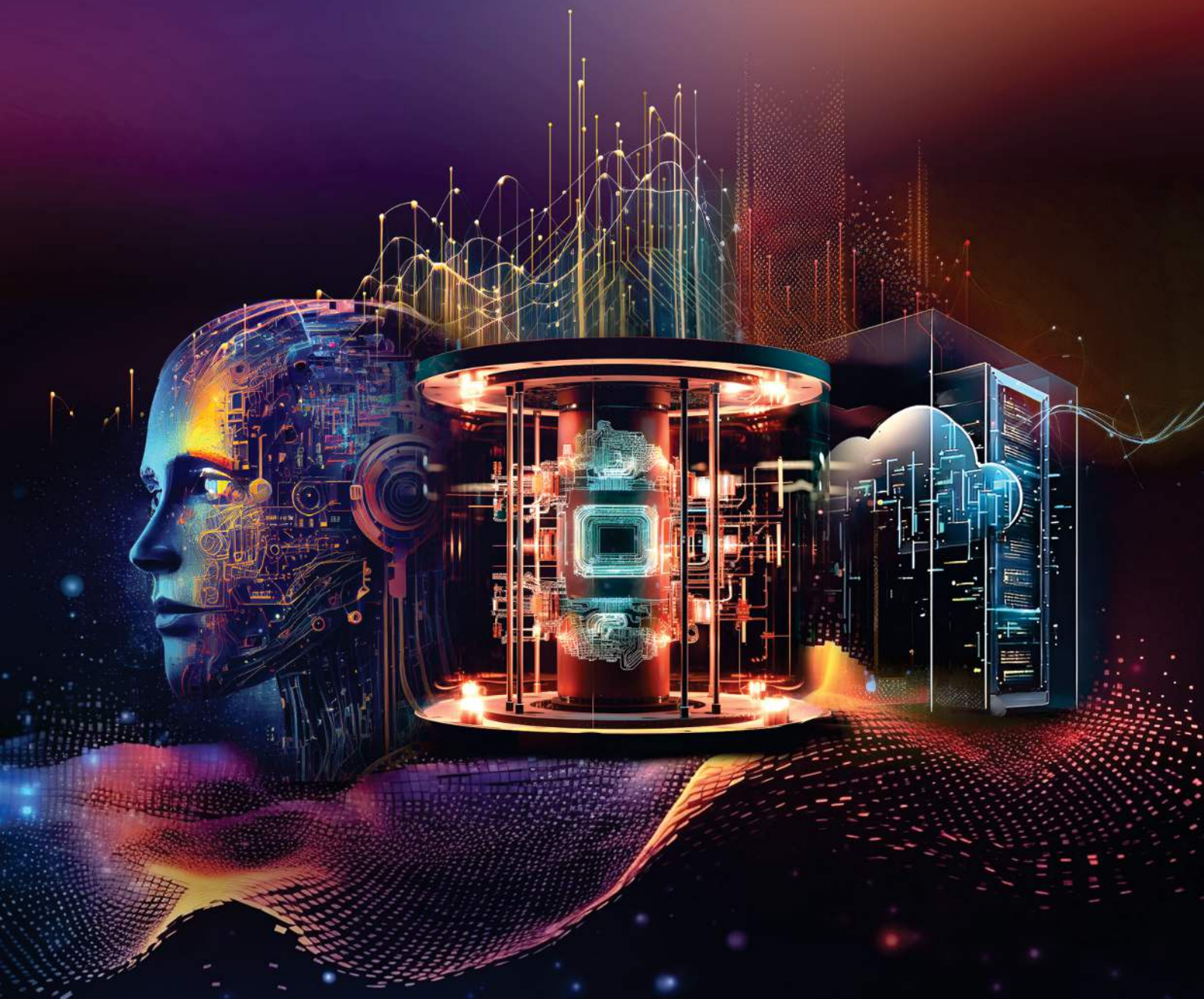
www.cdac.in



ANNUAL REPORT
2022-2023

CENTRE FOR DEVELOPMENT OF ADVANCED COMPUTING

One Vision. One Goal... Advanced Computing for Human Advancement…

Governing Council

(As on 31st March 2023)

Shri Ashwini Vaishnaw
Hon'ble Minister of Railways;
Communications and Electronics
and Information Technology
Chairperson, Governing Council, C-DAC

Shri Rajeev Chandrasekhar
Hon'ble Minister of State in the Ministry of
Skill Development and Entrepreneurship; and
Electronics and Information Technology
Deputy Chairperson, Governing Council, C-DAC

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Secretary, Executive Vice Chairperson,
Governing Council, C-DAC
Ministry of Electronics &
Information Technology, New Delhi

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Secretary, Department of Science & Technology,
New Delhi.

Dr Nallathamby Kalaiselvi
DG, Department of Scientific &
Industrial Research (DSIR) and
DG, Council of Scientific and
Industrial Research (CSIR), New Delhi.

Shri Bhuvnesh Kumar
Additional Secretary &
Additional Secretary (Societies),
Ministry of Electronics &
Information Technology, New Delhi

Smt. Sunita Verma
Scientist 'G' and Group Coordinator
(R&D in IT)Ministry of Electronics &
Information Technology, New Delhi.

Shri Magesh Ethirajan
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C-DAC

Shri Rajesh Singh
Joint Secretary & Financial Adviser
Ministry of Electronics & Information
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Director, Indian Institute of
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Co-Founder MELA Ventures and
Mindtree, Bengaluru

Prof Kamakoti Veezhinathan
Director, Indian Institute of
Technology, Madras

Shri Somanath S
Chairman, Indian Space Research
Organization (ISRO), Bengaluru

Shri Parag Naik
Founder and CEO, Saankhya Labs Pvt. Ltd,
Bengaluru

Shri Arvind Kumar
Addl. Chief Secretary (IT), Govt. of UP

Shri Vijay Nehra
Secretary (IT), Govt. of Gujarat

Shri Sunil Misar
Registrar-in-Charge, C-DAC and
Non-Member Secretary,
Governing Council, C-DAC

Contents

Overview

During the year 2022-23, C-DAC accomplished various technological achievements, organized several events and received multiple recognitions. Param-Kamrupa (838 TFLOPS) supercomputing facility at IIT Guwahati was inaugurated by Smt. Droupadi Murmu, Hon'ble President of India, on October 13, 2022 enabling advance computing facilities in the North-East region. The landmark of 10 crore tele-consultations on eSanjeevani app was hailed by Shri Narendra Modi, Hon'ble Prime Minister of India, during 98th edition of Mann Ki Baat on February 26, 2023. MeriPehchaan, an extensive collaboration between the three main SSO platforms: e-Pramaan, Jan Parichay, and DigiLocker was launched on July 04, 2022 during Digital India Week by Shri Narendra Modi, Hon'ble Prime Minister of India. Stay Safe Online campaign, aimed at creating awareness among citizens to stay safe in an online world, has been launched by Shri Ashwini Vaishnaw, Hon'ble Minister for Electronics & Information Technology, Railways and Communications, Government of India on December 28, 2022. Shri Rajnath Singh, Hon'ble Minister of Defence of India unveiled the Agniveer portal on June 14, 2022, which was designed to facilitate the registration of Indian and Nepalese youth as part of the Agnipath Scheme. Kanthasth 2.0, a Translation Memory (TM) based computer-aided translation system, has been launched by Shri Amit Shah, Hon'ble Minister of Home Affairs of India on September 14, 2022 on the occasion of Hindi Diwas held at Surat, Gujarat. As part of Design Linked Incentive initiative, first roadshow was conducted on October 17, 2022 at Gandhinagar, Gujarat and second roadshow was conducted on February 24, 2023 at IISc Bangalore where Shri Rajeev Chandrasekhar, Hon'ble Minister of State, MeitY, Government of India was the Chief Guest.

Under Phase-II of National Supercomputing Mission, four systems viz. PARAM Ananta (838 TFLOPS) at IIT Gandhinagar, PARAM Porul (838 TFLOPS) at NIT Trichy, PARAM Kamrupa (838 TFLOPS) at IIT Guwahati, and PARAM Himalaya (838 TFLOPS) at IIT Mandi were made operational. C-DAC has partnered with M/s VVDN Technologies and M/s Kaynes Technologies for technology transfer of server design for proliferating Rudra servers in commercial server market. Using Spack, 300+ applications/ libraries/ tools in Molecular Dynamics, Computational Fluid Dynamics, Weather Prediction, Material Science, Computational Chemistry, Bioinformatics, Physics, ML, DL, and other domains were deployed on NSM sites. ANUGA Hydro 2D hydrodynamic model for flood prediction was run on Intel Cascade Lake cluster to produce timely flood forecasts in Mahanadi delta. C-DAC's National PARAM Supercomputing Facility (NPSF) HPC-AI infrastructure services utilization has remained above 70%. Usage of NPSF's HPC-AI infrastructure services has been acknowledged in 504 publications and 75 PhDs so far. About 631 users including 98 PhD scholars across 114 institutions executed their jobs on NPSF HPC-AI system for scientific, engineering and AI research covering many cross functional domains. In Quantum Computing, C-DAC has developed Software Defined Networking based QKD (Quantum Key Distribution) Network Stack which is deployed in the Metro Area Quantum Access Network (MAQAN), the first Software Defined QKD Network in India connecting four locations in Chennai. QSim, Quantum Simulator, is integrated with two high-performance computing facilities: PARAM Utkarsh and PARAM Shakti.

Under Digital India RISC-V (DIR-V), C-DAC has developed THEJAS32 SoC, a 32-bit high-performance microcontroller class processor built around VEGA ET1031. C-DAC has developed Reconfigurable Dataflow and Scalable Deep Learning Accelerator, specifically designed for inference operations in Deep Learning applications targeted for Computer Vision, Natural Language Processing etc. As part of the Design Linked Incentive (DLI) initiative, an online portal has been created for submission & evaluation of applications for DLI Scheme. Significant technology developments are underway in NAMPET Phase III, focusing on comprehensive Electric Vehicle (EV) charging solutions, Power Quality centre for Smart Grids, and advancements in Wide Band Gap (WBG) device-based converters & sensor technologies. The Ultrasonic Solid-Propellant Burn Rate Measurement System developed by C-DAC has been deployed at the High Energy Materials Research Laboratory (HEMRL), DRDO Pune. Vision processing

solution utilizing CMOS image sensor and Xilinx Zynq Ultrascale MPSoC is currently deployed at the EID Parry Sugar Mill in Tamil Nadu for an online sugar crystal characterisation application. During the year, transfer of technology of Smart Energy Meter to M/s Pragati Electrocom, Gurgaon and for AC charger to M/s Electronic Systems, Vadodara has been done. Shri. Alkesh Kumar Sharma, Secretary, MeitY launched the Portable TETRA Base Station (PTBS), the third variant of C-DAC TETRA Base Station on March 04, 2023.

"Tulsi", a multilingual (Hindi and English) voice enabled chatbot, has been developed and deployed for Ministry of AYUSH. Web portals of MSME (Udyam Registration and MSME Champions) were localized in 11 Indian languages. Under VIDYAAPATI initiative, a multi-domain text-to-text machine translation system is being developed for identified language pairs as a collaborative activity. Modernization of Traditional Knowledge Digital Library, Digitization & online portal for encyclopaedic Sanskrit dictionary and Web portal for national rail museum are some of the activities that have been undertaken by C-DAC for heritage preservation. C-DAC has created a 3D hologram of Dr. Ambedkar for Dr. Babasaheb Ambedkar Museum and Memorial in Pune which was inaugurated by Dr. Virendra Kumar, Hon'ble Minister for Social Justice and Empowerment, Government of India on May 06, 2022. Mobile application for Museums of India was launched by Shri G. Kishan Reddy, Hon'ble Minister of Culture and Tourism, Government of India on May 18, 2022.

Vishleshak, a unique Android based platform developed to get insights into malicious apps and "GHOST", an indigenously developed cryptographic tool for generation of secure and trusted elliptic curves over large prime field sizes have been launched by Shri Alkesh Kumar Sharma, Secretary, MeitY on January 28, 2023. More than 9.60 Cr e-Sign have been issued by C-DAC eSign Service from July 2016 to March 2023. C-DAC Security Information and Event Management (CDACSIEM), a security solution that collects & applies analytics to logs to detect threats has been deployed at various locations. M-Kavach - Analysis & Analytics Engine that collects metadata of mobile applications has been deployed at various strategic agencies. Third variant of Military Smart Card Operating System (MISCOS) was developed for Indian Navy. National Blockchain Framework (NBF), providing infrastructure and technology stack to enable large scale adoption of Blockchain based solutions, is being developed by C-DAC in collaboration with key agencies. To enable secure access of Aadhaar Number, Aadhaar Data Vault as a national service was made available in April 2022 and has provisioned more than 140 crore transactions since its availability. Cyber Forensics solutions were upgraded & deployed for key agencies in India. Various capacity building activities have been carried out during the year.

C-DAC is facilitating integration of EPFO system with the Common UAN Engine, thereby broadening the scope of UAN to encompass unorganized sector and enabling seamless & integrated service delivery to its stakeholders. Total 4,528 departments/ agencies were integrated using Mobile Seva platform. More than 16,000 road and bridge proposals have been approved through GeoSadak as of March 2023. C-DAC has implemented software solutions to ECI for its e-Services at the National Level and achieved around 58 crores of Voter-Id linkage with Aadhaar using Aadhaar Data Vault service. A single, integrated portal for e-BIS, facilitating application submission for granting of license and other associated actions has been developed. A central database for Aids and Assistive devices, which disabled individuals can avail under the DEPwD ADIP scheme, has been established as a component of the ARJUN-MIS Portal. C-DAC along with STQC & BIS has formulated Indian standard for Accessibility in ICT and Part II Determinants of Conformance (IS 17802 Part 2):2022 have been published in gazette by Bureau of Indian Standards (BIS) on May 10, 2022. The Secure BOSS Operating System has been customized for DSSC Bhopal and Student Exam Management & Assessment System. Meghdoot cloud has been implemented at Tamil Nadu State Data Center.

National Telemedicine Service of India, eSanjeevani, has served over 107.70 million patients at over 115,000 Health & Wellness Centres (as spokes) through 15,700+ hubs and over 1100 online OPDs serviced till March 2023. e-Sushrut - Hospital Management Information System has been rolled out in many states from Primary Health Centers to Medical College Hospital and Super Speciality Hospitals along with Health Facilities under various PSU's. e-Aushadhi deployment tally has increased to 25 installations in States and Central Programme under MoHFW. e-RaktKosh web portal was embarked as the interface for Blood Centres/Blood Banks/Blood donation camps and voluntary donors during Raktdaan Amrit Mahotsav, a nationwide voluntary blood donation drive of MoH&FW. e-Upkaran is a software system to manage Medical Equipment life cycle and has been deployed in 11 states. Automatic Assessment Tool has been developed to detect Autism using Visual Attention, Facial Expression Recognition and Vocal Emotion

Recognition. Autism Screening Mobile App has been launched by Shri Alkesh Kumar Sharma, Secretary, MeitY, on March 25, 2023. MANAS APP, a national digital wellbeing platform, has been rolled out by Shri Bhagat Singh Koshyari, Hon'ble Governor of Maharashtra on November 11, 2022 for the students of The Maharashtra University of Health Sciences (MUHS), Nashik. AI based system for screening & early detection of cancer has been deployed at AIIMS Delhi in June 2022.

Various industry specific post graduate diploma programmes, industry-academia collaborative programmes, IT training and skill development programmes are offered throughout the year. Furthermore, C-DAC develops and deploys technologies for education and training, including comprehensive exam management systems. C-DAC has signed an agreement with the Indian Air Force to conduct comprehensive exam management for Air Force Common Admission Test (AFCAT) and AgniveerVayu exam. Under the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA), C-DAC has been registered as one of the assessment agencies and has proctored 13.6 lakhs citizens. The FutureSkills PRIME (Programme for Re-Skilling/Up-Skilling of IT Manpower for Employability) is a nationwide program conducted by C-DAC, NIELIT, and NASSCOM centers/content providers through a Hub-n-Spoke approach, with more than 12 lakhs candidates enrolling in various offered programs. 200 online labs were integrated on Diksha Platform in online labs (Olabs).

The activities steered during the year have resulted in several research publications, patents, awards, recognitions and new collaborations with academic organizations within the country and abroad. The annual report covers the achievements and major activities of C-DAC during the year 2022-23.

Major Activities in Thematic Areas

High Performance Computing and Quantum Computing

C-DAC is known for pioneering efforts in design, development and deployment of High-Performance Computing (HPC) systems in India. It is engaged in indigenous R&D in HPC Components (including processor, server board, interconnect, cluster, cooling system), HPC System Software, HPC Applications, and HPC Solutions and Services along with peta-scale computing systems under National Supercomputing Mission (NSM) approved in 2015 by Cabinet Committee on Economic Affairs (CCEA). The NSM was commissioned with the goal of enhancing India's supercomputing capabilities in Infrastructure, Applications, Research and Development and Human Resource Development. C-DAC is also working in the emerging area of Quantum Computing which includes Quantum communications, Quantum Sensing and is participating in Cohort projects invited under MeitY Quantum Computing Application Laboratory.

Key activities under High Performance Computing area include the following components:

HPC Hardware Components: Research and development efforts are focused on designing and developing various HPC components, such as processors, server boards, interconnects, clusters, and cooling systems. The aim is to create efficient and high-performance computing hardware.

HPC Software Components: This includes the development of specialized software stacks and system software tailored for HPC systems parallel programming frameworks, compilers, schedulers, and other software elements that optimize the functioning of HPC systems.

HPC Applications: Development of HPC applications that can harness the computational power of supercomputers effectively. These applications cater to a wide range of scientific, engineering, and research domains, addressing complex and computationally-intensive problems.

HPC Solutions and Services: The organization offers comprehensive HPC solutions and services to users and institutions seeking advanced computing capabilities. This includes consultation, deployment, maintenance, and support for HPC systems.

Peta-scale Computing Systems: C-DAC is actively working towards the development of peta-scale computing systems, which have the capability to perform computations in the order of petaflops (quadrillions of floating-point operations per second). These systems represent a significant advancement in supercomputing capabilities.

Human Resource Development: NSM envisages development of 20,000 HPC aware manpower over duration of the mission. The manpower is envisioned to manage, monitor, and run complex HPC systems. This effort is driven by the NSM Expert Group on Human Resources Development (NSM-EG-HRD).

Key activities under Quantum Computing include QSim–Quantum Simulator (a specialized device that attempts to mimic the behavior of quantum systems. It simulates the interactions between quantum particles), Quantum Sensing, Centre for Excellence in Quantum Technology, and Quantum Key Distribution (QKD) Network Management.

A summary of activities carried out by C-DAC during 2022-23 is as given below.

National Supercomputing Mission (NSM)

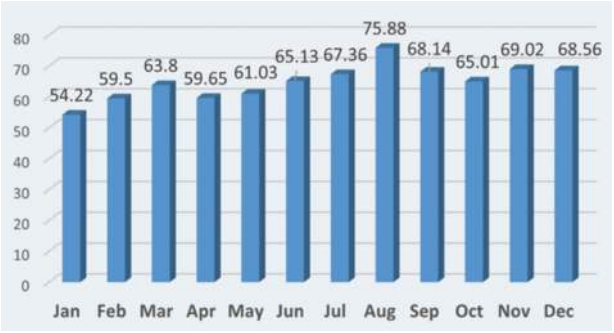
Under NSM, C-DAC is mandated to develop Indigenous supercomputers in a phased manner: from "Assembly" to "Manufacturing" to "Design and Manufacturing" of HPC systems. The ultimate goal of the National Supercomputing Mission is to establish India as a self-reliant (Atmanirbhar) player in the field of supercomputing, capable of developing and deploying world-class HPC systems that can address complex scientific, engineering, and societal challenges. The phased approach ensures systematic and steady progress towards achieving the same.

NSM plans to build and deploy 25 supercomputing facilities across India, with a cumulative compute power of 64 Petaflops. Till now, C-DAC has deployed 15 systems at IISc, IITs, IISER, JNCASR, NABI with a cumulative computing power of more than 24 Petaflops.

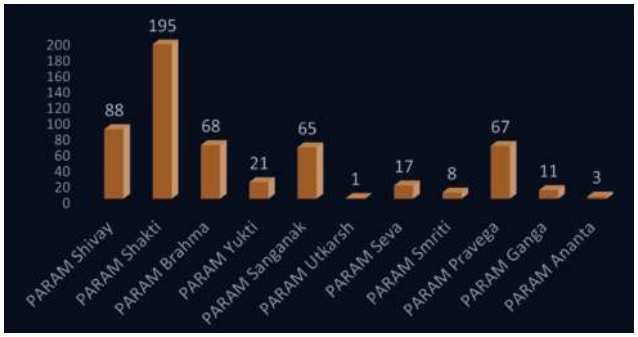
Three systems viz. PARAM Shivay (838 TFLOPS) at IIT BHU, PARAM Brahma (1.7 PFLOPS) at IISER Pune and PARAM Shakti (1.66 PFLOPS) at IIT Kharagpur are operational under Phase-1.

Twelve systems Viz. PARAM YUKTI (1.8 PFLOPS) at JNCASR Bangalore, PARAM Siddhi-AI (5.2 PFLOPS/ 210 PLOPS (AI)) at C-DAC Pune, PARAM Utkarsh (838 TFLOPS) at C-DAC Bangalore, PARAM SANGANAK (1.66 PFLOPS) at IIT Kanpur, PARAM Pravega (3.3 PFLOPS) at IISC Bangalore, PARAM Smriti (838 TFLOPS) at NABI Mohali, PARAM Seva (838 TFLOPS) at IIT Hyderabad, PARAM Ganga (1.66 PFLOPS) at IIT Roorkee, PARAM Ananta (838 TFLOPS) at IIT Gandhinagar, PARAM Porul (838 TFLOPS) at NIT Trichy, PARAM Kamrupa (838 TFLOPS) at IIT Guwahati, and PARAM Himalaya (838 TFLOPS) at IIT Mandi under Phase-2 are operational. These include four systems viz. PARAM Ananta, PARAM Porul, PARAM Kamrupa, and PARAM Himalaya deployed during the period 22-23. Param-Kamrupa (838 TFLOPS) supercomputing facility at IIT Guwahati was inaugurated by Smt. Droupadi Murmu, Hon'ble President of India, on October 13, 2022 enabling advance computing facilities in the North-East region.

These systems cater to the computational demands of a diverse range of users, including academia, researchers, Micro, Small, and Medium Enterprises (MSMEs), and startups. These advanced computing resources are made available to support and accelerate research and innovation in areas of national and strategic importance.



NSM systems utilization (Cumulative) - 2022



No of publications during 2022 using NSM Systems

C-DAC's National PARAM Supercomputing Facility (NPSF) HPC-AI infrastructure services utilization has remained above 70%. Usage of NPSF's HPC-AI infrastructure services has been acknowledged in 504 publications and 75 PhDs so far. About 631 users including 98 PhD scholars across 114 institutions executed their jobs on NPSF HPC-AI system for scientific, engineering and AI research covering many cross functional domains.

During Phase-2 of the National Supercomputing Mission (NSM), a significant number of components used in building the HPC systems are manufactured and assembled locally within India. This emphasizes the mission's objective of promoting indigenous development and reducing reliance on imported components. They include C-DAC's HPC Software Stack developed indigenously. A wide range of applications from scientific & engineering and data science domains are optimized and scaled for underneath architecture/ processor. The HPC systems developed under the National Supercomputing Mission (NSM), with their enhanced capabilities, are accessible to a substantial user base of over 6000 active researchers and academicians through the Nation Knowledge Network (NKN).

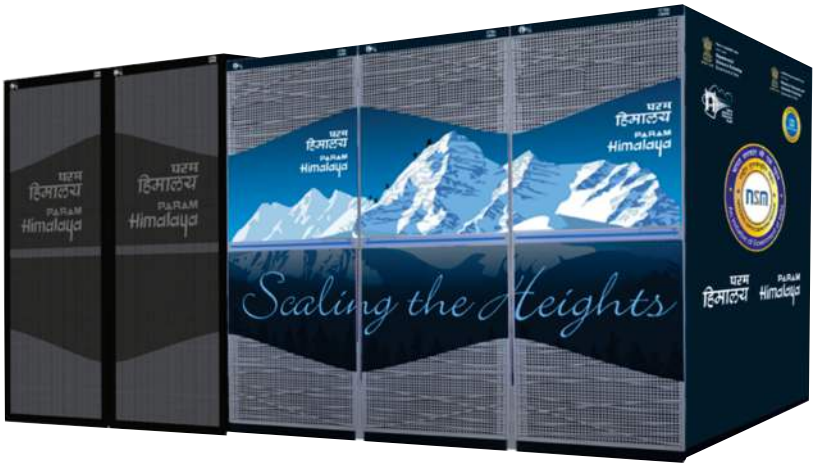
HPC System Deployments and Technologies

During the year, four High-Performance Computing (HPC) systems were installed at various prestigious institutions in India. These systems include PARAM Ananta at IIT Gandhinagar, PARAM Porul at NIT Trichy, PARAM Kamrupa at IIT Guwahati, and PARAM Himalaya at IIT Mandi. Each of these HPC systems boasts a computational capacity of 838 TFLOPS, bringing advanced computing capabilities to their respective institutions and facilitating research and scientific endeavors. By March 2023, the NSM systems had attracted a significant user base of approximately 6000 individuals from 100+ institutes throughout the country. These users collectively executed an impressive total of 7.3 million computational jobs on the NSM systems.

PARAM Kamrupa

PARAM Ananta

PARAM Porul



PARAM Himalaya

PARAM Siddhi-AI

PARAM Siddhi-AI is a high-performance computing-artificial intelligence (HPC-AI) system and by far the fastest supercomputer developed in India with dual precision Rpeak of 6.5 PFlops (210PF mixed precision) and 4.6 PFlops Rmax.

It is built on NVIDIA DGX SuperPOD reference architecture. PARAM Siddhi-AI aids research in advanced materials, computational chemistry, astrophysics, healthcare systems, flood forecasting, and COVID-19-related applications by expediting simulations, improving medical imaging, and advancing Genome sequencing. The system is also being used for National Language Translation Mission (NLTM).

PoC for implementation of AI Research Analytics and Knowledge Dissemination Platform (AIRAWAT)

C-DAC is implementing PoC for AI Research Analytics and Knowledge Dissemination Platform (AIRAWAT) of 200 AI Petaflops. It will act as a common computational cloud platform for Big Data Analytics and Assimilation with a large, power-optimized AI cloud infrastructure connecting all Centers for Research Excellence in AI (COREs), Indian Centers for Transformational AI (ICTAIs) and other Academic, Research Labs, Scientific Community, Industry and Start-Ups institutions with NKN. In alignment with the Atmanirbhar Bharat initiative of the Government of India, AIRAWAT will empower Academia, Research Labs, Scientific Community, Industry and Start-Ups to develop indigenous AI enabled products and solutions. HPC-AI infrastructure of AIRAWAT PoC is proposed to be integrated with PARAM SIDDHI –AI system to make the cumulative compute capacity of 410 AI PF.

PARAM Vidya

PARAM Vidya systems were installed at four HPC Nodal Centers at IIT Goa, IIT Madras, IIT Palakkad and IIT Kharagpur under NSM. These Centers focus on manpower creation and up-skilling of students, faculty, scientists, researchers, and scientific users in the areas of HPC and AI.

Rudra Pilot system

Rudra-I server is designed, developed, and manufactured with security and trustworthiness. It has an exceptionally greater acceptance and has an edge in security-conscious environments and businesses. HPC applications were benchmarked. Performance was found to be at par with clusters with commercial servers elsewhere.

TFCNN Resnet50 Benchmark Container Image: nvcr.io/NVidia/tensorflow:20.06-tf1-py3

			Rudra			Siddhi			ARM HPC Dev-Kit		
	Batch Size	GPU	TF32 + XLA	AMP + XLA	FP32 + XLA	TF32+ XLA	AMP + XLA	FP32+ XLA	TF32+ XLA	AMP + XLA	FP32+ XLA
Enroot	256	1	847	2316	595	893	2424	588	1191	2373	653
		2	1601	4100	1148	1639	3550	1154	2197	4212	1273

Nvidia DL Resnet50 V1.5 Benchmark Container Image: nvcr.io/nvidia/tensorflow:22.01-tf1-py3

			Rudra			Siddhi			ARM HPC Dev-Kit		
	Batch Size	GPU	TF32 + XLA	AMP + XLA	FP32 + XLA	TF32+ XLA	AMP + XLA	FP32+ XLA	TF32+ XLA	AMP + XLA	FP32+ XLA
Enroot	256	1	1106	2183	569	1172	2363	622	1112	2137	575
		2	2003	3888	1110	2262	4472	1218	2151	3949	1123

PARAM Rudra, PARAM Siddhi & Arm Dev Kit - TensorFlow Benchmark Comparison

Phase 3 Systems

MOUs were signed with IIT Madras, SN Bose Kolkata, IUAC New Delhi and IIT Patna for installation and commissioning of systems using indigenous Rudra-1 servers under Phase 3.

PARAM Yuva II

Since its commissioning in February 2013 at C-DAC's National PARAM Supercomputing Facility (NPSF), PARAM Yuva II was used by scientists and engineers for research. With performance of 1,760.20 Megaflops per Watt, PARAM Yuva II was ranked 44th on "Green500" list released in November 2013 at Supercomputing conference'13 in Denver, Colorado, USA. This HPC system has been phased out in June 2022.

PARAM YUVA II

PARAM Shavak

PARAM Shavak is an affordable supercomputing solution in a box that aims to provide computational resources with advanced technologies to perform high-end computations for scientific, engineering, and academic programs to address and catalyze research using modeling, simulation, and data analysis. During 2022-23, PARAM Shavak systems were deployed at DIAT in Maharashtra, Dr Ambedkar Centre for Bio-informatics Research at Delhi University, University of Burdwan in West Bengal, and UNAHUR in Argentina.

Build Approach Development under NSM

Indigenous Rudra-I server

C-DAC's indigenously designed Rudra-I server platform is built for ½ width 1U and ½ width 2U Open19 form factor. Maximum supported Thermal Design Power (TDP) is up to 600W. Baseboard Management Controller (BMC) firmware for Rudra-I is used for server management. Rudra-I is targeted for Hyperscale Data Centers in addition to HPC, Cloud, Edge Computing, and Communication. It is poised to ensure India's self-sufficiency to design, develop and deliver as per the country's needs, and has critical strategic and national importance.

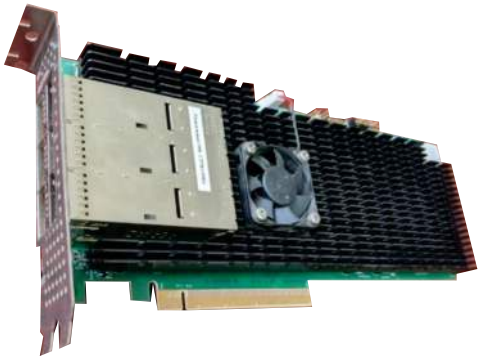
Phase-3 systems under build approach of NSM are being built using Rudra-I server. In July 2022, C-DAC signed contract with M/s VVDN Technologies Pvt. Ltd. for production of 6000 Rudra-I servers. C-DAC has partnered with M/s VVDN Technologies and M/s Kaynes Technologies with technology transfer of server design for proliferating Rudra servers in commercial server market.

C-DAC is aimed at achieving Rudra's "true market potential". Rudra is designed, developed and manufactured with security trustworthiness. C-DAC has promised a robust business continuity plan for Rudra series servers. It is continuing working on Rudra-II server in collaboration with Intel and, HDR switch and HDR NIC in collaboration with Nvidia.

RUDRA-II is based on Intel's 4th generation Xeon Scalable Processor (Sapphire Rapids) with Intel C741 Chipset. Rudra series servers support 1/10G Ethernet, HDR NIC slot, SSD/SATA. Rudra-II server is designed with effective thermal design to support up to 350W TDP processor.

Indigenous HPC Network – Trinetra

C-DAC's Trinetra interconnect development encompasses complex chip design, Platform design, and Lightweight Protocol networking software design. Development effort is split into multiple phases, with an aim of technology mastering, creating real-world products, and leveraging on know-how, to plan for future Indigenous Exascale network design. An important design decision taken during the early stages of development was the adaptation of Mesh-based network topologies, allowing for scalability to hundreds of thousands of compute nodes without the need for dedicated switching hardware. Trinetra is a project, consisting of Trinetra-PoC (used for early experimentation), Trinetra-A (currently in production), and Trinetra-B (Under development).



Trinetra-A Network Interface Card (NIC)

Trinetra-B

Trinetra-A, a fourth-generation network is an interconnect of 600 Gbps (100Gbps*6) throughput and supporting 3D Torus network topology for HPC. Multiple hardware and software components realize high bandwidth, low latency, and scalable network fabric supporting industry-standard programming interfaces.

OFED compliant software stack supports Industry standard programming interfaces such as message passing layer (MPI) and legacy TCP/IP using emulation. IP was released after finalizing software packet size and mechanism of posting. C-DAC has assembled 12-node Trinetra test cluster and 3D-Torus based Trinetra-A interconnect. It was benchmarked for HPL and a range of scientific applications including OpenFOAM, NAMD etc. Along with Rudra-I server, Trinetra-A was featured at Digital India Week held during July 4-8, 2022 at Gandhinagar, Gujarat.

Trinetra-B platform was validated for (a) data transmission over 10 concurrent channels of 200Gbps each, i.e., net aggregate fabric data rate of 2 terabits/ sec, full duplex, and (b) PCI-e Gen3, 16x interface using bidirectional DMA, with ~ 80% of peak throughput achieved. Up to 2k pairs of queues can be added for data transfers. Primary deployment is planned in C-DAC's next generation PARAM systems.

Special Purpose Computer for Molecular Dynamics (SPC-MD) Simulation: Architecture Exploration

Implemented optimized 3D FFT on two Alveo U200 board (Xilinx development board) with FPGA-to-FPGA interconnect for communication between them. Multi-FPGA 3D-FFT IP design was verified on Alveo board and results were matching with FFTW software. The design of the prototype board with different functional blocks was finalized. MD code Genesis was ported on Bio-inferno System and completed the performance analysis of the same on 16 nodes.

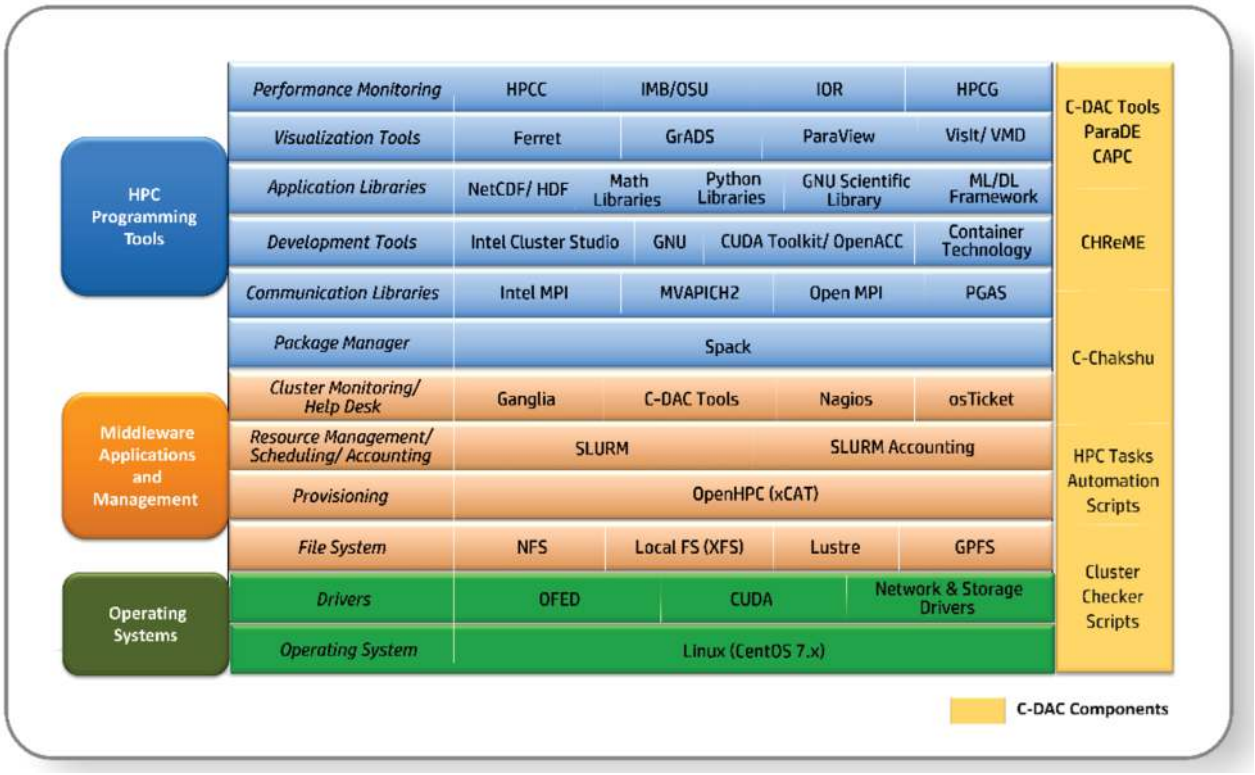
Design and Development of Direct Contact Liquid System (DCLC)

In order to cool HPC server using liquid cooling technology, a Coil-on-Chip Liquid Cooling System is designed in collaboration with IIT Bombay. It is optimized using CFD, and fabricated to extract heat load up to 330 W (165 W from each processor) to cool Rudra server board.

HPC System Software

C-DAC's HPC software Stack (CHCS)

C-DAC's HPC software Stack (CHCS) is based on a customized open-source software stack with value-added indigenous tools, technologies, and scripts. It automates the process of systematic build, deployment, and management of HPC and AI-based systems



Components of C-DAC's HPC Software Stack (CHCS)

All the supercomputing systems established under NSM are deployed with C-DAC's HPC Software Stack. This is proving helpful to get the data of user wise, institute wise, domain wise compute utilization of the systems.

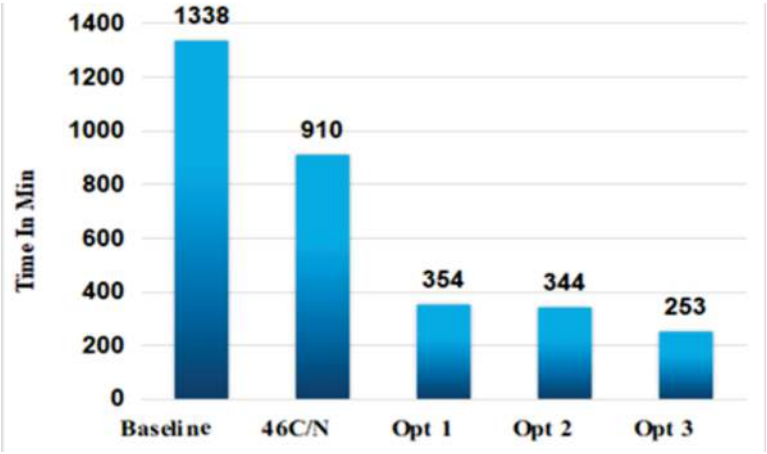
NSM Infra [www.nsmindia.in]

NSM India portal provides detailed information about NSM project and related ongoing activities, updates, training programs. It includes live chart of number of jobs submitted whose API is derived from C-Chakshu monitoring platform.

Application Porting, Optimization and Scaling services in HPC/DL under NSM

Using Spack, 300+ applications/ libraries/ tools in Molecular Dynamics, Computational Fluid Dynamics, Weather Prediction, Material Science, Computational Chemistry, Bioinformatics, Physics, ML, DL, and other domains were deployed on NSM sites. System acceptance tests were completed for NSM Systems at IISc Bangalore, C-DAC, IIT Gandhinagar, IIT Roorkee, IIT Hyderabad, NABI Mohali, IIT Mandi, NIT Trichy and IIT Guwahati.

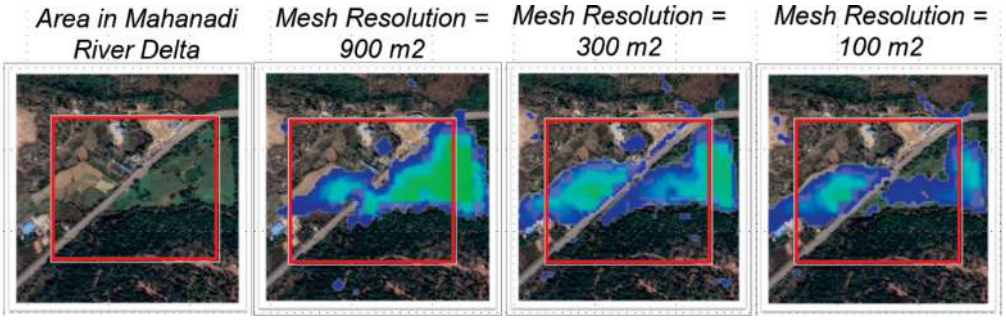
ANUGA hydrodynamic model for flood prediction, was optimized on Intel Cascade Lake cluster to produce timely flood forecasts in the Mahanadi delta. The simulated output was verified using ground observations and microwave Sentinel satellite data. Optimizations were carried out for Mahanadi delta with mesh resolution of 900 square meters and 300 square meters. A performance gain of 5X+ by tuning the domain algorithmic parameters and utilization of optimum number of cores per node was achieved for mesh resolution of 900 square meters.



MAH = Minimum Allowed Height
MAS = Minimum Allowed Speed
Baseline : 48C/N (MAH=1 mm, MAS= 0.0, CFL=1)
46C/N : Node to Core Ratio
Opt 1 : MAH =5 mm , MAS= 0.0, CFL=1
Opt 2 : MAH =5 mm , MAS= 0.0, CFL=1 Source Code Changes
Opt 3 : MAH =5 mm , MAS= 0.1 , CFL=1.5

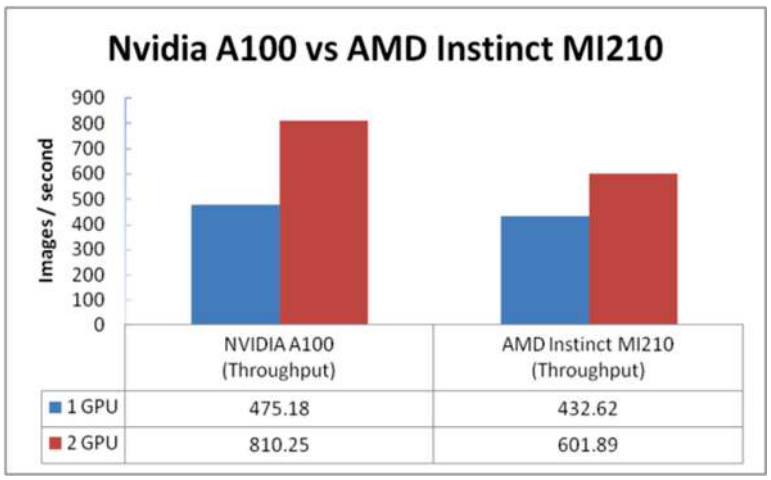
Mahanadi-Delta 11372 sq km; 900 sq m mesh resolution; 3.5 days' simulation (Using data set for Sep 15, 2021 – Heaviest rainfall)

Partitioning of 5.8 crore triangles with a mesh resolution of 300 square meters was achieved by upgrading the partitioning library. By optimizing domain algorithmic parameters, it was possible to complete simulation of delta regions on 64 nodes in 6 hours. Effort is ongoing to run simulation with a mesh resolution of 100 square meters for making early warnings with superior output within a realistic time.



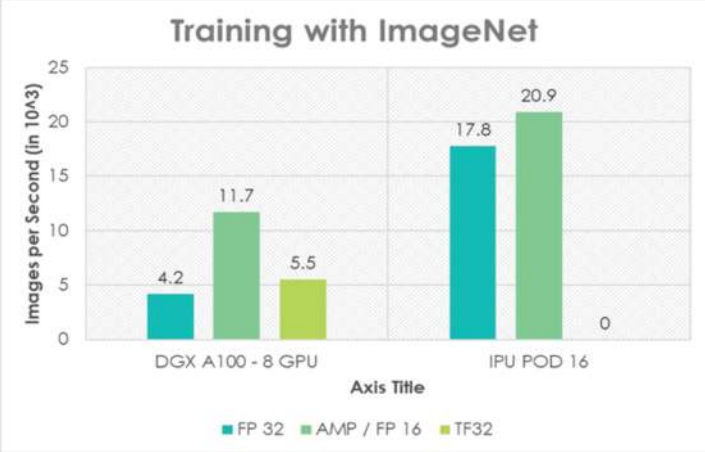
CUDA based SeisAcomod-2D was ported to Intel oneAPI DPC++ to make it runnable on Intel GPU. oneAPI is an open standard for a unified application programming interface intended to be used across different compute accelerator (coprocessor) architectures, including GPUs, AI accelerators and field-programmable gate arrays etc.

AMD Instinct MI200 Series accelerators were examined for HPC and DL workload to assess performance by AMD Instinct MI200 against NVIDIA A100. For DL workload TF-CNN Benchmarks were run with Resnet50 Model for a synthetic dataset.



Application	Resources	RUDRA NODE		NVIDIA vs AMD
	No of GPU Cards	NVIDIA A100 (Time - sec)	AMD Instinct MI210 (Time - sec)	Performance Comparison
TF-CNN	1	475.18 (img/sec)	432.62 (img/sec)	1.09x
	2	810.25 (img/sec)	601.89 (img/sec)	1.34x
SpeckFEM-3D	1	178.30	273.52	1.53x
	2	101.23	181.12	1.78x
NAMD	1	1052	955	0.90x
	2	609	567	0.93x
CP2K	1	120.29	120.18	0.99x
	2	60.46	60.23	0.99x

IPU system from Graphcore was explored to study and understand core compute model and its strength offered by architecture. Activities performed were: 1) POPLAR SDK for graph computation, developed computational graph for MLP; 2) IPU architecture and programming models; 3) Benchmarked IPU POD-16 system using ResNet-50 model with real and synthetic data by following different graph distribution strategies.



Resnet152 inference benchmark were explored on Rudra Server for cloud setup. Objective was to compare performance of RUDRA server cloud instances to AWS cloud instances. For OV-FP32 precision, Openstack on Rudra and AWS performed alike.

VM Description : OS – Ubuntu 18.04, Physical Core – 4, No of Threads – 2, Socket(s) – 1, RAM – 32 GB.

Output Metrics :

Latency : Time taken to process one unit of data (provided only one unit of data is processed at a single point of time). Lower is better.

Throughput : Frame per second. Higher is better.

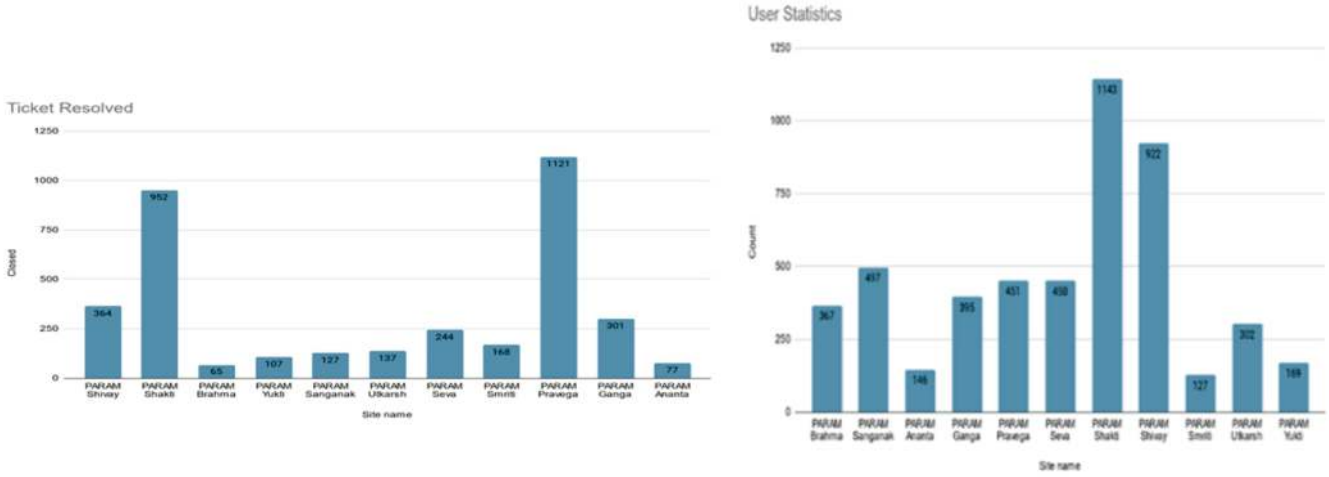
Workload	Precision	Sub Test	Rudra Openstack - Intel(R) Xeon(R) Gold 6240R CPU @2.40GHz, 8vCPUs				AWS – m5d.2xLarge – Intel(R) Xeon(R) Platinum 8259CL CPU @ 2.50GHz, 8vCPUs			
			1 Benchmark instance	2 Benchmark instance	4 Benchmark instance	8 Benchmark instance	1 Benchmark instance	2 Benchmark instance	4 Benchmark instance	8 Benchmark instance
Resnet 152	OV-FP32	Latency (ms)	50.48	95.57	185.22	359.75	51.82	94.75	185.42	369.62
		Throughput (FPS)	19.81	10.46	5.4	2.78	19.3	10.55	5.39	2.71
		CPU Util (%)	49.6	99.35	98.27	99.63	49.5	98.65	99.26	99.67
		Mem Util (GB)	0.71	1.21	2.22	4.46	2.25	3.88	7.11	13.53
		Accuracy	Top 1 : 77.6 & Top 2 : 93.5							
	OV-INT8*	Latency (ms)	14.54	28.03	51.9	100.46	29.86	48.94	123.43	240.95
		Throughput (FPS)	68.79	35.68	19.27	9.95	32.5	17.49	8.1	4.15
		CPU Util (%)	47.56	97.26	98.53	98.86	48.96	98.56	99.46	98.73
		Mem Util (GB)	0.47	0.64	1.08	1.96	1.17	1.37	2.77	4.93
		Accuracy	Top 1 : 77.3 & Top 2 : 93.5							

***avx512_vnni** flag is missing in **AWS,** hence the reason for less latency and throughput in **OV-INT8** precision on **AWS**

Resnet152 Inference Benchmark Result

User Behavior Analysis (UBA) searches for patterns of usage on HPC cluster that indicate unusual or anomalous behavior, regardless of whether the activities are coming from an anomalous user or actual user, or even malware or other processes. System logs were analyzed to get parameters like login time, IP address, user credentials, etc.

A robust Indian Number Plate Recognition Tool Through Modified and Tuned LPRNet was developed and deployed on Param Shavak. LPRNet model secures 95% accuracy on synthetic data by post-processing techniques.



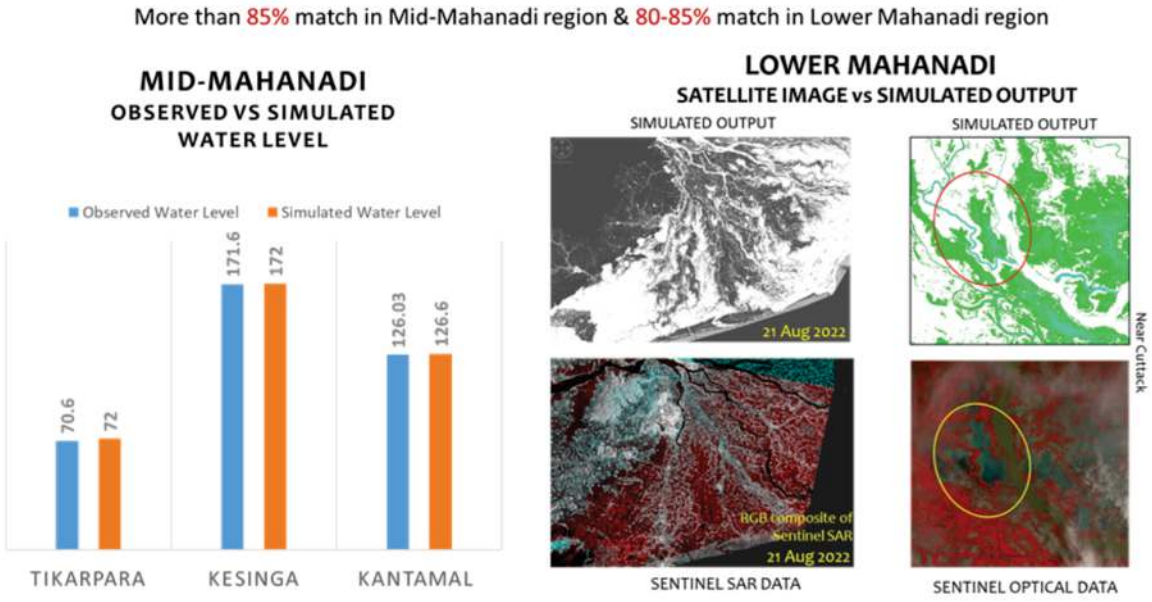
User support at NSM Infra

HPC Applications

Early Warning System for Flood Prediction in River Basins of India- SimInu

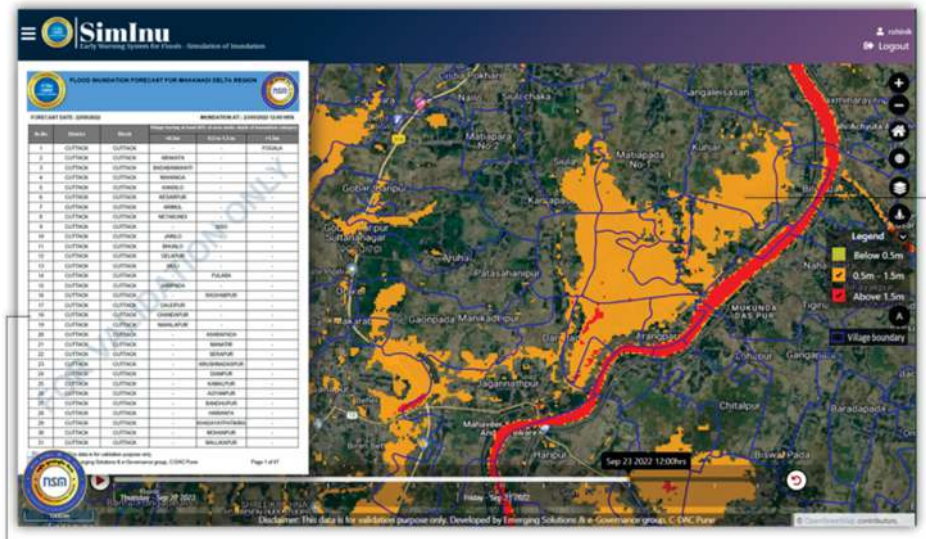
ANUGA Hydro 2D hydrodynamic model for flood prediction was run on Intel Cascade Lake cluster to produce timely flood forecasts in Mahanadi delta. Rainfall, river and dam discharges, surface roughness and tidal parameters have been used for Mahanadi River basin. Subsequently, evapotranspiration was also used to account for the loss of water from the domain. The runs were carried out with mesh resolution of 900 square meters and 300 square meters. Tapi river basin was also simulated for flood spread and depth estimation with mesh resolution of 900 square metres at the request of the user agency. The daily outputs include a 2-day flood forecast in the form of Village level percentage inundation maps and Water level information, which is shared with Central Water Commission, the user agency.

The simulated output was validated using ground observations and microwave Sentinel satellite data. The accuracy of the outputs varied to the tune of 80-85%, depending upon the changes in base topography.



Validation Exercises

An online geospatial portal has been developed viz., SimInu (short for Simulated Inundation) to provide information about flood-prone areas and their potential inundation risks. It serves as a comprehensive resource for individuals, communities, and authorities to assess and understand the extent and severity of flooding in specific regions. SimInu offers various features and functionalities, which include day-wise inundation progress, water level at every location hydro station monitoring, village level inundation reports, graphical and tabular data displays. Provisions to automate data processing and simulations have also been included in the portal.



SimInu-Online platform for flood information dissemination and analysis

Development of Multi-Sectorial Simulation Lab and Science Based Decision Support Framework to Address Urban Environment Issues

Integrated meteorology, air quality and hydrology system aim at coupled modeling with urban parameterization, urban canopy, UHI, boundary layer, data assimilation of atmospheric, chemical and morphology data with business as usual and what-if scenarios test bed and interoperable cross-sectorial data, metadata and query framework. It has a multi-scale, multi-disciplinary modeling ecosystem on NSM's HPC infrastructure.

A. Setup Weather Research and Forecasting (WRF) model for daily weather forecast and heavy rainfall events over Pune, Bhubaneswar, and Bengaluru:

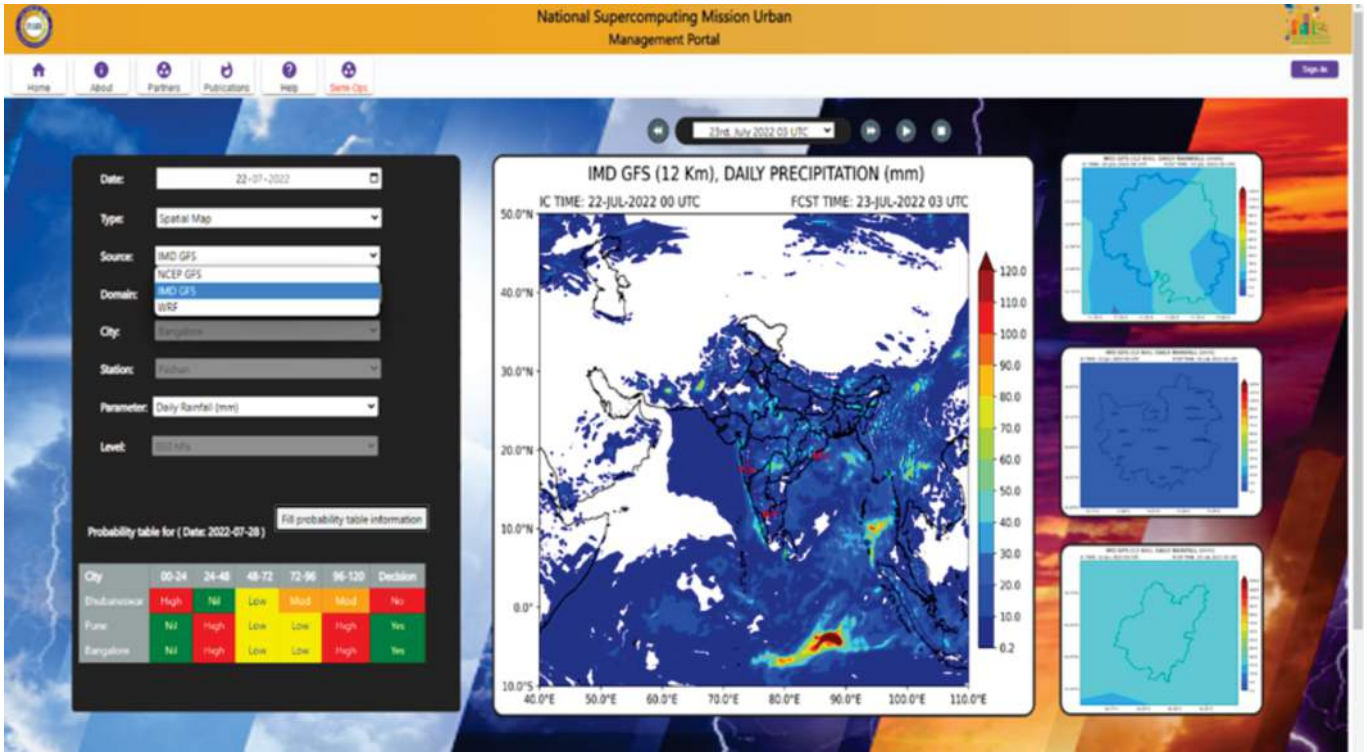
The work aimed to set up a 3-domain WRF model for daily weather forecasts and for predicting heavy rainfall events over three NSM cities, namely Pune, Bhubaneswar, and Bangalore through joint efforts with IIT Bhubaneswar and IISc Bangalore. The outermost domain covers southeast Asia with a spatial resolution of 4.5 km while the innermost domain covers city of interest with 0.5 km resolution after performing domain sensitivity analysis.

B. Sensitivity analysis and model setup for heat wave forecast over Pune, Bhubaneswar, and Bengaluru:

Prime objectives are to forecast heat wave events over urban cities. Domain and physics options were finalized which are currently being used for quasi-operational runs of heat wave forecast. Model is currently running with a single-layer urban canopy model which accounts for urban city structures into account.

C. Quasi-operational runs for heat wave forecast

A system is set-up to provide daily forecast of meteorological conditions and heat wave events. The entire process is automated. A high-resolution WRF model data is automatically extracted and converted into the required format. This is currently running for five NSM cities namely Ahmedabad, Bhubaneswar, Pune, Bangalore, and Delhi.



Screenshot of quasi-operational framework

D. WUDAPT LCZ maps into WRF model

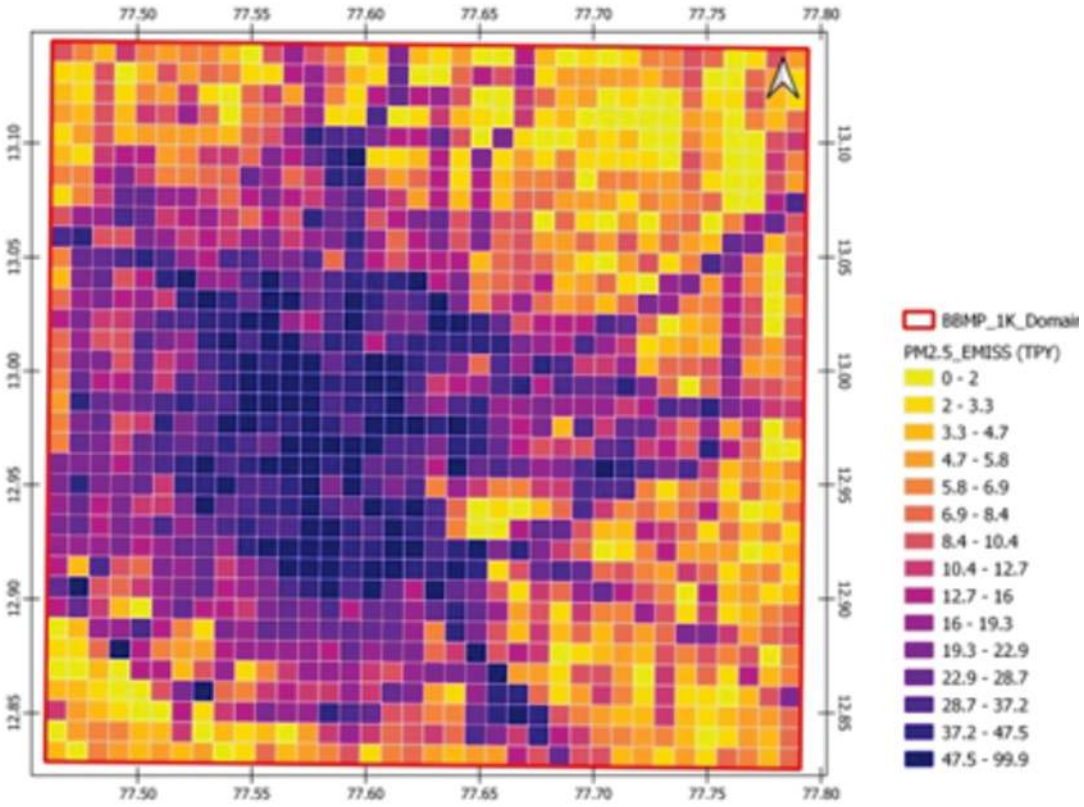
A detailed urban land use/ land cover map using Local Climate Zone (LCZ) classification system from World Urban Database and Access Portal Tools (WUDAPT) was implemented in WRF model to improve accuracy of forecasting system. WUDAPT LCZs represent specific land cover classes based on urban morphology characteristics along with Building Effect Parameterization (BEP) scheme. Experiments were performed using WUDAPT LCZ information and different urban canopy models available in WRF for heavy rainfall event simulation over Pune city.

E. Development of an automated model execution framework (Cyberinfrastructure)

An automated HPC based weather model execution framework provides raw / processed data for researchers, a decision support system (DSS) including what-if scenarios for policy makers, general weather forecasts, warnings for the common man, and a data analytics platform for various stakeholders.

F. Development and Set-up of air quality forecasting system over 5 cities and Air quality research

A semi-operational air quality forecasting system for Indian urban cities was set-up for Pune. This system was fine-tuned with ingestion of local emission inventory and data assimilation from various sources in collaboration with IITM. Local emission inventory for Pune is developed at a grid resolution of 1x1 km and for high population density area with finer resolution of 400 x 400 m. A WRF-Chem output-based DSS for Delhi is developed at IITM, Pune and being used by concerned authorities for policy making decisions. Local emission inventory for Bengaluru was developed at a grid resolution of 1x1 km and for high population density area with finer resolution of 400 x 400m.



Distribution of PM2.5 emissions for Bengaluru

G. Near-real time fire emission estimation and fire forecasting system for Delhi Air Quality

The research was targeted at impact analysis of fire emissions from North-West region of India over Delhi-NCR and its accurate quantification. An accurate temporal and spatial estimate of biomass burning emissions was developed to effectively implement control measures toward the reduction of biomass burning emissions.

CFD for pollution dispersion in a city/ region

A 3-D morphology data for Delhi city was generated from AW3D ALOS 30m DEM & OSM building shape file. OpenFOAM was used to conduct micro-scale simulation studies of wind and dispersion of pollutants. Steady-state pollutant dispersion simulations over a one square km building area of Lodhi road, New Delhi was carried out for a heavy pollution episode during the Diwali festival of year 2022. Important firecracker emissions of SO2 were analyzed over 4 days for dispersion and concentrations.

A HPC software suite for seismic imaging to aid oil and gas exploration

SeisRTM is the Reverse Time Migration (RTM) software for seismic imaging of complex structures under the earth. It is developed to perform RTM using Conventional Wavefield Saving and Boundary Wavefield Saving techniques. It includes enhanced utilities such as creating 2D geometry, 2D interpolation, conversion of the binary model file to SEG-Y format, smoothing, padding, muting, stacking, frequency analysis, wavelet generation etc.

Drug Information Authoring Tool (DIAT)

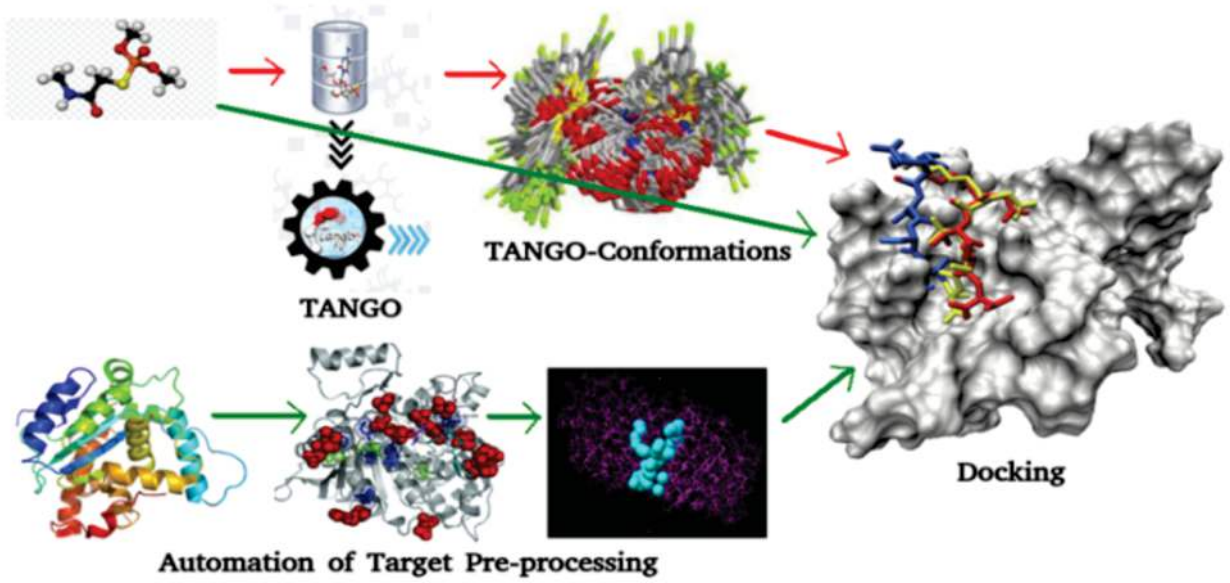
DIAT is a web-based application to help in the creation and curation of drug information and build corpus for the development of Common Drug Codes for India (CDCI) for use across healthcare records, supply, and pharmacy systems. This has been integrated with the drug registry building block of Ayushman Bharat Digital Mission (ABDM) for drug manufacturers to add drug information for standardization. DIAT instance was hosted on NHA's staging server in December 2022.

Bio-ICE
Bio-ICE is a cloud-based Integrated Computing Environment (ICE) to cater needs of computational biologists. It is equipped with in-house developed Big Data analytics tools for both genomics and molecular modeling data. It provides services in the area of genome analytics including NGS, and molecular dynamics simulations.

AnvayaNGS
It is an interface to Bioinformatics tools and databases that are loosely coupled together in a coordinated system to execute a set of analyses tools in series or in parallel. During the period, work on following pipelines was completed: RnaSeq Analysis, de-novo transcript assembly, de-novo genome assembly, and Transposon sequence data analysis.

BioAviator
Bioaviator offers a private cloud-based genomics environment by providing Next-generation sequencing (NGS) tools as a service model. NGS produces a large volume of sequence data at a rapid pace, and researchers often use it to analyze whole genomes, exomes, and transcriptomes, as well as other specialized techniques. Bioaviator tool is a scalable and efficient solution for analyzing large biological data sets. It uses a distributed processing model to provide rapid and accurate analysis of NGS data.

Tango-Dock
A TANGO based automatic docking pipeline - TANGO-DOCK - performs docking of multiple ligands against multiple proteins with a single command or single click as a web portal. It generates consensus table of grid scores and the complex structure with the best-bounded ligand. It is currently available as a command line utility and as a web portal where users can just submit the job and later get the output mailed as a hyperlink to their email accounts.



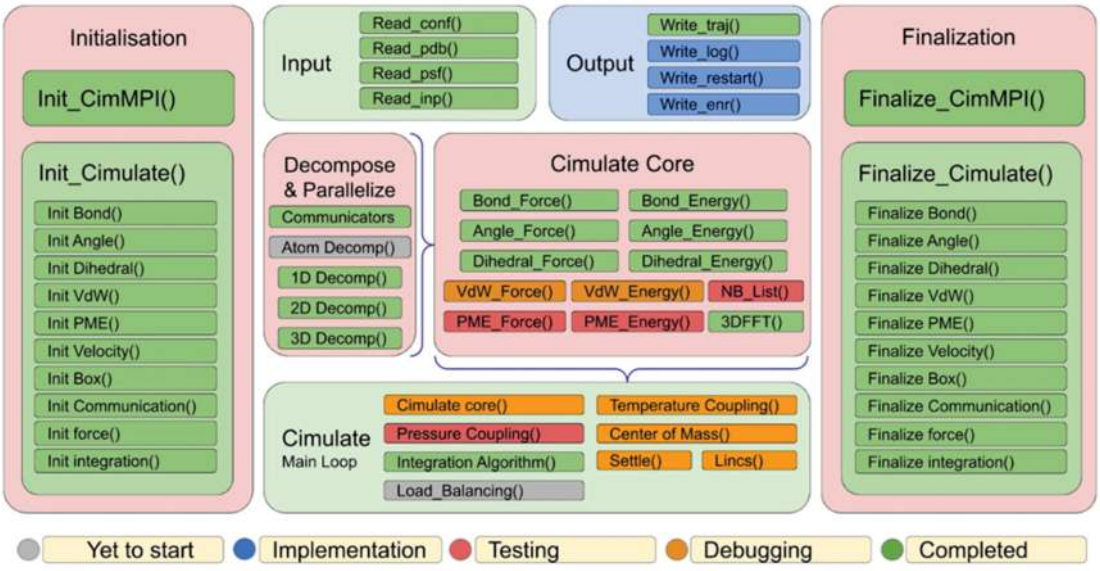
Tango-Dock

CIMULATE
Molecular dynamics simulation is a computer simulation of motion of atoms in a system. It is based on application of Newtonian dynamics to study time evolution of atoms and molecules to defined thermodynamic environment. CIMULATE is a MPI based parallel application for the simulation of bio-molecules. It is in house developed Molecular Dynamics simulation software written in C and attempt has been made to make it light weight molecular dynamics code for NSM cluster.

Debugging of the code for parallelization issues has been done for various sub algorithms and methods like PME, verlet algorithm, leapfrog algorithm, pressure and temperature coupling etc. New approach of decomposition was

implemented for consistency results on varying numbers of processes. Code is also being tested and debugged for various other issues such as accuracy, segmentation faults after very long runs, Cell list implementation for large system sizes. PME code was rewritten to optimize the number of grid points. Bond stretching issue was resolved.

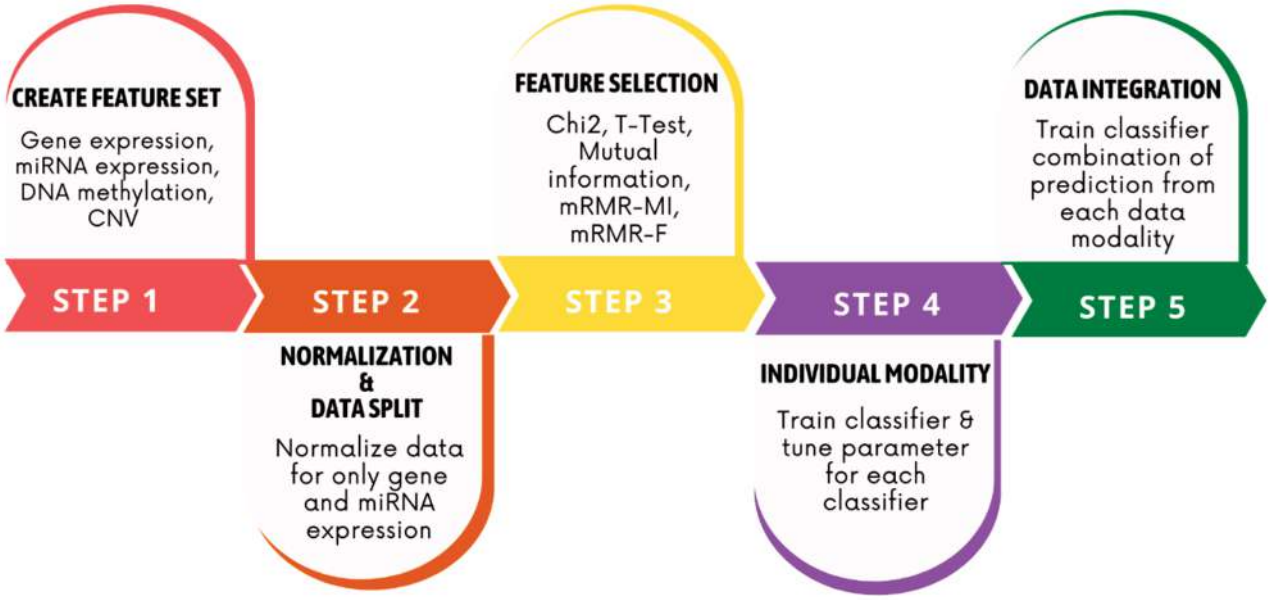
The code can be used later for studying various biological events which involves study of motion of bio molecules such as protein folding/misfolding.



CIMULATE

Petascale Genomics studies in Breast Cancer

In this study, survival prediction of breast cancer patients was undertaken using multi-omics data from 302 female patients available in Cancer Genome Atlas (TCGA). Data included gene expression, miRNA expression, DNA methylation, and copy number variation. A computational ML pipeline was developed using Support Vector Machine and Partial Least Squares algorithms. Study demonstrates effective use of a multi-ensemble ML model with efficient feature selection methods as a robust protocol for cancer genotype to phenotype correlation.



Steps in model development for supervised breast cancer survival prediction

Petascale Genomics studies in 1000 Genome Data

In this study, genomic variation using allele frequency differences of vitiligo genes across 26 ethnic populations from 1000 Genomes Project is studied. Significant allele frequency variations (minor allele frequency ≥ 0.05) of SNPs, pertaining to genes involved in vitiligo disease from 26 ethnic populations from 1000 Genomes Project based on Chi-square distribution with p-value of ≤ 0.05 and Bonferroni's multiple adjustment tests, were identified. Population stratification and fixation index analysis was carried out to understand genetic differentiation. Functional annotation of variants was carried out using dbSNP, SnpEff, and CADD score.

Petascale Genomics studies in Mycobacterium africanum

Mycobacterium var. africanum (Maf) is responsible for causing tuberculosis in West Africa. It consists of two lineages, viz., L5 and L6, which cause tuberculosis in Eastern and Western regions of West Africa respectively. To understand genetic diversity of Maf, population genomics and phylogeny approaches were used. Cluster-specific missense variants obtained in this study mapped to existing growth attenuation studies further explaining their impaired fitness and specific adaptation to their defined ecological niches.

Petascale Genomics studies in Mycobacterium bovis

Despite implementation of several control programs through testing and culling, occurrences of Bovine Tuberculosis (bTB) have been on the rise. This is explained through existence of a number of wildlife species which act as reservoir hosts and are responsible for transmitting bTB to cattle. Hence, this study aims to understand genetic diversity of Mycobacterium bovis using population genomics and phylogeny approaches.

Meta-analysis of the lung microbiomes in Pulmonary Tuberculosis

Previous studies on TB microbiomes (Hong et al., 2020, Du et al., 2022) have a lot of discrepancy in their outcomes in terms of marker species associated with tuberculosis disease. In the present investigation, a meta-analysis of these previous studies is being carried out in order to determine the common signature species associated to TB across these demographically diverse studies.

DPICT Visualization and Analysis Tool for Molecular Simulation and Visualization

Objective of this activity is to build an Advanced Molecular Dynamics Visualization and Analysis Tool supporting simultaneous viewing of multiple trajectories. This tool is able to read various trajectory file formats like AMBER, GROMACS etc. and carry out various analyses on structural parameters, in a parallel manner.

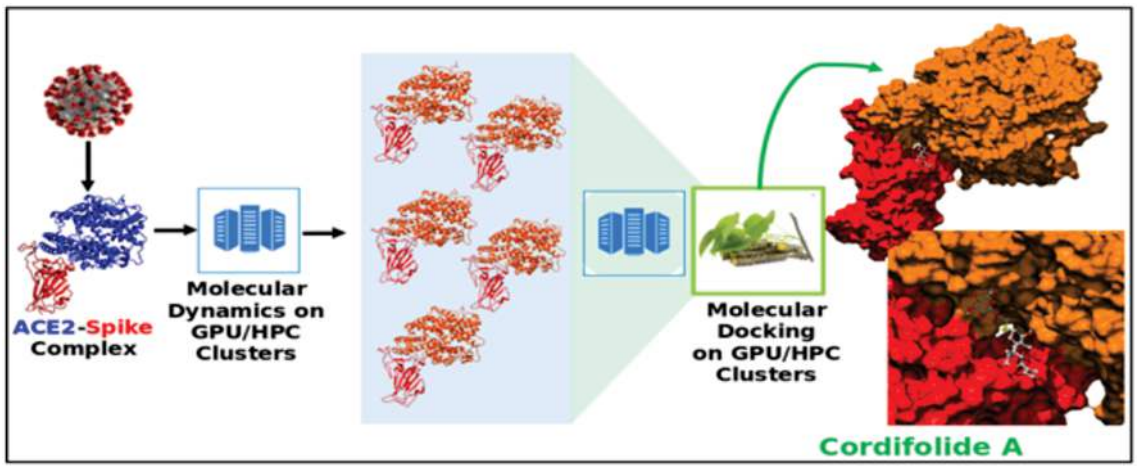
MolToxPred

MolToxPred is a Python-based command line tool for the prediction of toxicity of small molecules.

Petascale Research in Molecular Modelling

a) **Phytochemicals and FDA-approved drugs targeted against the ACE2–Spike complex of SARS-CoV-2 using computational methods.**

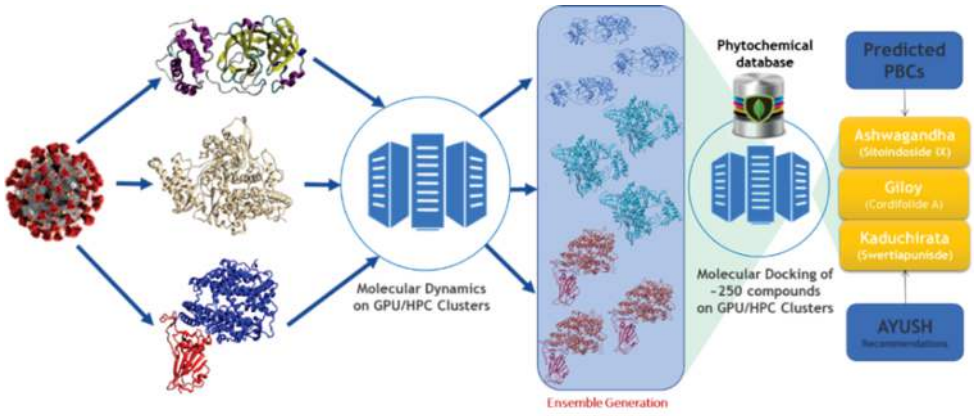
FDA-approved drugs and phytochemicals from Indian medicinal plants were explored. Molecular docking and simulations of these molecules targeting the ACE2–Spike complex were performed. MD simulations of ligand-free, Rutin DAB10-bound, and Swertiapuniside-bound ACE2–Spike complex revealed abrogation of hydrogen bonding network between two proteins. Few novel interactions specific to Rutin-DAB10 and Swertiapuniside were identified. Conformational flexibility of drug-binding pocket was captured using RMSD-based clustering of ligand-free simulations. Phytochemicals identified belonged to Withania somnifera, Swertia chirayita, Tinospora cordifolia and Rutin DAB10, fulvestrant, elbasvir from FDA.



Phytochemicals and FDA-approved drugs targeted against ACE2–Spike complex

b) Natural plant products as potential inhibitors of RNA dependent RNA polymerase of SARS-CoV2

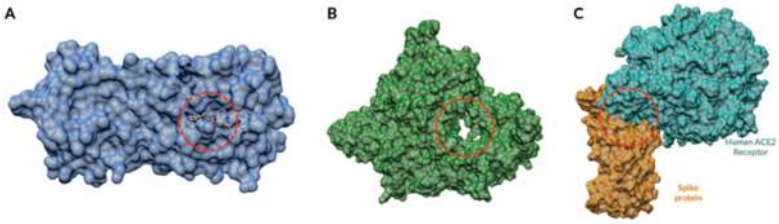
A detailed interaction study between phytochemicals from Indian medicinal plants and RdRP of SARS-CoV-2 was performed. Top four phytochemicals obtained through molecular docking were, swertiapuniside, cordifolide A, sitoindoside IX, and amarogentin belonging to Swertia chirayita, Tinospora cordifolia and Withania somnifera. Ligand-interacting residues belonged to either of seven conserved motifs of RdRP. These residues were polar and charged amino acids, namely, ARG 553, ARG 555, ASP 618, ASP 760, ASP 761, GLU 811, and SER 814. The glycosidic moieties of the phytochemicals were observed to form favorable interactions with these residues.



HPC driven Drug discovery study on SARS-CoV-2 using Ayurvedic phytochemicals

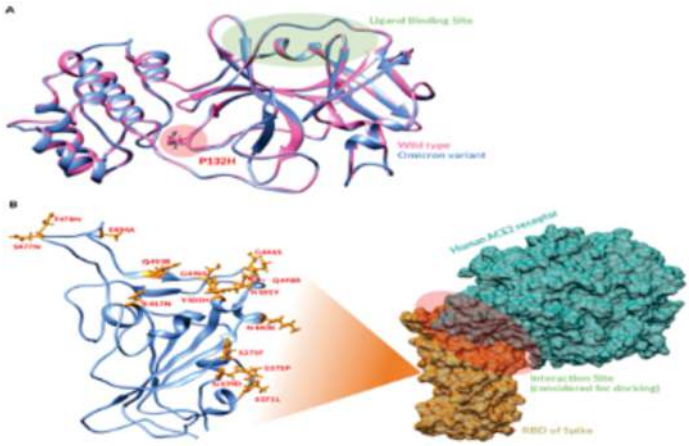
c) Computational Drug Repurposing Studies on SARS-CoV-2 Proteins using High-performance computing in collaboration with CCRAS Ayush.

Phytochemicals of Balchaturbhadrachurn: Three SARS-CoV-2 drug targets, namely, main protease, RNA dependent RNA polymerase and spike-ACE2 complex were docked using a set of 32 phytochemicals that belonged to the formulation of Balchaturbhadrachurn. An enhanced docking methodology has been implemented to perform molecular docking of these phytochemicals against the above-mentioned drug targets of SARS-CoV-2.



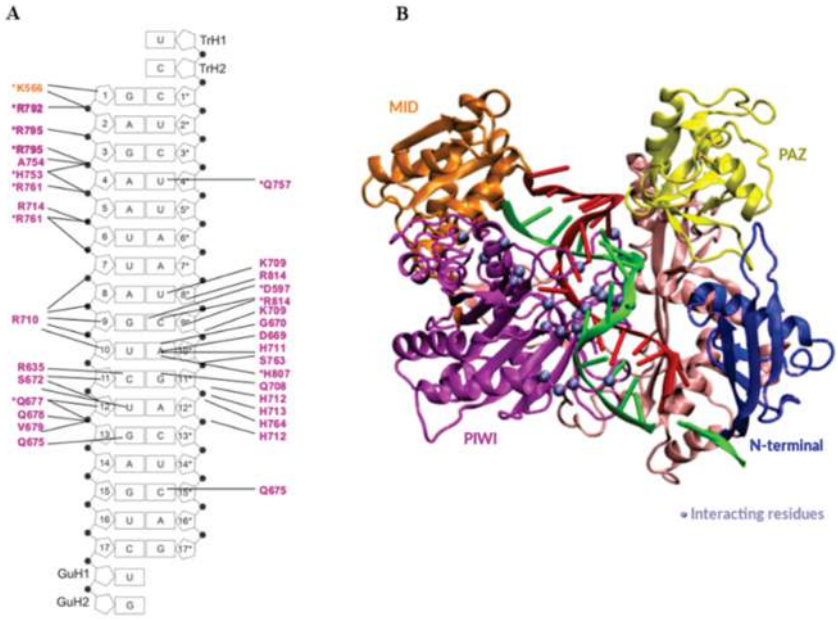
(A) MPro bound to N3 as in 6LU7, (B) RdRP with RNA primer binding region circled in red and (C) SA complex from 6LZG with the interaction site circled in red

Phytochemicals of AYUSH64: OMICRON variant of two SARS-CoV-2 drug targets, main protease and spike-ACE2 complex were docked using phytochemicals of AYUSH-64. Docking individual conformations with akummicine-N-oxide, akummiginone, echitamidine-n-oxide, and echitaminic acid revealed that binding was better in mutant as compared to wild type. It was inferred that these phytochemicals from AYUSH-64 formulation may have potential to act against Omicron variant of SARS-CoV-2.



Mapping of mutations on proteins of SARS-CoV2 (A) Main protease (B) Spike-ACE2 complex

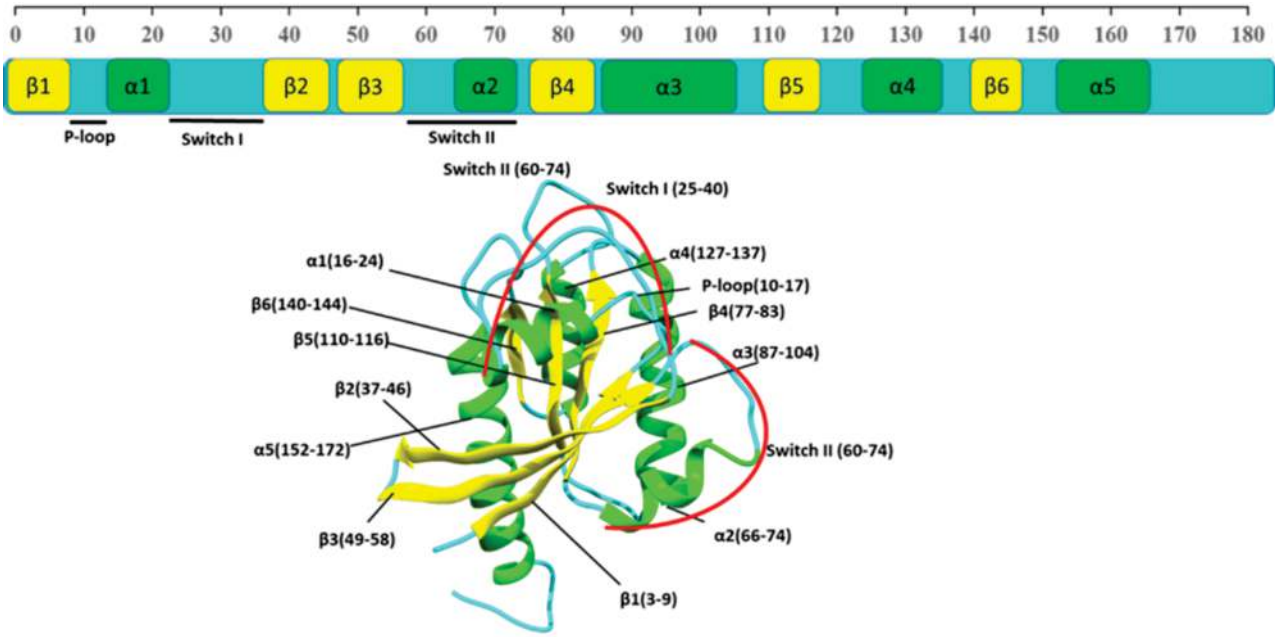
d) **Targeting COVID19 with RNA based siRNA strategy: A molecular dynamics study:**
siRNAs were designed against targets from a highly conserved region of Spike gene of SARS-CoV-2 which does not have any significant matches within whole human genome. In order to understand RISC mechanism of SARS-CoV-2 siRNA targets, human argonaute (Ago2) protein in complex with siRNA-vRNA duplexes were built. siRNA-vRNA3 duplex showed seed region base pairing, stable interactions and binding with Ago2 protein.



(A) Ago2 protein residues interacting with siRNA-vRNA3 duplex
(B) Location of the residues in the Ago2 protein

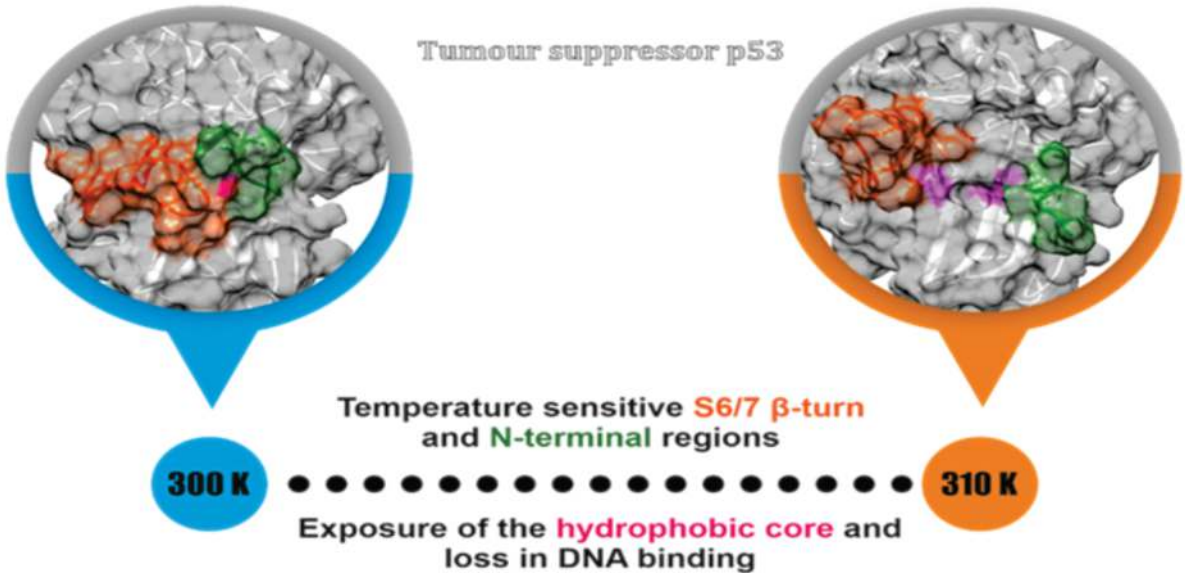
e) **Cancer protein molecular modeling studies**
RAS Oncogene: KRAS protein is known to be frequently mutated in various cancers. Understanding structural changes owing to mutations in GDP-bound (inactive state) and GTP-bound (active state) may help in design of better therapeutics. To understand structural flexibility due to mutations specifically located at P-loop regions

(G12D, G12V and G13D), extensive molecular dynamics simulations (24 μs) was carried for both inactive (GDP-bound) and active (GTP-bound) structures for the wild type and these mutants.



Structure of wild-type (WT) KRAS depicting different secondary structure elements and their sequence

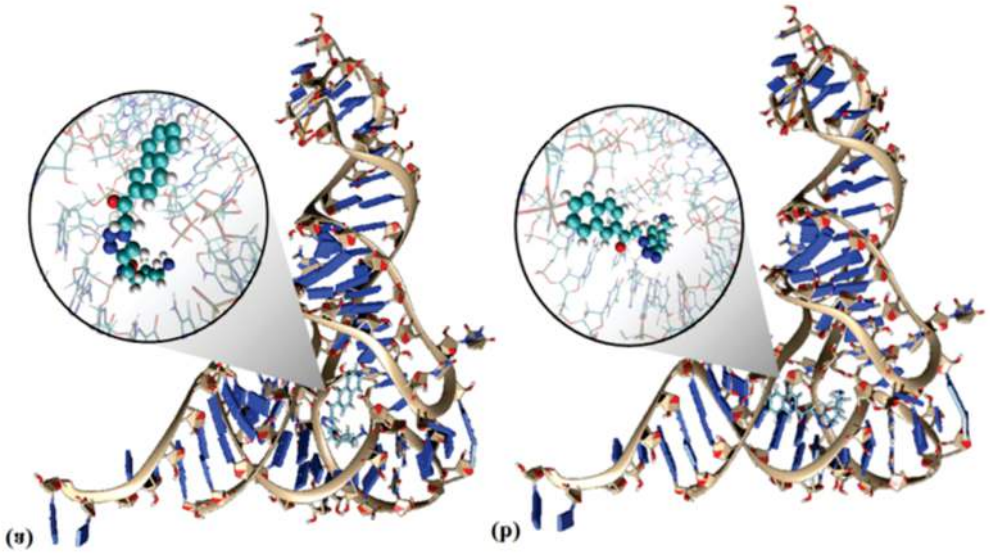
p53 tumour suppressor: A cumulative of 20 μs simulation was performed for DNA-free and DNA-bound form of p53 at 300 K and 310 K. Conformational signatures captured were validated through available experimental information.



Temperature sensitive nature regions of p53 that can be used for designing therapeutics

f) Antisense technology: Next-Generation drug discovery strategy

The tRNA3Lys Docking and Simulations: Docking of ligands on to tRNA3Lys was carried out followed by classical molecular dynamics simulations for 900 ns. Study shows that 1,4T ligand binds strongly to tRNA, whereas 1,5T ligand binds specifically to TC loop of tRNA. 1,5T ligand effectively influences opening of tRNA which can inhibit HIV-1 RT priming.



Different poses of ligand bound to tRNA3Lys

NSM Human Resources

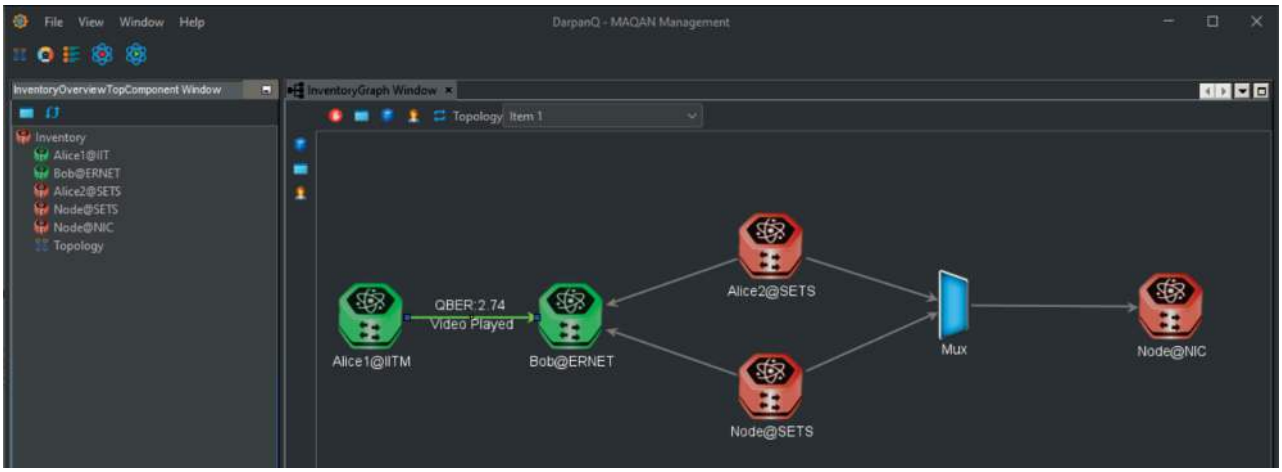
C-DAC conducted PG diploma in HPC System Administration under NSM during March 2022 – August 2022 and September 2022 – February 2023. As part of the NSM initiative, over 18,500 individuals, including students, researchers, and faculty members, have received training in the next generation of HPC-aware skills. This training has been conducted through various programs such as Faculty Development Programs, Workshops, Bootcamps, and Hackathons. C-DAC installed a PARAM Vidya system to impart training in HPC at respective NSM Nodal Centers. The following activities were carried out during 2022-23 in association with NSM Nodal Centers located at IIT Kharagpur, IIT Madras, IIT Goa and IIT Palakkad.

- NSM CFD workshop in hybrid mode at IIT Mumbai during May 2022
- HPC Domain Specific Workshop during June 09, 2022 - July 15, 2022. Number of participants: 1008
- Online OpenACC domain specific Bootcamps in Astrophysics, Molecular Dynamics & Quantum Chemistry and Climate & Weather modelling
- Two-day workshop at Manipur University during July 2022
- Faculty Development Workshop at IIT Goa in HPC for the faculties from colleges in Goa
- Intel OneAPI Awareness Workshop during July 14, 2022 - July 28, 2022. Number of participants: 168
- 5-day HPC workshop at NIT Mizoram during July 2022
- Course on Accelerated Applied Artificial Intelligence for 3 months on NPTEL platforms
- OpenACC Hackathon during September 12, 2022 – September 14, 2022. Number of participants: 60
- Workshop on HPC and its Multidisciplinary Applications at NIT Meghalaya
- HPC Workshop at GUJCOST during September 2022
- One-day workshop at NIT, Surat on September 20, 2022. Number of participants: 100
- Workshop on HPC & its usage in different domains at IGNTU on October 11, 2022. Number of participants: 40
- Introduction to Intel Profiling Tools on October 15, 2022. Number of participants: 55
- IUAC Workshop during October 30, 2022 – November 03, 2022. Number of participants: 35
- Workshop for MSME on HPC (NIMSME) on November 01, 2022. Number of participants: 54
- PG Diploma course in HPC System Administration and HPC Application programming for SC/ST candidates during October 2022 – March 2023
- Intel SYCL to NSM users from February 28, 2023 to end of March. Number of participants: 40

Quantum Computing and Communications

Quantum Key Distribution (QKD) Network Management and Orchestration for Metro Area Quantum Access Network (MAQAN)

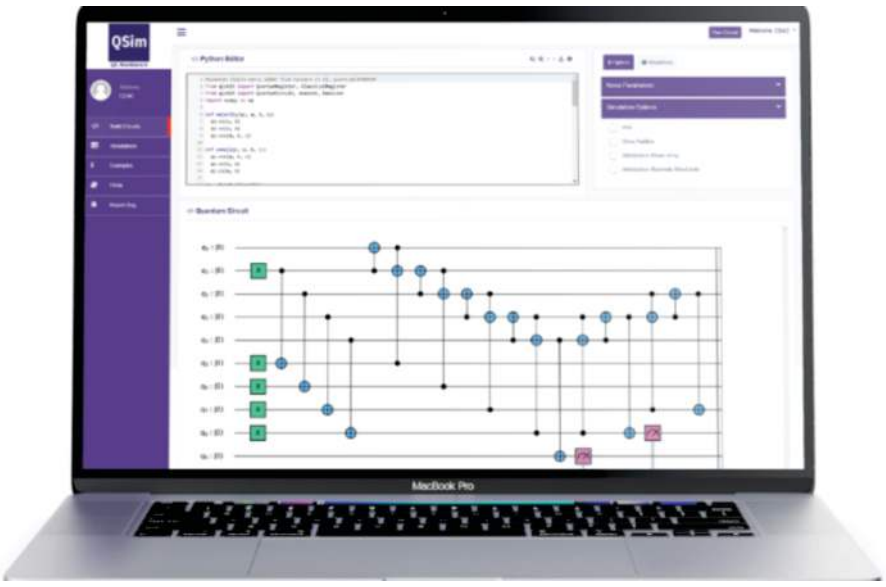
The major objective of the initiative is to develop Software Defined Networking based QKD Network Stack. The stack shall support the real time performance management of QKD Nodes and configuration of protocols for key generation including error estimation, error correction and privacy amplification. The management and orchestration of the QKD network feature shall allow the near real-time management of QKD networks including link provisioning and verification. The developed solution is deployed in the Metro Area Quantum Access Network (MAQAN), the first Software Defined QKD Network in India connecting four locations in Chennai.



Inventory Overview: DarpanQ – MAQAN Management

Design and Development of Quantum Computing Toolkit (simulator, workbench) and capacity building

In association with IISc Bengaluru and IIT Roorkee, C-DAC has developed QSim- a quantum computing toolkit to build the capability/capacity in QC research in the nation. It provides researchers and students with a platform to write, debug, and develop quantum algorithms in a controlled and simulated quantum computing environment. Presently, QSim is integrated with two high-performance computing facilities: PARAM Utkarsh and PARAM Shakti. ePramaan users can access QSim using their credentials. A plugin has been crafted to function as an identity layer over Open ID Connect (OIDC), facilitating seamless single sign-on (SSO) integration with ePramaan.



QC Workbench Interface

Quantum Sensing

C-DAC in collaboration with Tejpur University, Assam is developing a Quantum Optical Sensor to measure the low-level concentration of Arsenic and Lead in drinking water. Detection of solvent present in a solution with very low concentration (ppm) has a limit for classical methods like chromatography, spectroscopy or even the most sensitive method of classical interferometric techniques. During the year, water samples with different known ultra fine concentration of Arsenic have been prepared and their refractive index is obtained using Abbe Refractometer. A number of algorithms have been developed for the complete simulation of the Hong–Ou–Mandel dip experiment.

Centre of Excellence in Quantum Technology

C-DAC in collaboration with Raman Research Institute (RRI), Bangalore and IISc Bangalore is working on the initiatives associated with Centre of Excellence in Quantum Technology. The main objective of this initiative is to build an expertise to perform research and development in the field of Quantum Technology in India. C-DAC aims to focus on the development of a scalable FPGA based quantum control & measurement hardware and complete software for superconducting qubit-based quantum processor. During the year, C-DAC has tested an arbitrary waveform generator in both the microwave and baseband regime. A Radio Frequency (RF) data acquisition system has also been designed with a well-defined Python interface. The designs are scalable for multi-qubit operations.

Digital India RISC-V (DIR-V) and Strategic Electronics

C-DAC possesses extensive expertise in the field of VLSI Systems design, ASIC IP development, microprocessor, microcontroller, and DSP hardware & software technologies. These areas serve as crucial foundational elements in various industrial and strategic technology domains. C-DAC has undertaken the design, deployment, and technology transfer of manufacturing processes for numerous large-scale electronics systems, as well as compact VLSI and Embedded System Products. These products find applications in diverse sectors, including Supercomputing, Energy Measurement, Personal Computing, Medical appliances, Power Sector, Process control, Communication, Transportation, Agriculture, Defense and more. The consistent success of technology transfers for large-scale manufacturing has reaffirmed the commercial viability of these products on multiple occasions. Details of activities carried out by C-DAC during the year in this thematic area are mentioned below.

National Level Initiatives

Digital India RISC-V (DIR-V) Initiative

DIR-V, a national initiative funded by the Ministry of Electronics & Information Technology (MeitY), Government of India aims to achieve self-reliance in Microprocessor Technology. A two-phased execution strategy formulated under this programme targets the design of an indigenous 64-bit Quad-core Microprocessor and implementation on an FPGA platform in the first phase and a 64-bit Quad-core Microprocessor-based SoC ASIC for Embedded Application in the second phase. The first phase concluded with the development of Linux Bootable VEGA Processor Series (IP cores) comprising five processors spanning from VEGA ET1031, a 32-bit processor to VEGA AS4161, a 64-bit quad-core processor.

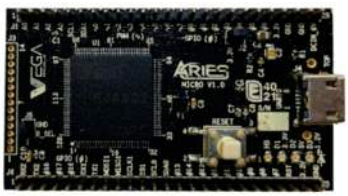
THEJAS32 SoC ASIC & ARIES Development Boards

THEJAS32 SoC is built around VEGA ET1031, a 32-bit high-performance microcontroller class processor. THEAJS32 operates at a frequency of 100MHz, including 256KB internal SRAM, three UARTs, four SPIs, three TIMERs, eight PWMs, three I2C interface, 32 GPIOs etc. The development board is targeted for low-powered embedded applications like sensor fusion, smart meters, small IoT devices, wearable devices, electronic toys, etc.

THEJAS32 SoC

ARIES

ARIES Micro



ARIES IoT

The first fully indigenous VEGA microprocessor-based SoC chip 'THEJAS32' was fabricated and assembled on the indigenously designed "Made in India" development boards, namely "ARIES"," ARIES Micro" and "ARIES IoT". These boards offer easy-to-use hardware and software, enabling the development of embedded systems for various applications, such as sensor fusion, system supervisors, remote sensors, small IoT devices, toy and electronic education equipment, and more. The VEGA SDK complements these boards by providing a comprehensive ecosystem with numerous examples and support documentation. Additionally, these boards are equipped with 2MB Boot Flash and a four-channel ADC onboard.

In addition to the above, C-DAC has developed IEEE 754 compliant Floating-Point Unit (FPU) IP cores and Parameterized Posit Arithmetic IP core compatible with RISC-V ISA.

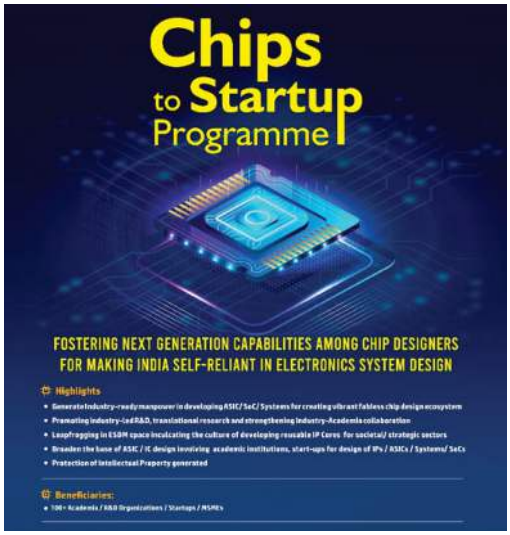
Reconfigurable DataFlow and Scalable Deep Learning Accelerator (RDFS_DLA) IP & Chip

Artificial Intelligence is driving the transformation of human-machine interactions. AI's application is spreading across various industries and domains, leading to a surge in demand in the market. However, this increased demand has also resulted in AI algorithms becoming computationally intensive and memory-intensive, posing challenges for developers who want to deploy these models on traditional hardware environments. To overcome these challenges, C-DAC has developed Reconfigurable DataFlow and Scalable Deep Learning Accelerator (RDFS_DLA) in collaboration with M/s. Sand Logic Technologies Pvt. Ltd., Bangalore & M/s. Inevitable Electronics Private Limited, Bangalore. This initiative aims to elevate India to the forefront of semiconductor and IP design creators in cutting-edge technologies like AI and Computer Vision. The Reconfigurable DataFlow and Scalable Deep Learning Accelerator (RDFS_DLA) is specifically designed for inference operations in Deep Learning applications.

Portal for submission and evaluation of applications received for DLI Scheme

Chips-to-Start-up (C2S) Programme

The C2S programme aims to address various aspects of Electronics value chain, including specialised manpower training, creating a repository for reusable IPs, and designing application-oriented Systems/ASICs/FPGAs. C-DAC has taken the initiative to implement the C2S Programme over 100 academic institutions and R&D organisations across India. Start-ups and MSMEs can participate through Academia-Industry Collaborative Projects. The deployment of these projects will be facilitated by leveraging the expertise available at Start-ups and MSMEs, fostering collaboration between academia and industry for mutual benefits.



Chips-to-Start-up (C2S) Program Highlight

Design Linked Incentive (DLI)

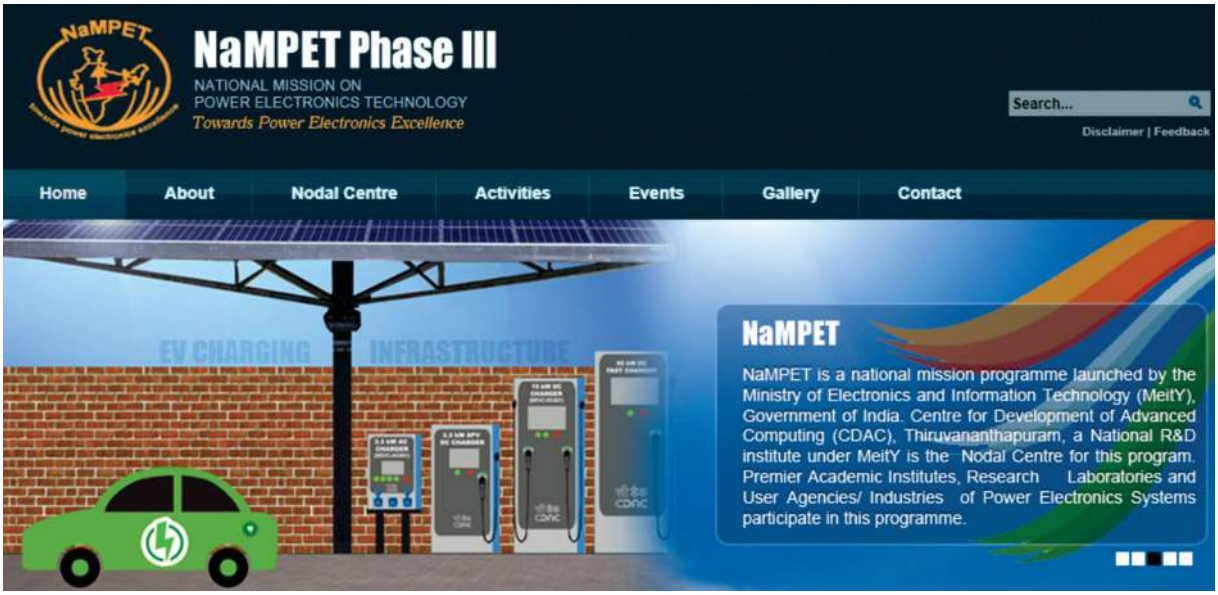
The Ministry of Electronics & Information Technology has announced the Design Linked Incentive (DLI) Scheme to strengthen the semiconductor chip design ecosystem in the country. C-DAC has been entrusted with the responsibility of implementation of DLI Scheme as a Nodal Agency. The DLI Scheme aims to offer financial incentives as well as design infrastructure support across various stages of development and deployment of semiconductor design(s) for Integrated Circuits (ICs), Chipsets, System on Chips (SoCs), Systems & IP Cores and semiconductor linked design(s) over a period of 5 years.

As a part of "Semicon India Future Design", first Roadshow for DLI Scheme was organized at Karnavati University, Gandhinagar, Gujarat, on October 17, 2022. Second Design Linked Initiative (DLI) Roadshow on Semicon India Future Design to stimulate the next-gen Semiconductor Designers and promote the culture of Co-development and joint ownership of IPs with active industry participation was conducted at IISc Bangalore on February 24, 2023. Both the events were chaired by Shri Rajeev Chandrasekhar, Hon'ble Minister of State, MeitY, Government of India.

As part of the initiative, an online portal has been created for submission & evaluation of applications for DLI Scheme. This portal is designed with a workflow system, providing role-based access to users for technical and financial evaluations of the applications. The system also enables users to track the status of their requests through email notifications, respond to queries, and print approved certificates online. This platform significantly reduces the time required for firms to apply for and receive approvals, streamlines the process for multiple approval requests, and facilitates faster processing overall.

National Mission on Power Electronics Technology (NaMPET – III)

NaMPET is a national-level R&D programme, promoting research, development, deployment, and commercialisation of Power Electronics Technology in India. The program seeks to strengthen the country's indigenous R&D expertise and infrastructure by fostering active collaboration among R&D institutions, academic institutions, and industries. C-DAC, the Nodal Centre for coordinating the activities of NaMPET, is fully involved in Phase III activities, concurrently transferring technologies developed in NaMPET Phase I and NaMPET Phase II. More than 20 academic institutions and about 30 industries are actively involved in technology developments and manufacturing as part of NaMPET. Significant technology developments are underway, focusing on comprehensive Electric Vehicle (EV) charging solutions, a Power Quality centre for Smart grids, Planar magnetic design for high-frequency applications, and advancements in Wide Band Gap (WBG) device-based converters and sensor technologies. Technology awareness is disseminated through various platforms, including NaMPET, MeitY, and C-DAC websites, as well as the NaMPET YouTube channel.



NaMPET Phase III website

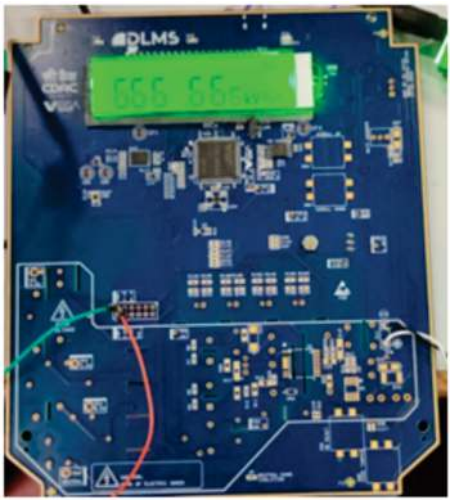
Vehicle Control Unit (VCU)

A vehicle Control Unit (VCU) is a supervisory controller and network manager in electric locomotives. C-DAC Vehicle Control Unit (VCU) technology has crossed Rs. 350 crore worth production for Indian Railways, establishing itself as one of the most reliable platforms in operation. The Railways plan to continue the long-term VCU handholding for 5 years. Technology extension has been initiated for DPWCS and full CAB redundancy in VCU. Additionally, C-DAC has initiated the development of an indigenous TCN MVB controller.

Vehicle Control Unit (VCU) for Indian Railways

Smart Energy Meter (SEM)

Smart Energy Meter (SEM) technology developed by C-DAC has been accepted by 9 Industries, and M/s GEPDEC, Noida, has cleared all relevant IS certifications and started pilot production. The first SEM platform with DIRV VEGA processor is developed and verified for functionality. Technology transfer function was conducted at MeitY during February 2023 for Smart Energy meter (M/s Pragati Electrocom, Gurgaon).



DIRV VEGA Smart Energy Meter SEM controller

Smart Energy Meter (SEM) ToT with M/s Pragati Electrocom

AC EV Charger

C-DAC has developed indigenous AC EV Charger technologies to meet the slow and fast charging needs of EVs. The chargers are customizable and are developed to meet the AIS-138 / IS-17017. Products developed include 3.3kW AC EV Charger: EVC-3P-3.3-1P, 7kW AC Fast Charger: EVC-1P-7-1P and 22kW AC Fast Charger: EVC-3P-22-3P. Technology transfer function was conducted at MeitY during February 2023 for AC charger (M/s Electronic Systems, Vadodara).

3.3kW AC EV Charger

7kW AC Fast Charger

22kW AC Fast Charger

AC Charger ToT with M/s Electronic Systems

Portable Refrigerator for Transportation of Vaccine

For effective vaccine transportation in remote locations, a portable refrigerator has been developed and is ready for technology transfer, with successful field verification in collaboration with Sree Chitarathirunal Institute of Medical Sciences. Furthermore, a battery-operated vaccine refrigerator specifically designed for remote locations is also under development.

Battery operated Vaccine refrigerator for Remote locations

The Agency for New and Renewable Energy Research and Technology (ANERT) & Kerala Development and Innovation Strategic Council (KDISC) are commercially deploying 1 Mega Watt Power Plant and a 48 Volt DC powering system for a 5-storied building using C-DAC technologies. Moreover, the first-of-its-kind indigenous Power system real-time simulator has been configured for IISC, Bengaluru. There are ongoing efforts to develop a power amplifier for Sonar applications for Naval Physical & Oceanographic Laboratory (NPOL), Kerala and Defense Research and Development Organisation (DRDO). Additionally, the development of a high-voltage (100kV) power supply for X-Ray has significant implications for the medical sector.

National Programme on Electronics and ICT Applications in Agriculture and Environment (AgriEnIcs)

The National Programme on Electronics and ICT applications in Agriculture and Environment (AgriEnIcs) is a multi-institutional initiative funded by MeitY, Government of India. The program seeks to advance research and development, foster innovation, and build a collaborative ecosystem between academia and industries/ startups to address challenges in agriculture and the environment while also focusing on international partnerships and capacity building. About 15 institutions - from academia, industry and government - are involved in this programme under five sub-activities which will cater to the nation to solve problems in Agriculture and Environment domain by introducing Electronics, Information and Communication Technologies. These encompass diverse technological solutions for monitoring cattle health and milk quality, assessing agricultural commodities, developing a robotic apple harvester, implementing smart practices in poultry farming, and indigenous solutions for real-time air quality monitoring & prediction. Each activity strives to leverage technology to improve efficiency and productivity in the respective domains.

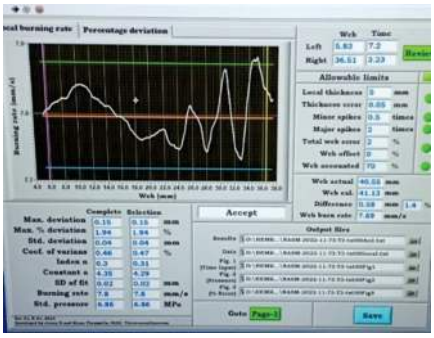
Solutions for Strategic Sectors

Ultrasonic Solid-Propellant Burn Rate Measurement System V2 (USBRMS V2)

The USBRMS system utilises ultrasound technology to measure the burning rate of solid propellants. This system comprises a high-pressure, high-temperature propellant burning test chamber and electronics for data acquisition, replay, and analysis. The principle of ultrasonic technique is employed, involving repeated measurements of the burning propellant specimen's thickness. In December 2022, the product was deployed at the High Energy Materials Research Laboratory (HEMRL), DRDO Pune. The system demonstrated an impressive accuracy level of over 99% in measuring the burn rate of propellants.

USBRMS Burning Chamber

USBRMS Electronics



USBRMS Screenshot

Thermal Conductivity Measurement System V1 (TCMS V1)

The Thermal Conductivity Measurement System (TCMS) is an advanced electronic system designed to measure the thermal conductivity of both solid and liquid specimens. The system uses the innovative 'Transient Hotwire' technology, where a copper or platinum wire acts as the primary sensor element for accurate thermal conductivity measurements. TCMS V1 collects nano-volt signals from the hotwire sensor element to determine thermal conductivity. The system also includes an excitation constant current source with micro-ampere level accuracy and stability, activating the hotwire sensor element during the measurement process. The primary application of TCMS V1 is for assessing the quality of various liquid propellants utilised in VSSC, ISRO. In rocket launching, the thermal conductivity of the liquid propellant plays a crucial role in determining its suitability as fuel for different stages of the launch. With precise measurements, TCMS V1 significantly evaluates the propellant's performance and overall fuel efficiency. The product has been deployed at VSSC, Thiruvananthapuram.

Thermal Conductivity Measurement System V1 (TCMS V1)

Indigenous Engine Controller (IEC)

The Indigenous Engine Controller (IEC) is designed for controlling the starting, shutdown and ventilation sequences of the Turbomeca Artouste III-B Helicopter Engine used in Cheetah and Chetak helicopters developed by Hindustan Aeronautics Limited (HAL), Bengaluru and being used by Indian Navy, Indian Airforce and Coastguard. It is certified by CEMILAC for MIL-STD 810F, MIL-STD 461F and MIL-STD 704D. C-DAC has signed an MoU with HAL to supply IEC units.

Indigenous Engine Controller (IEC)

Unmanned Ground Vehicles

Unmanned Ground Vehicles (UGVs) are robotic vehicles that operate without a human onboard and are designed for use in situations where human presence might be inconvenient, dangerous, or impossible. They can navigate through challenging terrains with their rugged build, low ground pressure, and traction tires, making them ideal for various applications, including defence, agriculture, homeland security, inspection, surveillance, and environmental

monitoring. C-DAC has plans to develop two UGVs for specific purposes. One UGV will be created for the Technology Innovation Hub for Autonomous Navigation (TIHAN) at IIT-Hyderabad, focusing on strategic applications. The other UGV will be developed for the Indian Council of Agricultural Research (ICAR) and designed for precise and targeted spray application of agrochemicals such as pesticides and fertilisers. These UGVs aim to revolutionise their respective fields by providing efficient and autonomous solutions for various tasks.

Autonomous Bathymetric Survey Vessel for Glacial Lake Profiling

"Glacial Lake Outburst Flood" (GLOF) denotes the sudden release of a substantial amount of water from a glacial lake, regardless of the triggering cause. GLOFs exhibit extreme peak discharges, often surpassing hydro-meteorologically induced floods by several times, resulting in remarkable erosion and transportation potential, sometimes resembling flow-type movements. The rapid accumulation of water in glacial lakes, especially those adjacent to receding glaciers, seismic activity, plate movements, and neo-tectonic events, can lead to abrupt breaches of their unstable moraine dams. In this context, conducting hydrographic surveys of glacial lakes is crucial for disaster prevention, preparedness, and management.

To address these challenges, this initiative aims to develop an autonomous bathymetric survey vessel specifically designed for profiling reservoirs and glacier lakes. Key activities include design and implementation of an Autonomous Vessel Platform, development of a Bathymetric and Water Parameter Sensor System, creation of Mission Planning and Data Archival Software, and design of an Advanced Glacier Lake Profiling Software (ALPS) for data analysis, simulation, and decision support. The initiative shall empower disaster management efforts and help mitigate the risks associated with glacial lake outburst floods.

Portable TETRA Base Station (PTBS)

C-DAC TETRA Network (CTN) offers a secure, reliable, and efficient communication solution based on the ETSI TETRA standard, primarily for critical public safety communications. The comprehensive CTN portfolio includes 25 products, such as Base Stations, mobile terminals, network managers, dispatcher units, voice logger, radio location tracker, and gateways for interconnecting with other communication systems. This has been a pioneering effort in development of Professional Mobile Radio (PMR) products and solutions in our country.

CTN product portfolio includes three types of Base Stations: Xtreme TETRA Base Station, Micro TETRA Base Station (already transferred to M/s Larsen & Toubro Limited), and Portable TETRA Base Station (PTBS). PTBS, with a portable form factor and transmit power of up to 15 Watts, bridges the gap between the Xtreme and Micro variants. Its quick deployment capability makes it particularly suitable for addressing communication needs during disaster and emergency situations. The entire CTN product range is ready for Transfer of Technology and Software Licensing. Shri Alkesh Kumar Sharma, Secretary, MeitY launched the Portable TETRA Base Station (PTBS), the third variant of C-DAC TETRA Base Station on March 04, 2023.

Portable TETRA Base Station (PTBS)

Cognitive Radio

"Cognitive Radio for Strategic Applications" is an R&D initiative aimed at spearheading technological advancements in Cognitive Radio (CR) for strategic applications. The activity focuses on core technology development in both platform and waveform aspects. As part of this initiative, a Proof-of-Concept Cognitive Radio system was developed and showcased to various prestigious organisations, including Indian Navy, Indian Army, Department of Defense Standardization, DCPW (MHA), ITBP, DRDO (DEAL, CAIR & SAG), NTRO, ISRO, and various industries. The demonstration took place at an invited workshop in Thiruvananthapuram on January 20, 2023 receiving considerable attention and appreciation. Recognising its potential, the Directorate of Naval Signals (DNS) from the Indian Navy extended an invitation to showcase this groundbreaking technology at the Indian Navy Pavilion during the Commanders' Conference in Goa, scheduled for March 06-07, 2023. This invitation further underscores the significance and impact of the achievements in the field of Cognitive Radio for strategic applications.

Cognitive Radio Proto Unit

Intelligent Transportation Solutions

IndusCopter

IndusCopter, a flexible micro-AUV (Autonomous Underwater Vehicle) drone platform, is designed to cater to a wide range of applications. The UAV prototype is centred around C-DAC's Indus-IoT board, which incorporates multiple onboard sensors for diverse IoT applications. Essential functionalities like telemetry, flight control, and payload Application are all implemented on the Indus-IoT board. Additionally, the UAV is equipped with onboard wireless interfaces, Wi-Fi, and Bluetooth, enabling manual remote navigation control and communication with a remote server or cloud. The modular design of the IndusCopter facilitates seamless integration with external flight controllers, joystick remote controls, sensors/actuators, and remote servers. Users can operate and control the UAV through an Android App or joystick. Moreover, with slight enhancements, the IndusCopter can operate in autonomous mode, further expanding its versatility and capabilities.

IndusCopter: A flexible micro-AUV drone platform

On-board Driver Assistance and Warning System (ODAWS)

Onboard Driver Assistance and Warning System (ODAWS) is a vehicle safety system that uses onboard sensors to monitor the driver's behaviour and the vehicle's surroundings. It provides acoustic and visual alerts to assist the driver. The initiative involves the development of sub-modules such as navigational unit, driver assistance console, and mmWave radar sensor. The mmWave radar sensors probe nearby vehicles' positional and dynamic characteristics, while the navigational sensor provides precise geo-spatial orientation and driving behaviour trends. The ODAWS algorithm interprets sensor data to offer real-time notifications, enhancing road safety. The system features an automotive-grade design, multiple obstacle detection & tracking, real-time data acquisition & assistance, and data-logging capability. This activity is implemented by C-DAC in collaboration with IIT Madras as a part of the InTranSE-II mission of the Ministry of Electronics & Information Technology, Government of India.

Common SMart iot Connectiv (CoSMiC)

CoSMiC is a software middleware that enables deployment of IoT based on oneM2M global standard. It offers users and application service providers in various domains the use of application-agnostic open standards and interfaces for end-to-end communication, adhering to the oneM2M standard. The platform's common service layer interfaces with any vendor-specific standards, promoting interoperability with smart city dashboards and preventing vendor lock-in. CoSMiC complies with 12 common service functions, including Registration, Discovery, Security, Group Management, Data Management & Repository, Subscription & Notification, Device Management, Application & Service Management, Communication Management & Delivery Handling, Network Service Exposure, Location, Service Charging and Accounting. Moreover, CoSMiC provides Interworking Proxy Entity (IPE) APIs to connect non-oneM2M devices or third-party applications to the platform. CoSMiC provides an end-to-end solution for seamless IoT device and application connection.

CoSMiC: Common SMart iot Connectiv

Retrofit oneM2M Adaptor for C-DAC Traffic Controllers (ReACT)

Retrofit oneM2M Adaptor for C-DAC Traffic Controllers (ReACT) is a retrofit software adaptor designed to make C-DAC Traffic Controllers compatible with the oneM2M standard. The oneM2M is the global standards initiative that covers requirements, architecture, API specifications, security solutions and interoperability for Machine-to-Machine and IoT technologies. It connects to the C-DAC Traffic controller hardware (WiTraC and CUTE) through Ethernet and communicates with the Common Service layer (CoSMiC) using the HTTP protocol. ReACT automatically registers itself with CoSMiC upon startup and translates UDP packets into oneM2M-based HTTP format before sending them to CoSMiC. Additionally, ReACT receives control data from the Traffic Monitoring and Management Application (TraMM) through CoSMiC.

ReACT: Retrofit oneM2M Adaptor for C-DAC Traffic Controllers

Solutions for Agricultural and Environmental Sectors

Industrial Vision Sensor (IVIS)

The IVIS system is a cutting-edge vision processing solution that utilises a Sony IMX249 Full HD, 30 FPS CMOS image sensor and a powerful Xilinx Zynq Ultrascale MPSoC for next-generation machine vision applications. It comes in two variants – (a) IVIS-Smart functions as a standalone intelligent automation system capable of on-board processing of image algorithms and vision logics for decision-making and (b) IVIS-10GigE acts as an industrial camera, supporting global camera interface standards like GigE Vision/GeniCam, with a high data throughput of 10Gbps. The IVIS system is currently deployed at the EID Parry Sugar Mill in Tamil Nadu for an online sugar crystal characterisation application. It uses classical image analysis techniques to measure crystal size distribution parameters in the massecuite automatically. This data is crucial for optimising sugar crystal growth in crystallisation pans and ensuring the quality control of the final sugar product.

Industrial Vision Sensor (IVIS) –Smart

Aqua SURAKSHA

Aqua SURAKSHA is a Bio-Sensing System developed under the initiative "Measuring Endocrine Disrupting Chemicals (EDC) and Aquatic diagnostics through Bio-Sensory Network with a special reference to North East India (MEAN)" funded by the Ministry of Electronics & Information Technology, Government of India. The system is designed for detecting Endocrine Disrupting Chemicals (EDCs) in the aquatic ecosystem. EDCs include insecticides, pesticides, and other agrochemicals used in pest control in agricultural fields. These chemicals often enter lakes and water bodies as agricultural runoff, potentially exceeding the maximum residue level (MRL) and leading to residual pesticide issues in India. Aqua SURAKSHA aims to address and monitor these concerns related to EDCs in the environment. The developed systems are currently deployed at five locations in North East India (Bharalu River & Borsola Beel at Guwahati, Assam; Samaguri Beel & Damal Beel at Nagaon, Assam; Charan Beel at Morigaon, Assam) for extensive field trial.

Aqua SURAKSHA - a Bio-Sensing system to evaluate Endocrine Disrupting Chemicals in Aquatic Ecosystem

AI-based Air Quality Monitoring System (AQ-AIMS)

C-DAC, in association with IIT (Indian School of Mines) Dhanbad, has developed an IoT application for monitoring various environmental pollutants such as PM10, PM2.5, PM1.0, NH3, SO2, NO2, CO, O3, CO2, HCL and TVOC which are generated from mining and cement industries. Additionally, the instruments will measure ambient temperature, relative humidity, luminosity and noise level. AQ-AIMS is a cloud solution for real-time air quality monitoring, and advanced analytics help forecast air quality trends. The solution is under field trial at Ultratech Cement Industry, Gurgaon.

AQ-AIMS: Air Quality Monitoring System

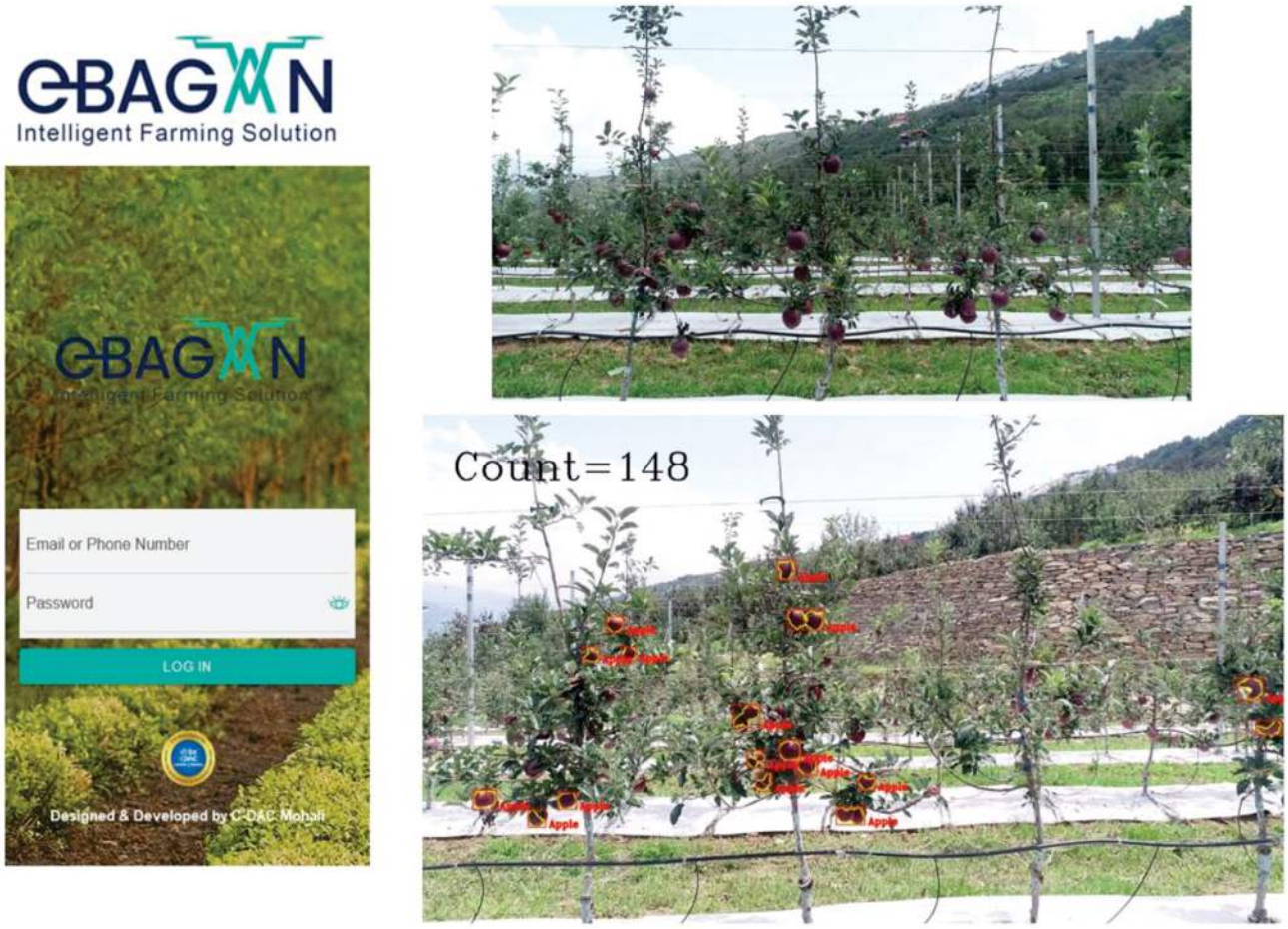
Smart Eye

Smart Eye is a visual inspection system used in black tea processing to detect and eliminate foreign particles. It includes a conveyor unit with a pneumatic flap fitted at the end of the conveyor for foreign matter removal and a vision module that analyses images of tea samples passing through the conveyor belt. The system's image analysis software detects foreign matter mixed with tea in real-time and triggers the pneumatic valve to open the flap, discarding the portion of finished tea containing foreign particles.

Smart Eye System for Tea Foreign Matter Detection

Stream Data Analytics Framework for Precision Farming – Agriculture/ Forest

This initiative aims to serve the farming community by leveraging digital transformation and incorporating AI, IoT, and data analytics technologies to enhance productivity, minimize losses, and increase farmer incomes. The initiative includes a user-friendly web interface and a mobile application called "eBagaan" for information sharing with local farmers. The system allows farmers to monitor their farms using unmanned aerial vehicles (UAVs), equipped with multiple sensing devices to capture data. Field coverage planning for yield estimation is developed with various statistical features, and a plant growth model-based water management system is implemented. Collaborators under the initiative include ICAR-Indian Agricultural Research Institute-New Delhi, Himachal Pradesh Horticulture Development Society-Shimla and Directorate of Horticulture-Himachal Pradesh. The field trials of the developed solution were carried out at apple orchards in the state of Himachal Pradesh.



eBagaan Mobile Application

Capacity building Program

Unmanned Aircraft Systems (UAS)

Capacity building for human resource development in Unmanned Aircraft Systems (UAS) and related technologies is a new initiative by C-DAC, supported by MeitY. The initiative aims to achieve several objectives, including enhancing the capacity and capabilities of select institutions in identified work themes (WTs) on UAS, fostering the development of competent human resources, and promoting an entrepreneurial mindset among students. Five work themes have been identified, covering areas such as Drone Electronics, GNC Algorithms & Simulation, Aeromechanics, Drone Applications, and Allied UAS Technologies.

A National Ecosystem is being established to realise these goals, involving 30 institutions across various states in a hub and spoke model. This includes five IITs/IIITs as Resource Centres (RC), fifteen IITs and NITs as Participating Institutes (PI-Academic), and ten C-DAC/NIELIT Centres as Participating Institutes (PI-C-DAC/NIELIT Centres). The initiative aims to train over 42,500 personnel over 5 years through formal and informal activities, such as lab establishments, academic and skilling programs, training activities, prototype development, and knowledge creation. This is set to significantly contribute to the development and advancement of UAS technology in India.

Multilingual Computing and Heritage Computing

Language computing and heritage computing play crucial role in preserving and promoting cultural diversity, historical knowledge, and vernacular languages. C-DAC has worked on some of the key technology areas such as Chatbots and Bidirectional Machine Translation system for various Indian languages. Towards preserving heritage and old records, C-DAC has developed solutions for Intelligent and Interactive Museums, modernization of Traditional Knowledge Digital Library, Web portal for National Rail Museum and mobile application for Museums of India. During the year, C-DAC continued to work in the areas of Speech Technologies, Digital Preservation, Machine-aided Translation etc. Details of activities carried by C-DAC during the year are mentioned below.

Speech and Language Technologies

Tulsi: A multilingual (Hindi and English) voice enabled chatbot

Tulsi is a multilingual (Hindi and English) voice-enabled chatbot that has been deployed for the National Medicinal Plants Board (NMPB), Ministry of AYUSH on eCharak Platform during October 2022. It helps to address user queries on medicinal plants cultivation, schemes, and marketing. It is available as a plugin for Web and Mobile apps. The chatbot has been trained to address a wide range of user queries related to the services of NMPB such as Market Price, Buyer / Seller Details, Medicinal Plants Info, Schemes, Post a Query in NMPB Helpline, etc.

Scalable Speaker Recognition Technology in Different Applications

Under National Language Translation Mission (NLTM) initiative of Government of India, a consortia-based activity 'Speech Technologies in Indian languages' has been started. It aims at development and deployment of Scalable Speaker Recognition Technology in different applications, specially including India-specific scenarios such as multi-environment, multi-language, multi-dialect, multi-accent, code-switched speech, etc. Consortia members include IIT Madras, IIT Dharwad, IIIT Dharwad, NIT Patna, KLE Tech, KL University, and NIT Nagaland. Under the initiative, C-DAC is working on Forensic Speaker Recognition.

Speech Technologies for North Eastern Languages

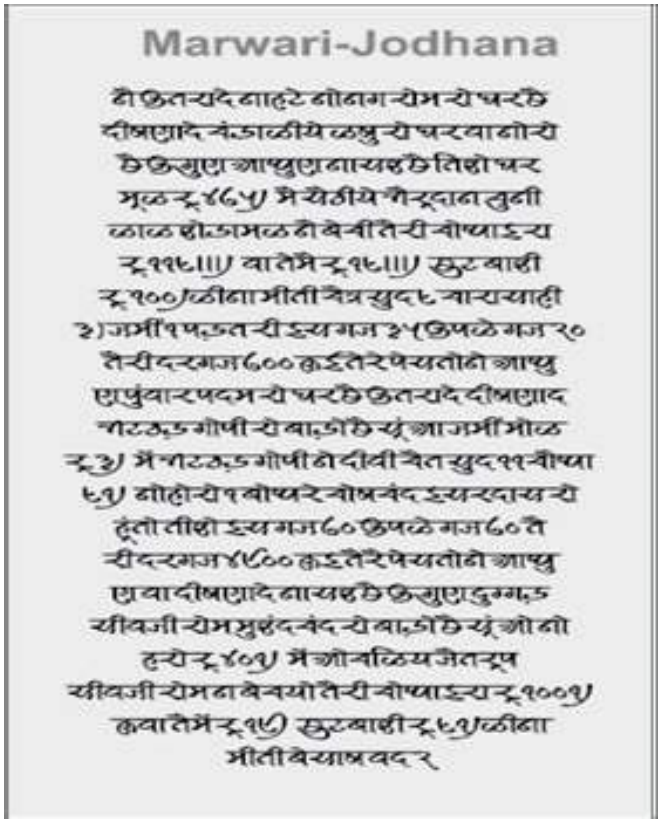
C-DAC in collaboration with IIT Madras, IIT Guwahati, NIT Manipur, and IIIT Siri City is working on speech technologies for North Eastern languages. This activity is taken up as consortium-based umbrella activity "Speech Technologies in Indian languages" under the National Language Translation Mission (NLTM) initiative of Government of India.

It aims at the development of a robust and scalable spoken Keyword Spotting System (KWS), capable of retrieving information in multiple languages. As part of the activity, a multi-purpose speech database of three North-East Indian languages, namely, Nepali, Mizo, and Nagamese will be created. The secondary objective of this activity is to implement a KWS-driven healthcare information dissemination system in 10 eastern and northeastern Indian languages. C-DAC is working on the task of data collection in Nepali language, curation of datasets in Bengali language, and development of KWS in these languages.

Marwari Font and Language Learning Mobile Application

The Rajasthan State Archives has entrusted C-DAC to develop Marwari language fonts. This is a significant step in promoting and proliferating the Marwari language. The two Marwari language fonts that have been developed are: Marwari (Bikaneri) and Marwari (Jodhpuri). Marwari (Bikaneri) font is based on the Bikaneri style of writing Marwari. This style is characterized by its use of thick and thin strokes, and it is the most common style of writing Marwari in Rajasthan. Marwari (Jodhpuri) font is based on the Jodhpuri style of writing Marwari. This style is characterized by its use of rounded strokes. In addition to the Marwari language fonts, C-DAC has also developed a mobile application for learning Marwari language and a keyboard for typing Marwari language.

Marwari font (Bikaneri Style)



Marwari font (Jodhpuri Style)

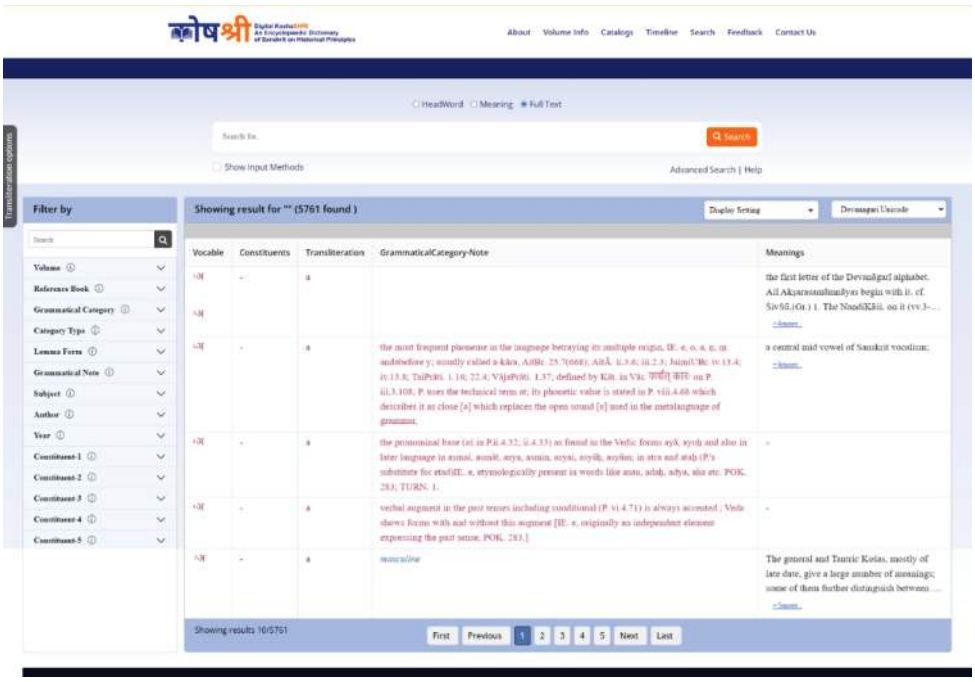
Digital Preservation and Heritage Computing

Modernization of Traditional Knowledge Digital Library

The initiative aims to modernize the Traditional Knowledge Digital Library (TKDL) through the creation and implementation of web applications. These applications aim to establish a unified interface for managing the entire workflow, encompassing tasks like content uploading, content approval, and management of third-party contributions. By leveraging cutting-edge and resilient ICT technologies, the entire workflow is efficiently streamlined and made accessible through a unified interface. These web applications facilitate access to digitized traditional medicinal information for patent offices and research institutes, all governed by well-defined policies.

Digital Preservation and Online Portal for Encyclopaedic Sanskrit Dictionary

The initiative, funded by the Department of Science & Technology (DST), aims to provide technological solutions to build Sanskrit dictionary database and an online portal. C-DAC has collaborated with the Deccan College Post-graduate and Research Institute, Pune for domain knowledge and 35 volumes of the Encyclopedic Sanskrit Dictionary published since 1948. As a part of initiative, C-DAC has developed a specialized Optical Character Recognition (OCR) which supports character recognition in Sanskrit, Roman & English languages intermingled, vocable/article identification and automatic element extraction. C-DAC has also designed and developed Sanskrit Font (Koshashri) with various Vedic symbols. The Koshashri font also supports matching Roman & English and an Inputting Tool for typing. The Automatic Lexicographical Element Extraction Tool is developed which consists of Image Processing, Deep Learning based OCR for Deccan College's Sanskrit Encyclopaedic Dictionary and Element Parser. Sanskrit dictionary editor (SDE) is developed which presents the contents of dictionary articles in tree-view, tagged format with in-place editing features.



Sanskrit Dictionary Editor Software

3D Holographic Animation for Dr. Babasaheb Ambedkar Museum and Memorial, Pune

C-DAC created a 3D hologram of Dr. Ambedkar for the Dr. Babasaheb Ambedkar Museum and Memorial in Pune, established by the Symbiosis Society. The inauguration of the same was done in a special event held on May 06, 2022, by Dr. Virendra Kumar, Hon'ble Minister for Social Justice and Empowerment, Government of India. This activity was entrusted to Symbiosis Museum and sponsored by the Ministry of Social Justice & Empowerment. Through the utilization of the 3D hologram, museum visitors can now experience Dr. Ambedkar's historic speech, delivered at the constituent assembly on December 17, 1946, as if he were present in person. C-DAC assisted Symbiosis in setting up the 3D Holography Technology and developed the 3D model of Dr. Ambedkar for holographic projection. C-DAC animated the 3D model for facial expressions, gestures and lip-synchronization as per the original speech and rendered it on PARAM Shavak VR.

3D Holographic Animation for Dr. Babasaheb Ambedkar

Machine Aided Translation

Kanthasth 2.0

Kanthasth 2.0 is a Translation Memory (TM) based computer-aided translation system that helps in the translation process for English to Hindi & vice-versa Translation. It is an enhanced and updated version of Kanthasth 1.0, which will help the translators in their daily work of translating documents from English to Hindi and vice-versa in Unicode font. Neural Machine Translation (NMT) and Automatic Speech Recognition (ASR) are integrated with additional facilities for the end users to ease the translation of documents. Prominent characteristics encompass an AI-driven Chatbot, predictive typing, seamless work-flow integration, file sharing, fuzzy matching for translation, Term-base integration, Concordance search, and quality check functionalities. Kanthasth 2.0 has been launched by Shri Amit Shah, Hon'ble Minister of Home Affairs of India on September 14, 2022 on the occasion of Hindi Diwas held at Surat, Gujarat.

Discourse Integrated Machine Translation from Dravidian Language to Dravidian Language (DL-DiscoMT)

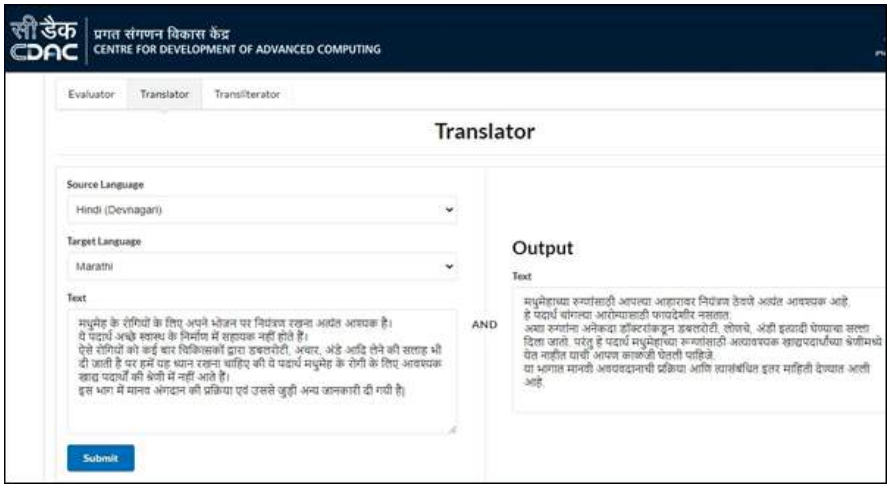
DL-DiscoMT is a collaborative initiative led by AU-KBC, Anna University, Chennai, with active participation from IIIT Hyderabad, Central University of Hyderabad, ICFOSS Trivandrum, MIT Manipal, C-DAC, and DAIICT Gandhinagar. The primary objective is to create and implement a machine translation (MT) system as a service, specifically focusing on translating between Hindi and Tamil, as well as other Dravidian languages. This initiative is a vital component of the broader endeavor to develop Indian Language Speech-to-Speech Machine Translation (SSMT) and Text-to-Text Machine Translation (TTMT) systems for Indian languages.

The activity shall include integration of Discourse Analysis (DA) into machine translation (MT) with the goal of enhancing the quality of translated texts. The main focus is on identifying discourse markers and addressing issues related to coherence & cohesion in the translated output, particularly when dealing with challenges that go beyond the sentence level. Additionally, the work aims to enrich the content available in Dravidian languages on the internet, primarily in domains such as Governance & Policy, Science & Technology, Education, Health, Agriculture, and more.

VIDYAAPATI: A Bidirectional Machine Translation system for Bengali, Konkani, Maithili, Marathi, and Hindi

This initiative is undertaken in collaboration with IIT Bombay, Goa University, IIT Patna, Indian Statistical Institute-Kolkata, Jadavpur University-Kolkata, and Jawaharlal Nehru University-Delhi. It aims to develop a multi-domain text-to-text machine translation system in synchrony with speech consortia to facilitate bidirectional translation between the languages Hindi - Bengali, Konkani, Maithili, and Marathi.

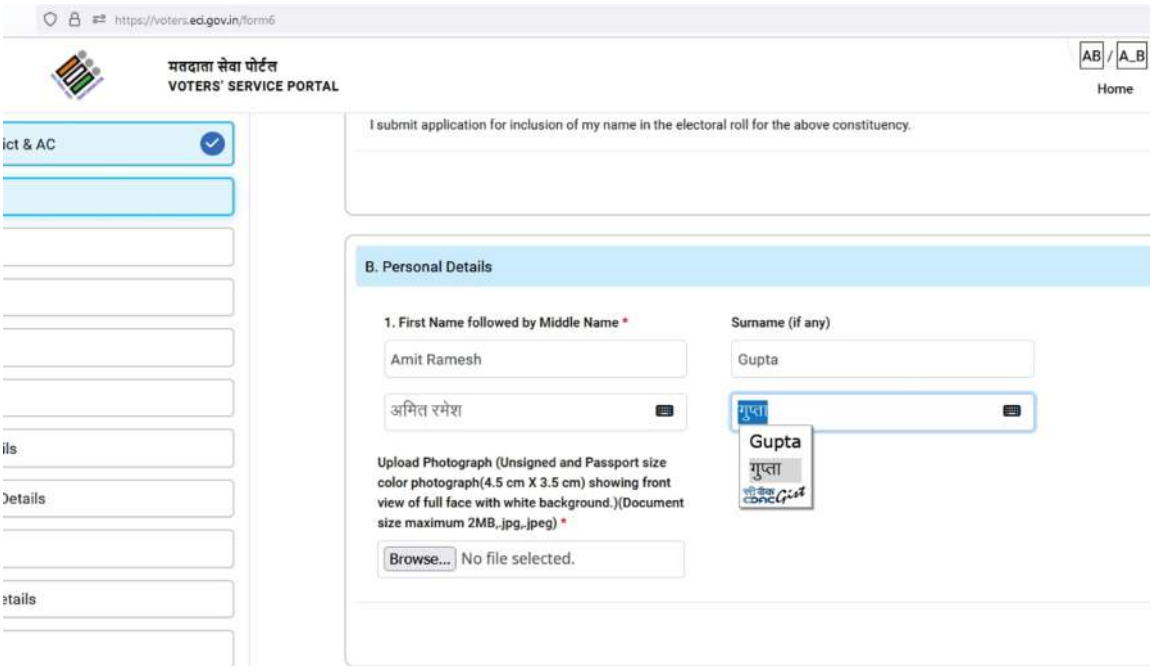
The task includes generating linguistic resources, establishing benchmark data for each language pair, defining evaluation standards, creating corpora, and implementing the Machine Translation (MT) system for all stakeholders involved. As of now, nearly 14,500 Hindi training corpora have been translated into Bengali. Simultaneously, the process of gathering and processing test sentences in various domains is currently underway.



Hindi to Marathi and vice versa Machine translation System

Indian language transliteration and search solutions for ERONet

This initiative is for providing C-DAC's Indian language transliteration solution for transliteration of names & addresses of the electors from English to Indian languages & vice-versa and Indian language search solution for the names in the electoral roll. This solution along with some customization is being used for integration in the new version of ERONet-2. C-DAC's solution is provided for 14 Indian languages namely Assamese, Bangla, Gujarati, Hindi, Kannada, Konkani, Malayalam, Manipuri, Marathi, Odia, Punjabi, Tamil, Telugu, and Urdu. The initiative is funded by Election Commission of India.



Voter's services portal

Localisation of Government Web Portals

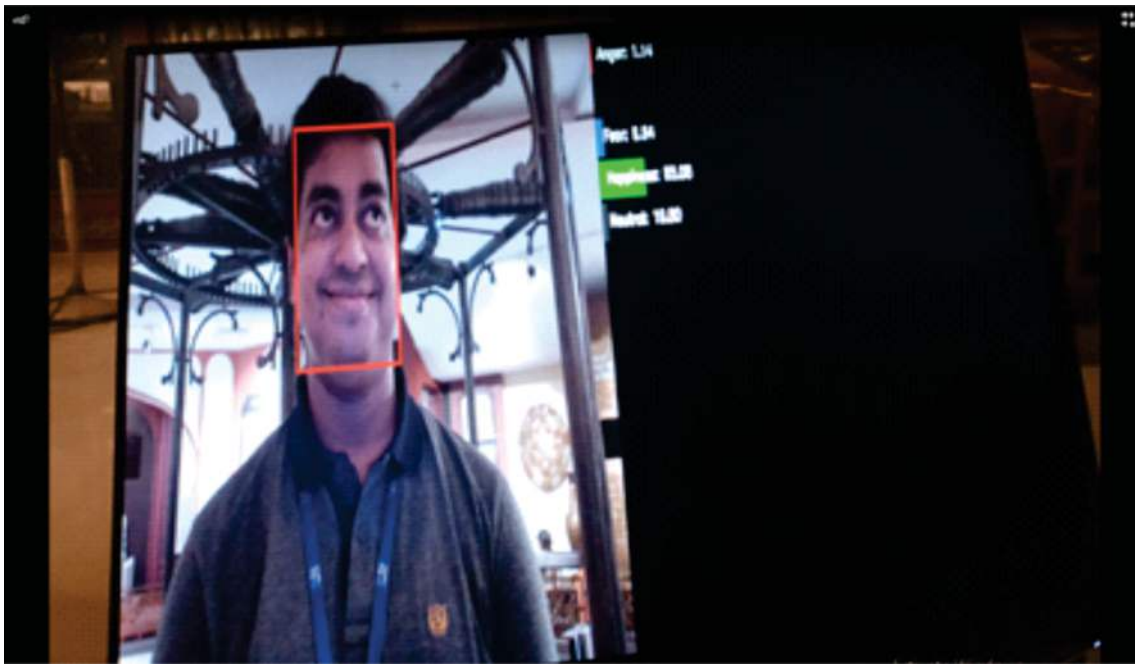
C-DAC's Go-translate framework is used for Localization of the static information on the Government web portals such as portal of Ministry of Micro, Small Medium enterprises (MSMEs) namely https://udyamregistration.gov.in/ and https://champions.gov.in/ in multiple Indian languages. The framework helps in the translation of static information on websites, more specifically, user interfaces, and digital documents for rendering it on-the-fly to a user in the desired local language. Currently. these portals have been made available in 11 Indian languages namely Assamese, Bangla, Gujarati, Hindi, Kannada, Marathi, Malayalam, Punjabi, Tamil, Telugu and Urdu.

Solutions for Museums

An Interactive and Intelligent Museum Exhibit Based on Attention Analysis

An interactive and intelligent museum exhibit has been built based on the attention analysis. During the year, C-DAC has focused on developing the Attention and Expression analysis module using data gathered from two exhibits at Science City, Kolkata. One exhibit featured Classical Instruments and collected data from over 150 visitors, while the other exhibit, centered around a Diorama, gathered data from more than 50 visitors. Subsequently, the module underwent rigorous testing & field trials and enhancements were made to fine-tune the system in preparation for the final version.

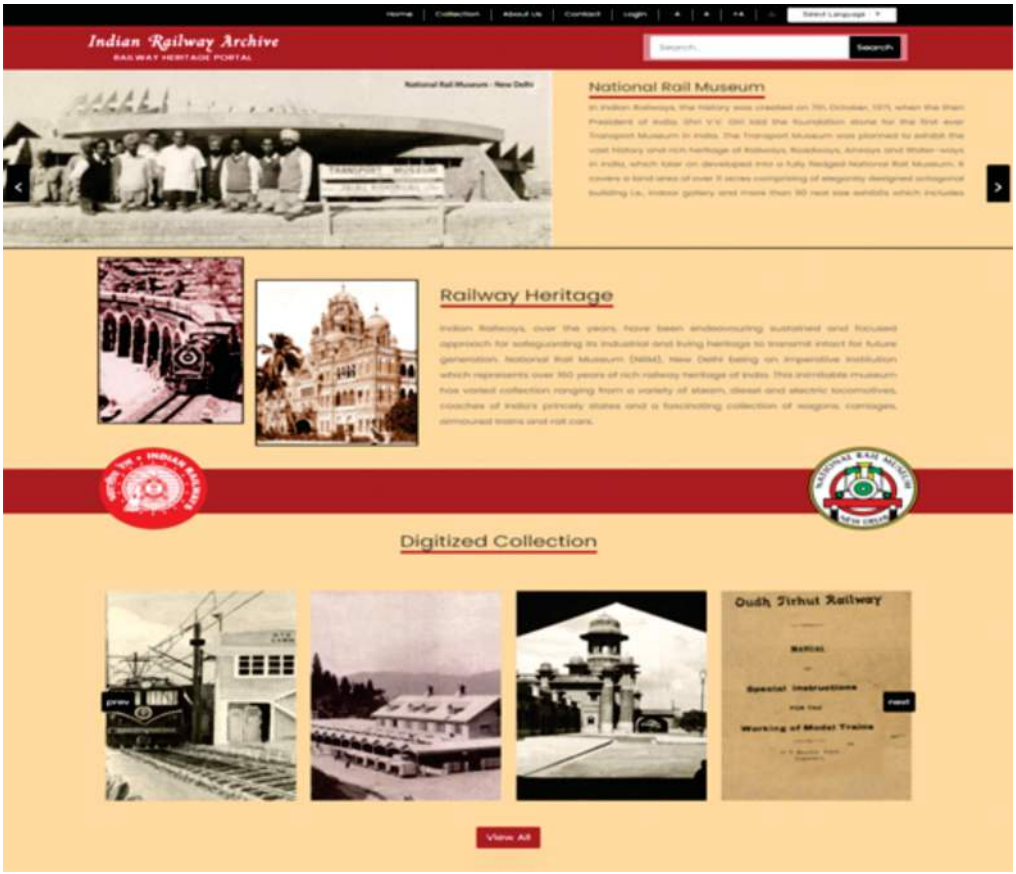
The integrated system underwent evaluation and performance enhancement in both laboratory settings and user premises, using data from approximately 30 visitors. The visual analytics components offered valuable insights to the museum authorities regarding the visitors. These insights included the gender of the visitors, as well as the age range of the visitors, determined using a computer vision algorithms. Additionally, the eye scan path of the visitors during their viewing experience was provided to the authorities, aiding in the placement of exhibit objects for optimal presentation.



Visual Analytics based on facial expression

Web portal for National Rail Museum

C-DAC has developed Railway heritage Portal which displays over 167 years of Railways' heritage contents comprising of 2 million pages, and showcasing various Railway collections using theme bucket, meta data based and full text search. It offers metadata searchable collection, and implementation of payment gateway for different access models.



Indian Railway Archive - Railway Heritage Portal

Museums of India Mobile App (Android Version)

The "Museums of India Mobile App" is a mobile application that provides users with access to a collection of information and resources related to various museums across India. It offers a convenient platform for users to explore and learn about the rich cultural heritage and historical artifacts showcased in these museums. The app may include details about exhibits, galleries, events, and other relevant information to enhance the museum-going experience for visitors.

On May 18, 2022, a special event commemorating International Museum Day and Azadi Ka Amrit Mahotsav took place at National Gallery of Modern Art (NGMA), New Delhi, during which the 'Museums of India Mobile App' was launched by Shri G. Kishan Reddy, Hon'ble Minister for Culture and Tourism, Government of India. There are more than 1000 downloads of this app from Google play store. The mobile app supports features like search and retrieval, access to 3D interactive objects and category-based browsing. One can mark favourite objects and share the link on social media platforms. The 'Museums of India Mobile App' can immensely benefit the students, teachers, tourists and scholars as the museum collections are now easily available on their finger tip.

'Museums of India' Mobile App

Cyber Security and Cyber Forensics

With a focus on R&D, developing solutions/ products and providing services, C-DAC has carried out significant advancements in the field of Cyber Security and Cyber Forensics in the current year. The R&D efforts of C-DAC have tackled numerous challenges in a well-rounded fashion as per the vision of Government of India. This includes key areas such as Mobile Security, Critical Infrastructure Security, Identity Management & PKI, Proactive Threat Analysis, Blockchain Technologies, Cryptography, Software Vulnerability Research, Cyber Forensics, and Network Management. C-DAC has also carried out Capacity Building, Skill Development, Awareness Generation and Cyber Security Services to further support many of the technology endeavours. Some of the significant and notable achievements covering solutions, products, and services offered under the thematic area during the year are listed below.

Mobile Security

Vishleshak - A Platform for Security & Threat Assessment of Android Apps

The major target of malicious apps is to misuse the critical resources of the mobile devices, get remote access to the devices and obtain critical user data. This necessitates to analyze these apps in order to assess the threats posed by them. Vishleshak is a unique Android based platform developed to bypass the strong anti-reversing defences and get insights into these apps. Key features of the platform include evasion of root detection, evasion of debuggable properties, resource access monitoring, monitor app specific network endpoint communications, instrumentation tool support, and tracking usage of dangerous permissions. More than 200 applications have been analyzed using the Vishleshak platform and a total of 4 pilot deployments have been done at various strategic agencies. Shri Alkesh Kumar Sharma, Secretary, MeitY launched Vishleshak on January 28, 2023.

Vishleshak – A Platform for Security & Threat Assessment of Android Apps

M-Kavach - Analysis & Analytics Engine

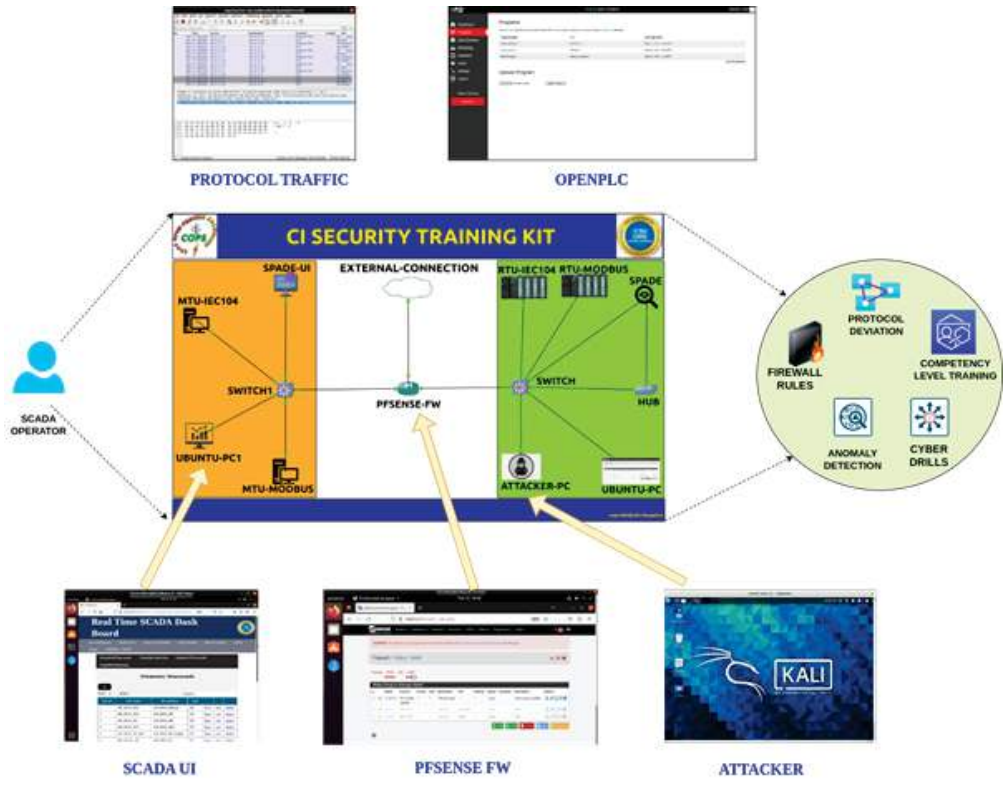
M-Kavach - Analysis & Analytics Engine collects metadata of mobile applications which is further processed to monitor sudden spike or downtrend in the users' sentiment or number of downloads. APKs of applications with sudden spike or downtrend are downloaded from the Playstore and further analyzed. Based on the analysis results, the application is categorized as either potentially benign or malign. Further, the engine detects the availability of banned apps in third party app stores and also has the capability to detect cloned applications given two APKs as input. The solution has been deployed at various strategic agencies.

M-Kavach - Analysis & Analytics Dashboard

Critical Infrastructure Security

Critical Infrastructure Security Training Kit

C-DAC has developed a SCADA network simulation kit embedded with necessary simulated components communicating through SCADA protocols over the Live, Virtual and Constructive (LVC) SCADA Testbed. The training kit addresses the SCADA security training requirements, by providing a realistic environment for users to understand attacks on the SCADA environment. The kit supports training for different competency levels on the provided infrastructure. Using this kit any user can build the required network topology and realize attack scenarios using the training manuals provided for preparing and conducting various SCADA related attacks. The kit has been demonstrated during the workshop on CI Security held on March 16, 2023 which was attended by a total of 24 number of Industries and Educational organizations.

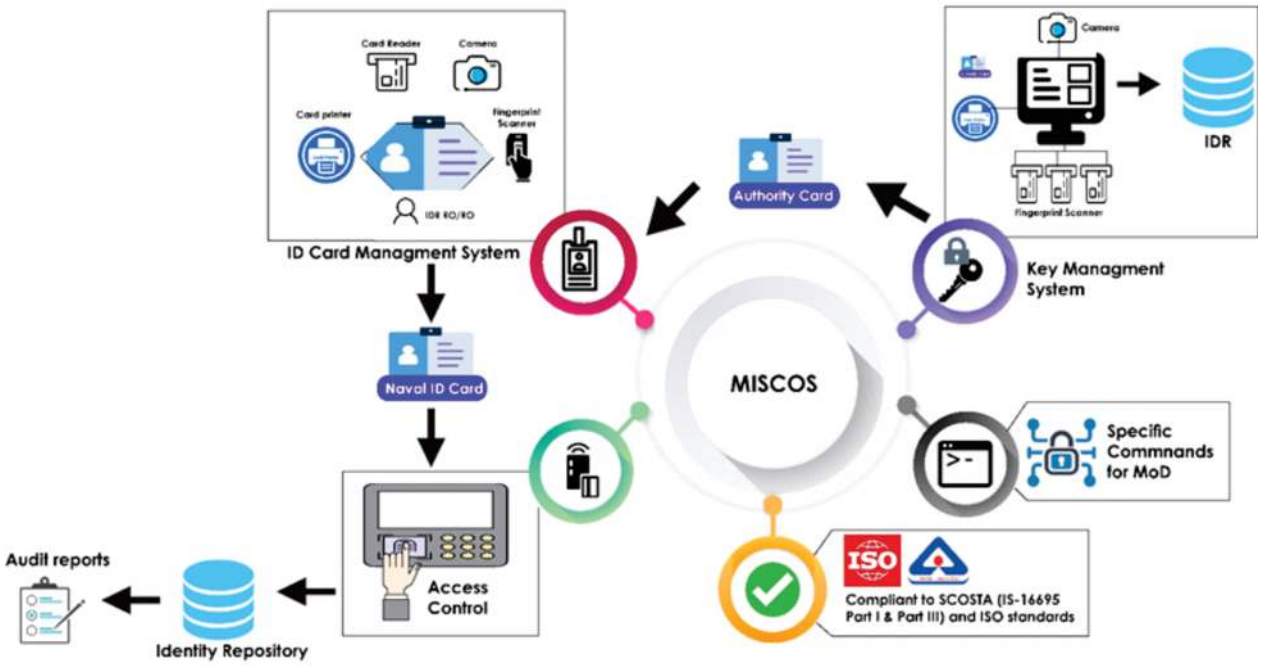


CI Security Training Kit

MISCOS for Indian Navy

As an initiative of Ministry of Defence (MoD), C-DAC has designed Military Smart Card Operating System (MISCOS) that shall reside in secure microcontroller of the smart card used for authentication purpose in strategic sector. Salient features of MISCOS include compliance to SCOSTA IS 16695 Part I and Part II with additional security features as per the requirement of Navy, Key Management System (KMS) for secured operations and strong resistance to identify fraud, tampering, counterfeiting and unauthorized entry in defense premises.

A development setup of solution is available at MISCOS LAB, Gurugram. MISCOS is developed on three chipsets of two OEM – Infineon & NXP. During the year, the third variant of MISCOS was developed for NXP P71D352B chipset. Application Processing Data Unit (APDU) was provided to Bharat Electronics Ltd (BEL), Bangalore for layout creation of various cards including Seed card, Activation Terminal (AT) card, Secure Access Module (SAM) card, Service Personnel card, Temporary card and Token.



Military Smart Card Operating System (MISCOS) & its applications

Information Security Services (ISS)

C-DAC is currently a CERT-In empanelled agency offering Information Security Services (ISS) to various state / central government and private organizations. As part of this, C-DAC has carried out 117 information security services for various agencies. Further, C-DAC has received Comprehensive Security Review Projects from Banks like SBI, PNB, BOI, Critical Applications and Infrastructure. Audit engagement projects were from organizations like Power Grid, APEPDCL, Damodar Valley Corporation, POSOCO, AIIMS and APSPDCL. C-DAC has also carried out security audit of NID Assam, NERLDC Shillong & Guwahati, CISF Office and BVFCL. During the period, C-DAC audited and issued 360+ certificates/audit reports for applications, network infrastructure and various Compliance Audit.

Cryptography

GHOST: Generation of In-House Secure Trusted Elliptic Curve

C-DAC has indigenously developed "GHOST", a cryptographic tool for the generation of secure and trusted elliptic curves over large prime field sizes which is aimed for use by Indian Strategic Units. The tool is also used for security verification and trust evaluation of a foreign elliptic curve defined over prime field for use in cryptography. In addition, GHOST estimates and suggests computational resource investment required to randomly draw a prime order elliptic curve over a desired prime field size within stipulated time. GHOST integrates indigenous GhostPKI application for enterprise users and facilitates SSL or TLS Security, E-mail Security, Digital Signing Services, Encryption

and Authentication Services in closed environment. The GHOST elliptic curve is under field trial at Indian Army since February 2023. Shri Alkesh Kumar Sharma, Secretary, MeitY launched GHOST on January 28, 2023.

TrusToken

C-DAC has developed indigenous USB Token for doing various cryptographic operations. The USB is based on ISO 16695 Standards and also supports ECC. The Token is capable of doing all the cryptographic operations, both asymmetric operations such as RSA up to 4096 bits, ECC (P-256 curve) and symmetric operations such as AES and DES. Along with the use of USB token, a Secure Application Framework is developed enabling Remote Authentication Framework, Session Key Establishment & Secure VPN Establishment and Heartbeat Checking Framework to check the existence of USB token in the client system. Potential applications have been built around the USB token such as PDF Signer Tool, P7 Signer Tool, Server SK-VPN Dashboard, Standalone SK-VPN Client Application for Windows and Linux, Secure Access to Web Applications, Secure Login and Data Rights Management Software.

TrusToken

Proactive Threat Analysis

CDACSIEM

CDACSIEM (C-DAC Security Information and Event Management) is a security solution that collects, normalizes, stores, aggregates, and applies analytics to logs which are validated against a set of correlation rules to discover trends, detect threats, and enable organizations to investigate any alerts. It uses advanced analytics to find complex threats with minimal noise and provide incident response frameworks that enable it to automate remediation actions on threats. CDACSIEM can ingest logs up to hundreds of gigabytes per day with long-term data retention. Currently the solution has been deployed at Research Centre Imarat-Hyderabad, Punjab University-Chandigarh, National Police Academy-Hyderabad, Punjab National Bank HQ-New Delhi and Murgaon Port Trust-Goa.

CDACSIEM Dashboard

CDACSIEM is also integrated with Web Application Vulnerability Scanner. This scanner performs passive web security scan to discover common web application vulnerabilities and server configuration issues. Key features include Vulnerability Classification, Authenticated Scanning, Compliance with OWASP Top 10, Risk Score Calculation, Graphical Dashboard, Scheduled based Scan, Automated Remediation, Centralised Vulnerability Database and Report Generation.

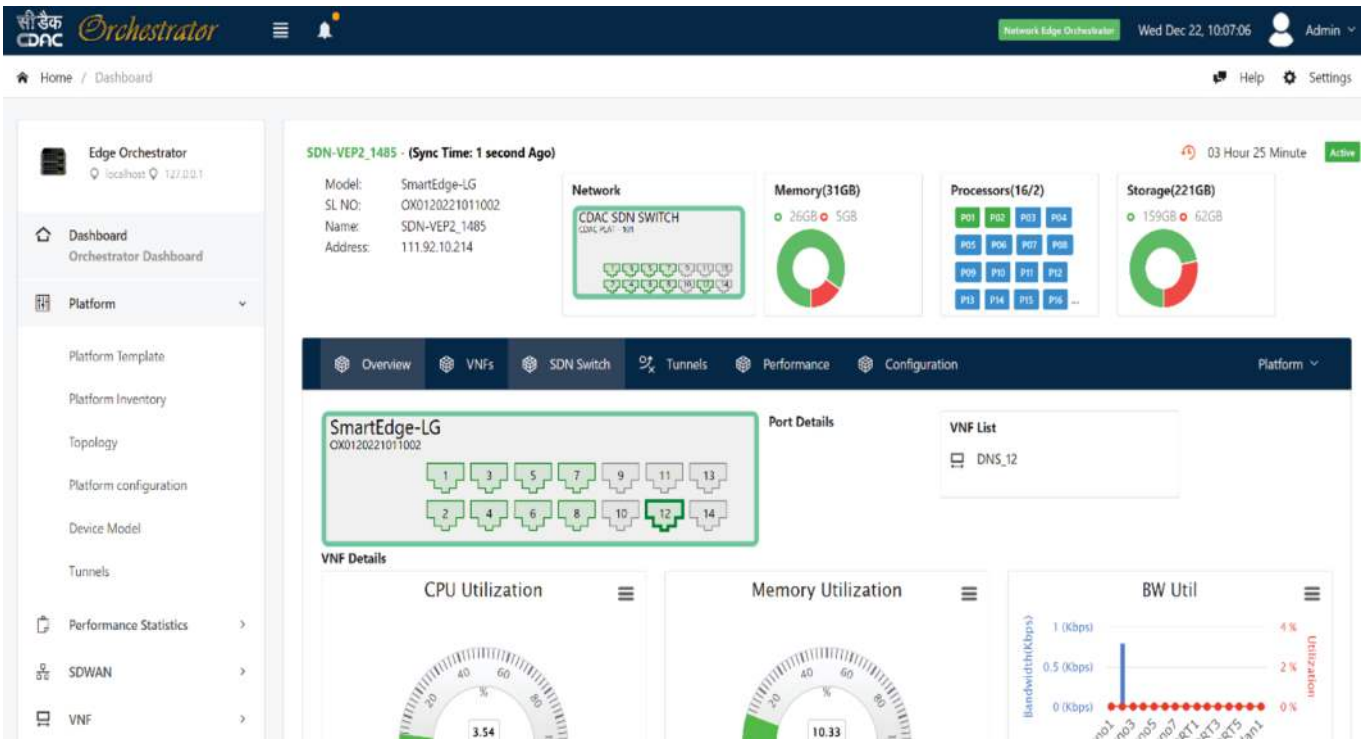
Vulnerability Research

C-DAC is actively involved in vulnerability research and discovery of various prominent applications & tools available in the IECT ecosystem. C-DAC actively collaborates with CERT-In and other institutions of repute to jointly identify and provide necessary solution to fix vulnerabilities. In the current year, C-DAC has discovered more than eight vulnerabilities of various applications.

Network Management

SDN and NFV based Network Service Delivery Platform

SDN (Software-Defined Networking) and NFV (Network functions virtualization) based Network Service Delivery Platform is an indigenous agile network service delivery platform with smart network edge boxes and service orchestration software. The smart network edge box, which is based on generic purpose hardware, is capable of running multiple Virtual Network Functions (VNFs) for Routing, Switching, Firewalling and so on. The service orchestration software is capable of chaining multiple such VNFs to form a network service like Software Defined Wide Area Network (SDWAN) or Network Security Services. The solution is having wide applicability in the impending 5G deployments. Moreover, through the software solution of networks, much agility can be achieved on the way the network services are deployed by network service providers and enterprises. By eliminating the need of specialized hardware for network functions, savings can also be achieved on the hardware cost.

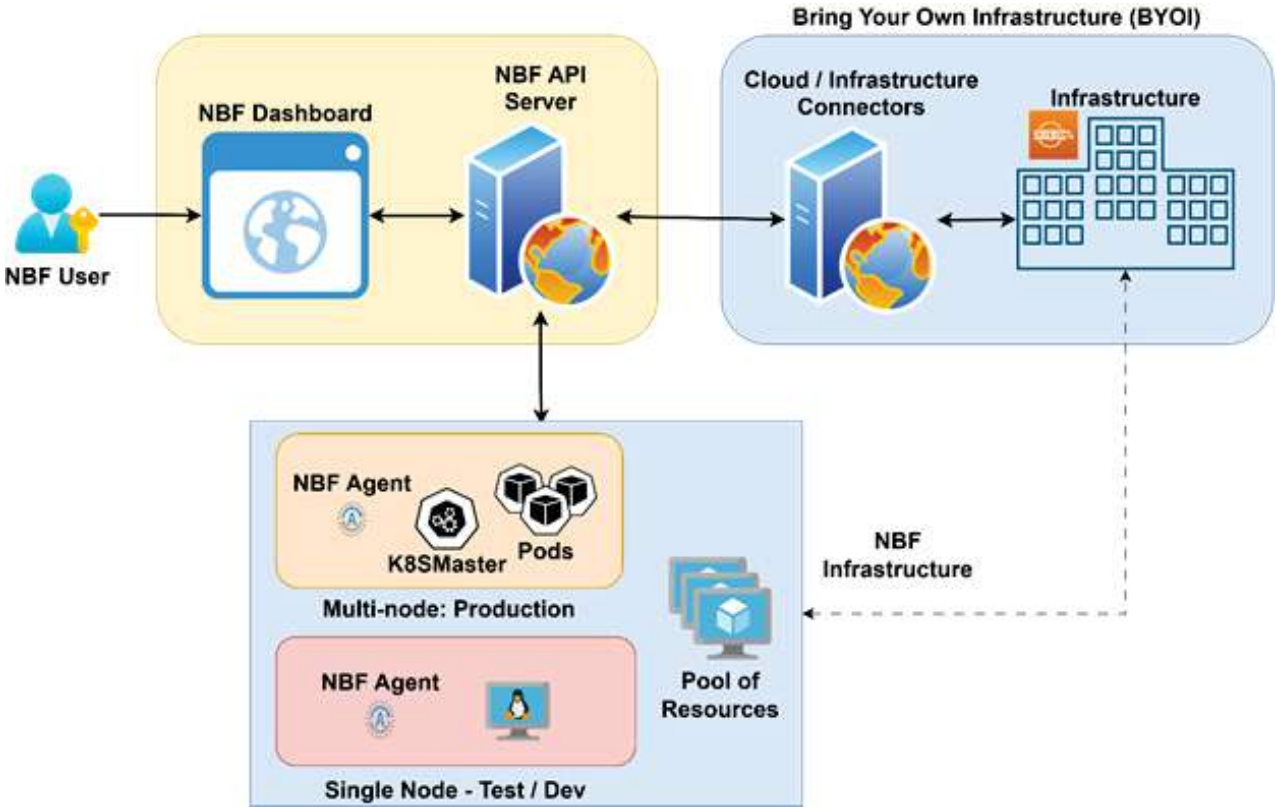


SDN and NFV based Network Service Delivery Platform

Blockchain Technologies

National Blockchain Framework (NBF)

National Blockchain Framework (NBF) provides infrastructure and technology stack to enable trust for applications in the domain of e-Governance and make India ready for large scale adoption of Blockchain technology. NBF focuses on enabling Blockchain-as-a-Service and addresses the research challenges across various layers of the Blockchain technology stack. This is being implemented jointly by C-DAC, NIC, IIT Hyderabad, IIIT Hyderabad, IDRBT and SETS Chennai. Key features include (a) Technology Framework for faster and secure Development of Applications (b) Addressing research challenges in security, performance & interoperability and (c) On-boarding applications collaborating with government departments for use cases.



National Blockchain Framework

Identity Management & PKI

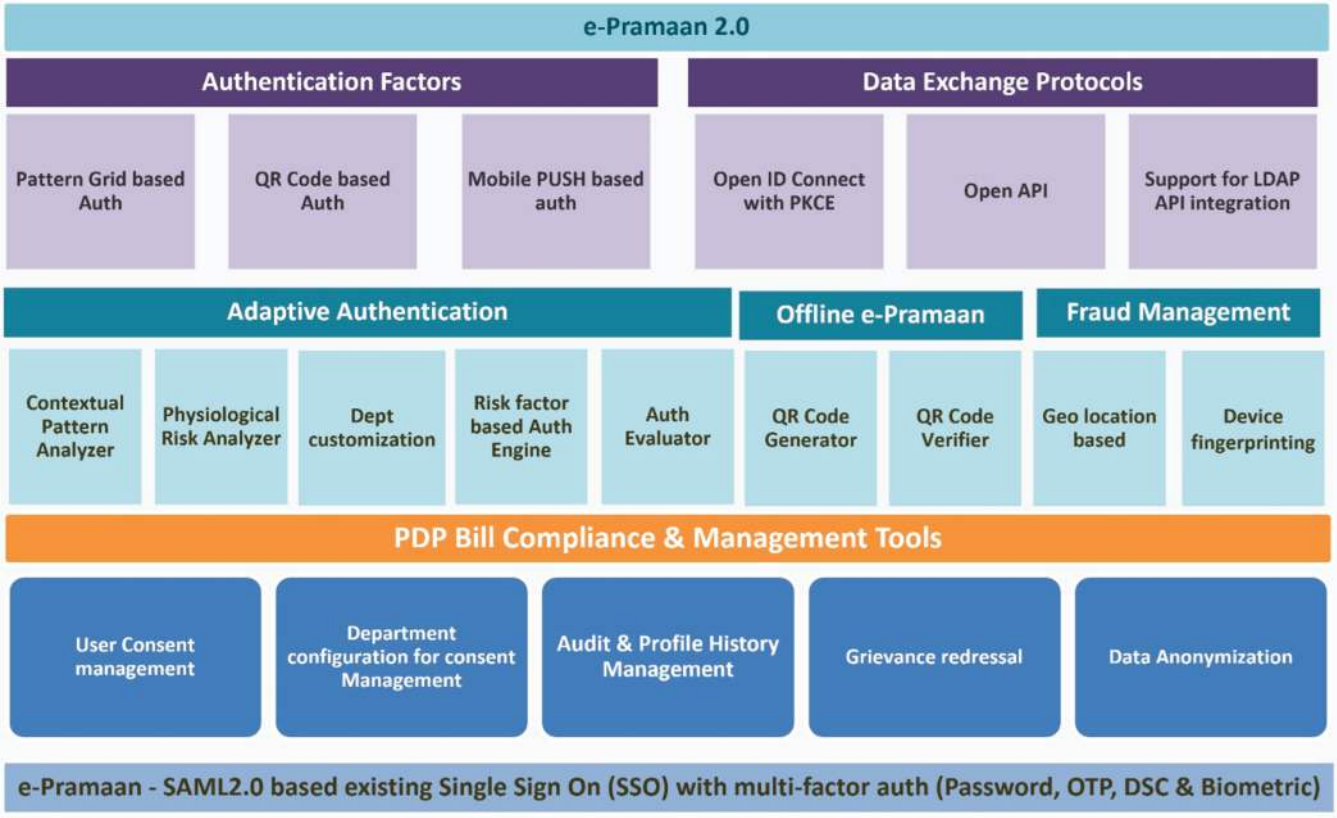
e-Hastakshar: An Online Digital Signing Facility

e-Sign services are offered by trusted third party service providers like Certifying Authorities (CA) licensed as per the IT Act under the Controller of Certifying Authorities (CCA) and UIDAI guidelines. C-DAC through its e-Hastakshar initiative enables citizens with valid Aadhaar ID and registered mobile number to carryout online digital signing of their documents. C-DAC's e-Sign service provides authentication based on multiple factors such as One-Time-Password (OTP, received through registered mobile in Aadhaar database)/TOTP/Biometric (Fingerprint and IRIS). C-DAC carried out integration with various Central/State/Union Territories government departments for leveraging e-Sign services. More than 9.60 Cr e-Sign have been issued by C-DAC from July 2016 to March 2023. During the year, the highest issued signatures by C-DAC ESP in a day stands at 2.08 Lakhs.

e-Pramaan 2.0: Authentication enhanced

e-Pramaan is a unique whole-of-government initiative for enabling Single Sign On (SSO) and e-Authentication for users of various entities. e-Pramaan 2.0 is an enhanced version, which aims to provide additional authentication features, user consent management, and robust security through fraud management techniques & an adaptive authentication feature. Furthermore, it also supports the Security Assertion Markup Language 2.0 (SAML 2.0) and Open ID Connect (OIDC) protocols, making it compatible with both web and mobile applications for authentication. The grid-based pattern authentication technique has also been incorporated as an additional authentication method. 339 e-Services from various Ministries and States are using e-Pramaan to achieve secure and strong authentication for their applications.

e-Pramaan is also facilitated through Meri Pehchaan, which is an extensive collaboration between the three main SSO platforms, e-Pramaan, Jan Parichay, and DigiLocker. NSSO allows uniform registration, which means that individuals only need to provide certain details once to use various services through any of the SSO platforms. All features of e-Pramaan can also be availed through NSSO. The Hon'ble Prime Minister launched MeriPehchaan on July 04, 2022, during the Digital India Week held at Gandhinagar, Gujarat.



e-Pramaan 2.0

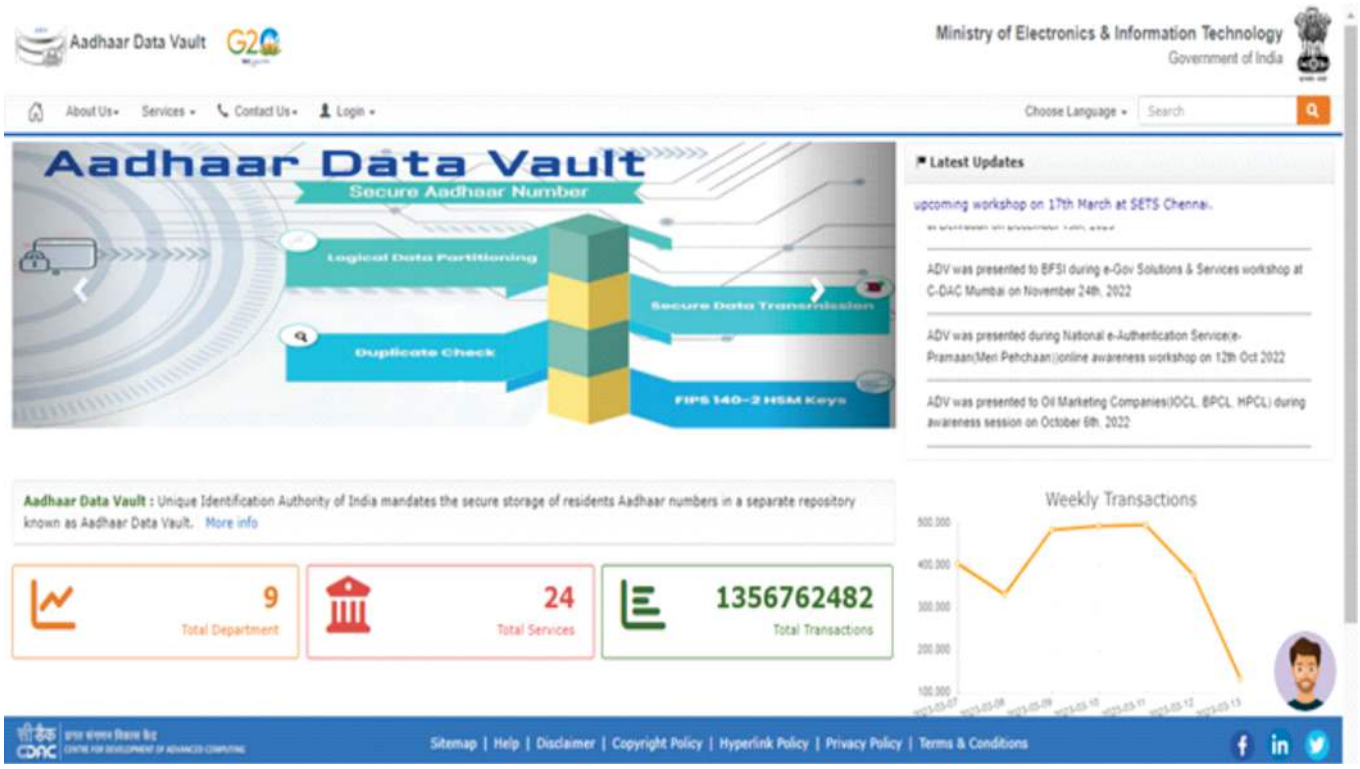
Aadhaar Ecosystem: National Services & Platform

C-DAC has a strong presence to facilitate Aadhaar-based authentication, e-KYC, and secure management of Aadhaar and its related data through national services and by offering the same platform as a product to various entities.

Aadhaar Data Vault as a Service

Under the Aadhaar Act and Regulations, 2016, the Unique Identification Authority of India (UIDAI) made it compulsory for the secure storage of the Aadhaar number and its related data collected by AUAs/KUAs/Sub-AUAs/ or any other agencies. To facilitate the same, a nationwide Aadhaar Data Vault as a service was made available during April 2022 to provide the secure storage of Aadhaar Numbers. Since its inception, many prominent entities such as Election Commission of India, Oil Marketing Companies (IOCL, HPCL and BPCL), Assam government, SIDBI, NSSO,

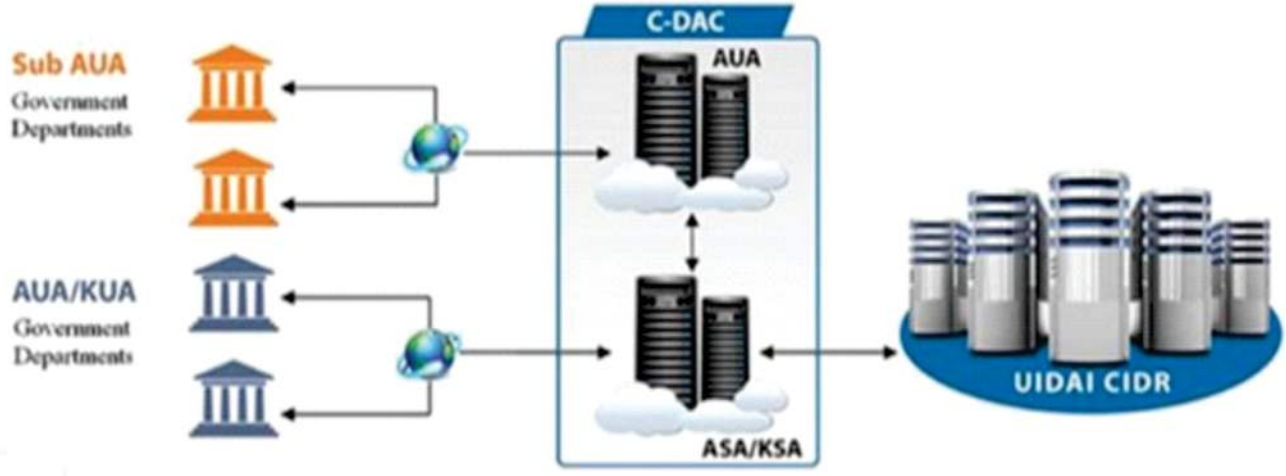
ESIC and others are using this service to secure their Aadhaar numbers in the vault. Aadhaar number is a unique ID and storing it in Aadhaar Data Vault helps entities find duplicate beneficiaries in different schemes. As of March 2023, more than 135 crore transactions had been carried out on this national service.



Aadhaar Data Vault

Aadhaar Authentication and e-KYC as a Service

C-DAC is empanelled with UIDAI as Authentication Service Agency (ASA), e-KYC Service Agency (KSA) and Authentication User Agency (AUA) for providing Aadhaar based authentication and e-KYC as a national service to various entities.



ASA-AUA (C-DAC Aadhaar Ecosystem)

Aadhaar Authentication and e-KYC Platform

The Aadhaar framework for Indian Oil Corporation Limited (IOCL) and Centre for e-Governance (CeG), Government of Karnataka to facilitate Aadhaar based authentication and e-KYC are provided as a solution and managed by C-DAC.

IOCL uses the platform to facilitate Aadhaar based authentication and e-KYC for Ujjawala Yojana 2.0. More than 2.4 crores of authentication/e-KYC are performed using this platform. Aadhaar Data Vault, one of the components of the overall solution, is used to secure Aadhaar numbers, and around 25 crore Aadhaar numbers of LPG beneficiaries are stored in the Aadhaar Data Vault as of March 2023.

Centre for e-Governance (CeG), Karnataka also has an instance of this solution to cater to the need for Aadhaar authentication and e-KYC to its residents availing beneficiary schemes in the Karnataka state. Over 30 crores of authentication/e-KYC have been performed as of March 2023 by CeG using this platform, which is deployed at the State Data Centre of CeG.

Cyber Forensics

CyberCheck

CyberCheck is a tool for forensics imaging and analysis of Disk based evidences. The Disk Forensics Tool is enhanced with Partition Preview, Deleted Partition Recovery, Link File analysis and enhancements in various modules including Browser Forensics, Windows 10 Forensics & Registry Analysis.

Advik CDR Analyser

Advik is a Call Data Record (CDR) Analyzer which can import and analyze CDR/IPDR logs of any service provider in India and generates a comprehensive report of frequency statistics including service provider details and subscriber details (SDR) of CDR Numbers. The tool is enhanced with features for Single Click CDR importer, Master database update and enhancements in CDR Importer & Case Management.

WinLift

Win-LiFT is a Windows Live Forensics Tool, enabling acquisition of volatile data from the required machine and analysis of the acquired data. During the year, the tool is enhanced with USN Journal analysis, PE Analysis and Browser Forensics of new Web Browsers- Yandex, Maxthon and UC Browser.

TrueImager

TrueImager is a high speed, light weight, portable disk imaging hardware solution with battery backup support. The storage media data acquisition tool is enhanced to support acquisition through PCI Express.

Cyber Forensic Triage Tool for Windows Offline Forensic Analysis

The proposed initiative aims to identify high priority artefacts which may hold the details of all recent activities and metadata of files & programs inside Windows Computers. This shall include identification of methodologies to decode the details available in those artefact files to reconstruct the evidence related to deleted and wiped-out information intentionally or unintentionally. Key outcomes shall include Cyber Forensics Triage Tool capable of doing major OS Artifacts Analysis, Link & Timeline Analysis and Detailed Report Generation. The initiative has been funded by Directorate of Forensic Science Services (DFSS), MHA.

Capacity Building and Awareness Generation

Capacity Development on Smart Device Forensics and Creation of Resource Centre for the North-Eastern Police Forces

This initiative aimed to create Resource Centre and Trained Manpower on Smart Device Forensics investigation. Under this initiative, Resource Centre has been created at NEPA, Shillong consisting of forensic workstation, mobile forensic software, IPDR analyzer tool and other necessary Computer systems, along with smart devices and the same has been utilized in conducting three levels (awareness, Intermediate and Advanced) of training programs. Overall

under the initiative, 562 Police personnel at Awareness Level, 101 Police personnel at Intermediate level and 66 Police personnel at Advanced level have been trained.

Cyber Forensic Training cum Investigation Labs at North-Eastern States and Cloud based Centralized Cyber Forensics Lab Infrastructure

C-DAC in collaboration with NIELIT is involved in Cyber Forensic Training cum development of Investigation Labs at North-Eastern States. During the year, 497 participants attended awareness level training, 280 participants attended Beginner level training, 52 participants attended Advanced level training, 22 participants attended Masters training and 46 participants attended Judiciary training. Till March 2023, in all 2138 Police Personal have been trained.

Information Security Education and Awareness (ISEA)

Information Security Education and Awareness (ISEA) initiative focuses on capacity building in the area of Information Security. During the year as part of ISEA Phase II, more than 12,000 candidates have been trained in various formal/non-formal courses in the area of Information Security through 52 institutions. Around 10 lakh candidates have been trained/under-going training in formal courses through affiliated colleges and 4,719 Government officials have been trained in various short-term programmes. Also, 89 awareness workshops have been organized through direct/e-learning/Virtual Instructor Led Training (VILT) mode across the country for different stakeholders covering 27,607 participants inter alia 11 workshops organized by covering 3,141 participants for MeitY and its attached organizations as part of Cyber Jagrukta Diwas. Besides this, 823 school teachers have been trained as master trainers in 2 training programs. 14 programs (2 AIR Programs and 12 TV programs) were organized by covering various topics of Cyber Security. In addition, online quizzes on cyber hygiene/cyber security aspects have been organized regularly for various users, in which 6.22 lakh candidates have participated and 3.21 lakh candidates have cleared the same.

C-DAC is also implementing 'Stay Safe Online (SSO)' campaign during India's presidency of G20. The campaign aimed at creating awareness among citizens to stay safe in an online world on the widespread use of social media platforms and rapid adoption of digital payments. The campaign involves the dissemination of multilingual awareness content and envisages a series of workshops/ webinars, and competitions at schools, colleges, workplaces, & industries to effectively disseminate cyber safety awareness. Stay Safe Online campaign has been launched by Shri Ashwini Vaishnaw, Hon'ble Minister for Electronics & Information Technology, Railways and Communications, Government of India on December 28, 2022.

Software Technologies Including FOSS

C-DAC has played a pivotal role in the conception, creation, and implementation of diverse e-Governance solutions & services, including Free and Open-Source Software (FOSS), GIS-based and accessibility-based solutions etc. for a diverse range of stakeholders. Platforms such as Mobile Seva app store facilitated various state and central departments/ agencies whereas software solutions such as GeoSadak, EPFO system, e-BIS, etc. have significantly added value to direct and indirect stakeholders. Various activities undertaken by C-DAC during the year in this area are listed below.

e-Governance Application and Services

Mobile Based Services

C-DAC offers mobile services through the App store and Mobile seva platform. These services are available to different entities as a national service.

Mobile AppStore

Mobile Seva Appstore is Nation's first indigenous App store and hosts more than 1,196 live apps with 9.02 crore downloads of various domains and categories. An extensive testing process is in place to ensure that secure apps are hosted on the platform. Hassle-free upload and download of Apps are supported and verified & digitally signed APK/APKS/AAB files are uploaded on the AppStore.

Mobile Seva-III

Mobile Seva is an integrated whole-of-government platform for all Government departments and agencies in the country to deliver public services to citizens and businesses over mobile devices. This platform offers features like geo-fencing digital broadcast, secure chat App, m-Gov App container, and Mobile App testing framework. 4,528 Dept/Agencies are integrated and utilizing services of this platform with overall 5000+ Cr transactions statistics. Additionally, 707 Services are available on the short code: 166/51969 through this platform.

Mobile based Services

Services for Election Commission of India

C-DAC has implemented and furnished software solutions to ECI for the implementation of its e-Services at the national level. These services are built on top of the electoral roll with 94 crores of electors and are provided to both citizens & ECI officials. These services are used extensively by citizens and officials throughout the year, especially during special drives, camps, publications, etc. The electoral roll management system was used to process over 8 crore forms, which were received for inclusion, deletion, and modification in the electoral roll. This system also facilitated the generation of EPIC & e-Roll PDFs, and more than 4.5 crore EPIC PDFs & 50 Lakhs e-Roll PDFs were generated.

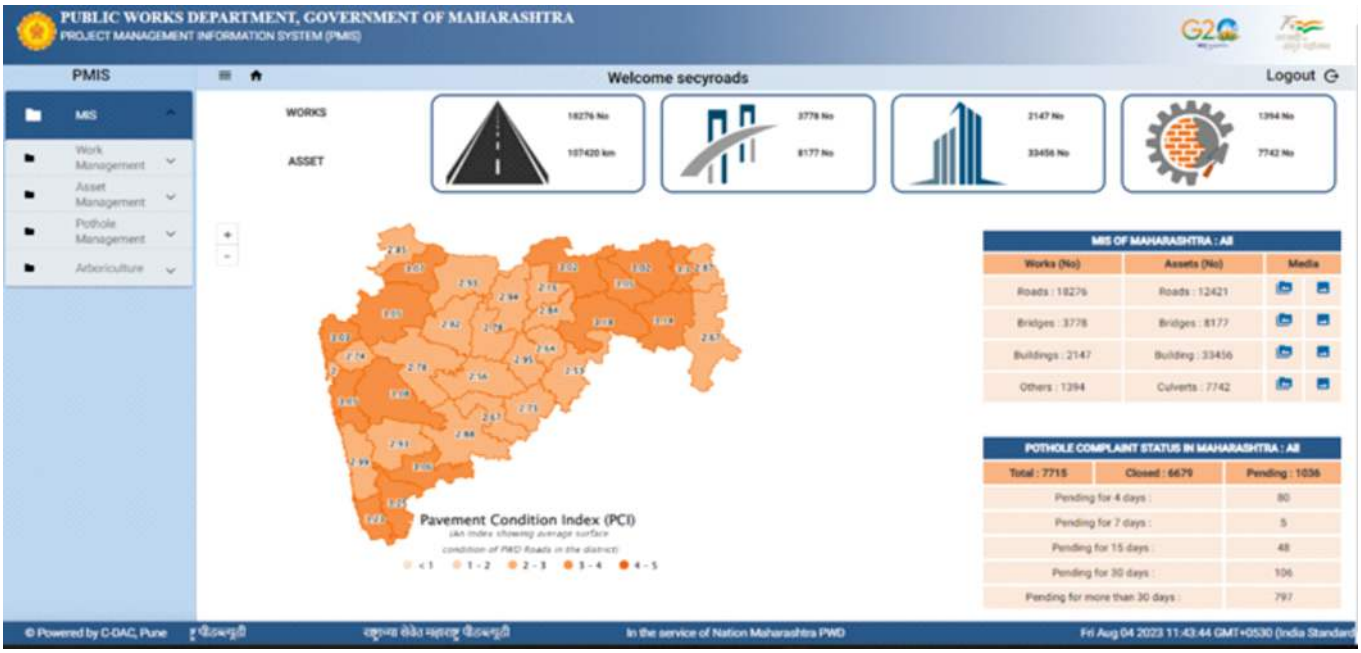
This system was integrated with Face Identification & De-duplication system, which was designed and developed by C-DAC to identify potential duplicates based on similar photographs. Using the integrated de-duplication tool, more than 3 crore identical photo entries were identified and over 1 crore duplicate records were deleted after thorough field verification by ECI officials. Also, as of March 2023, around 58 crores Voter Id were linked securely to Aadhaar number using the Aadhaar Data Vault service.

Portal for Election Commission of India

Project Management Information System (PMIS)

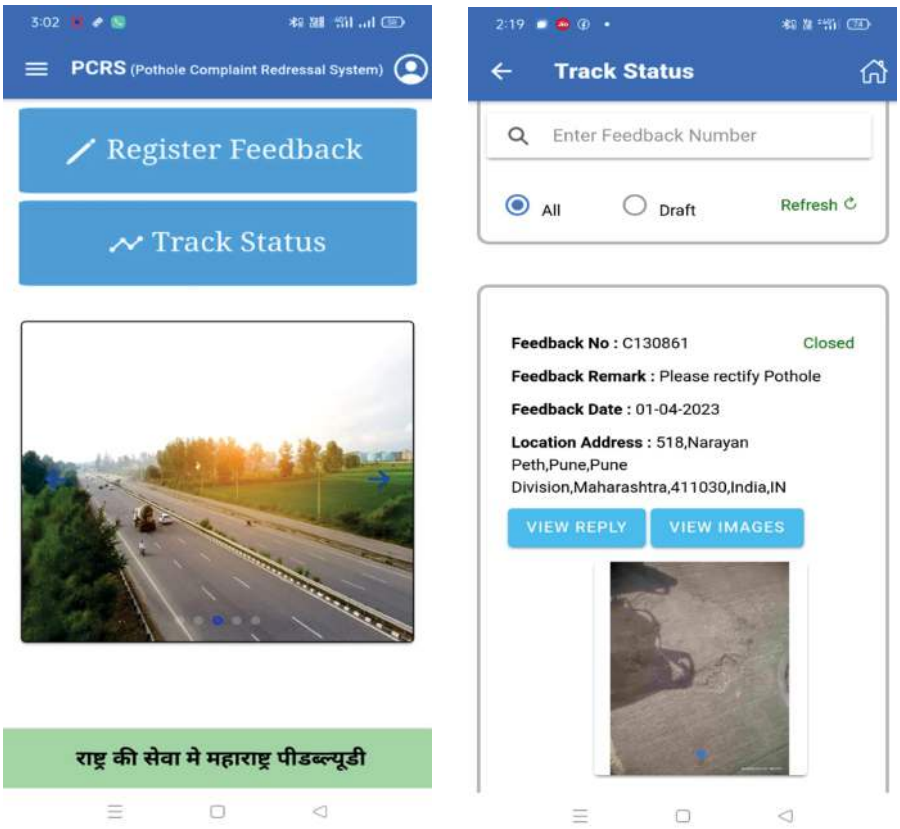
The Project Management Information System (PMIS) is designed for the Public Works Department (PwD) of the Government of Maharashtra with the objective of enhancing transparency in the department's operations. PMIS includes four major functions: Asset Management System, Works Management System, Comprehensive Dashboard-based MIS, and Pothole Complaint Redressal System (PCRS) mobile app. The system makes it easy to automate Business processes for transparency, accessibility, and efficiency for various transactions about an asset, such as works under way/completed, work orders, physical progress, e-Billing, etc.

The Assets Management component of the system has been created as a part of the government's PM Gathi Sakthi initiative to capture and compile the specifics of the assets in the department, specifically for roads, structures, bridges, land, machinery, and stores. The department currently has 1,04,916 km of road details, including national highways, state highways, Maharashtra state highway, major district roads, other district roads, and village roads. Additionally, details about 33,448 buildings and 7,688 bridges have been captured through this system.



Project Management Information System

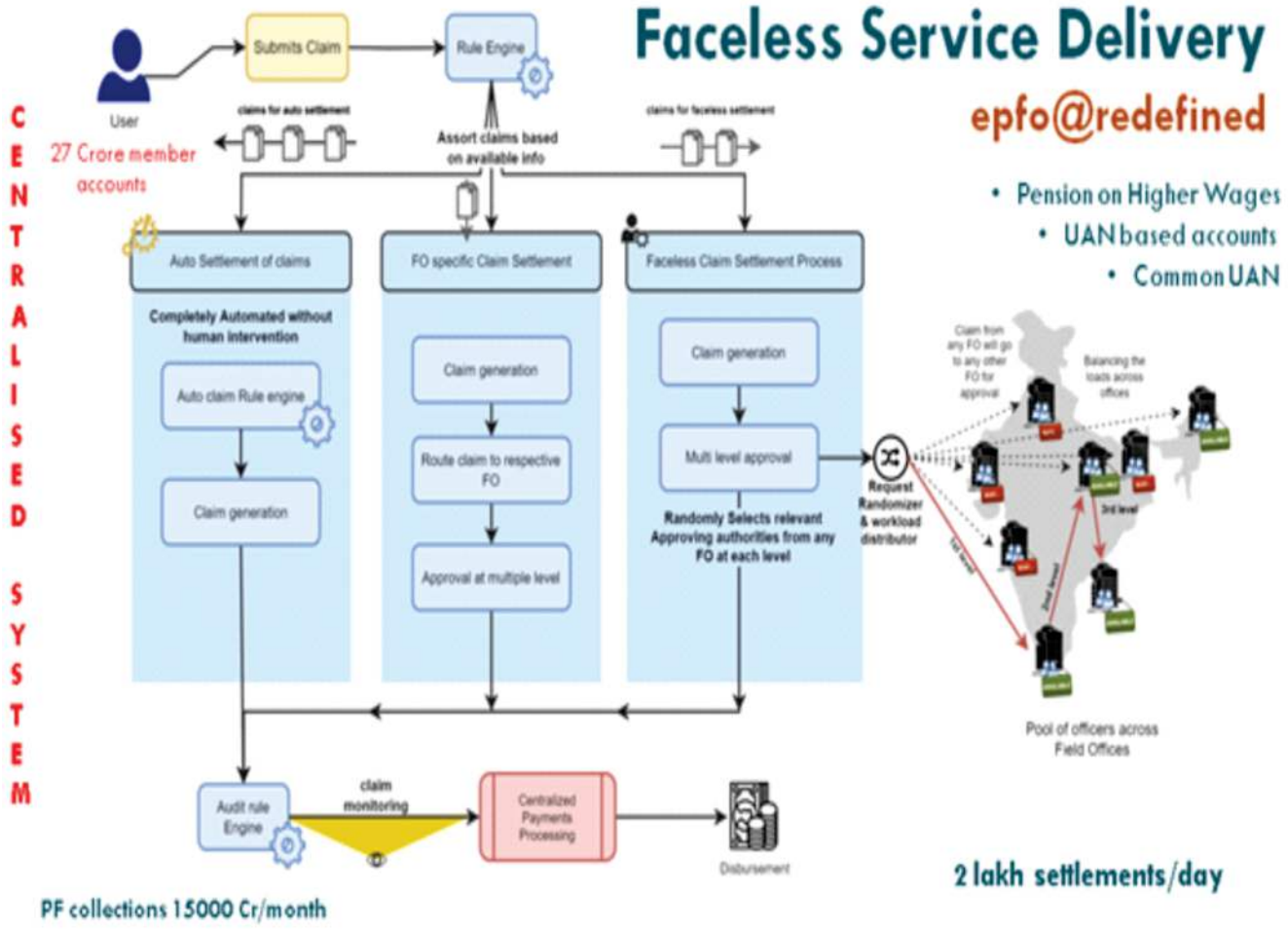
The Works Management component of the system automates the complete workflow of works starting from their inception until their completion, with a facility to map these works to the assets. Nearly 19,000 works of the department in the state are captured as of now, and a comprehensive MIS has been developed for real-time monitoring of the status, expenditure, grants received, and budget provision of works. The pothole compliant redressal component (PCRC) of the system is a GIS-based "PCRS" mobile app that allows citizens to register a complaint regarding the quality of the road along with 3 photographs of the site.



PCRS Mobile App

Centralized IT Enabled System for EPFO

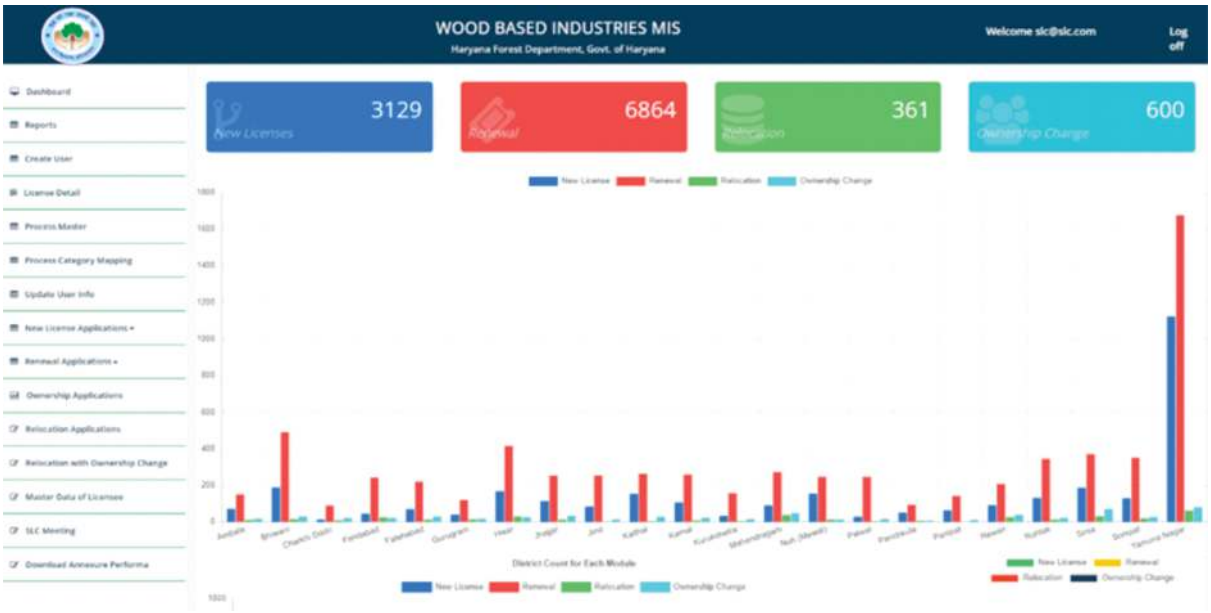
The centralized IT Enabled System for EPFO has been implemented to achieve the objective of One Member-One Account. The faceless service delivery feature of the system is a key factor to ensure transparency and efficient service delivery. Furthermore, C-DAC is enabling EPFO system with the Common UAN Engine, which will expand the ambit of UAN, once coined by EPFO, to the unorganized sector as well. This falls under the much-publicized, government-sponsored initiative of everyone having a uniform social security code. This will make sure that all sectors, both organized and unorganized, can work together and handle any financial payments made under the Government of India, DBT schemes, in a more efficient way.



Faceless Service Delivery by EPFO

Wood Based Industries Licensing System (Forest Department)

The process of issuance of a Wood Based Industries (WBI) license is automated with the help of a web-based solution. A WBI license is a document or certificate that gives permission to the applicant (person seeking to open a WBI unit) to commence business in a particular area or location. The software can assist in handling the requests related to the issuance of a new unit license, the renewal of the existing unit license, transfer of ownership and relocation of the unit. The system has many important features such as e-Sign using Aadhaar, e-Lottery, SMS alerts, online payment, and dashboard for visualizing the information. The system was deployed at Forest Department of Haryana with about 7,000 licenses issued, Forest Department of Uttar Pradesh with about 6,000 licenses issued and Forest Department of Punjab with about 4,000 licenses issued. The system is also given to the Forest Department in West Bengal.



Wood Based Industries Licensing System Dashboard

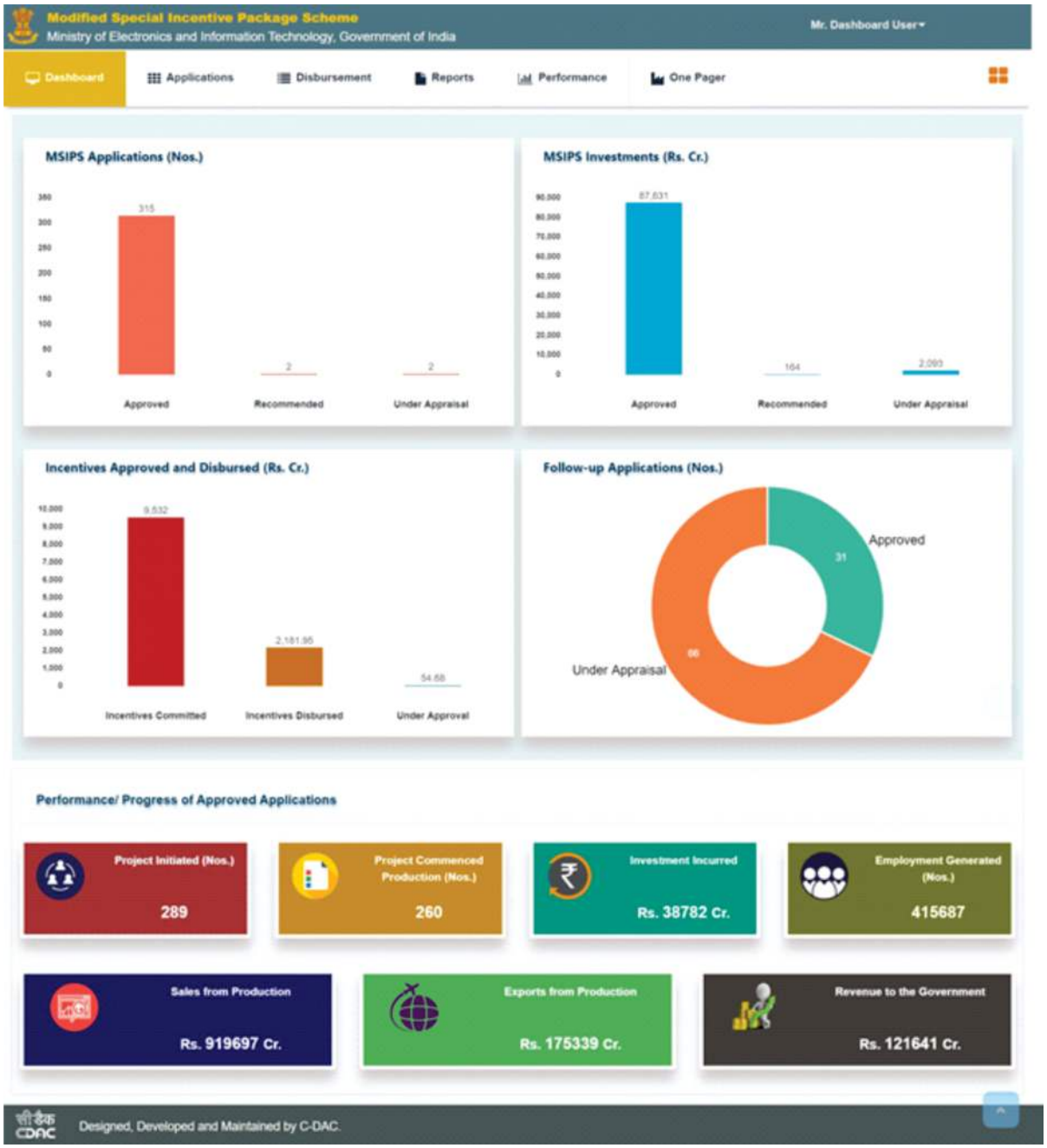
Web Portal & Dashboards for State S&T Programme (SSTP), DST

C-DAC has developed the dashboards for SSTP to grant and restrict activities for State S&T Council and Union Territory, along with monitoring the activities and events organized by them. The main feature of the developed portal comprises of customized dashboard, portal highlighting STI eco system etc. along with dashboard for State councils and UTs to facilitate updation of their activities.

Web Portal & Dashboard for State S&T Programme, DST

Online MSIPS 2.0 (e-MSIPS)

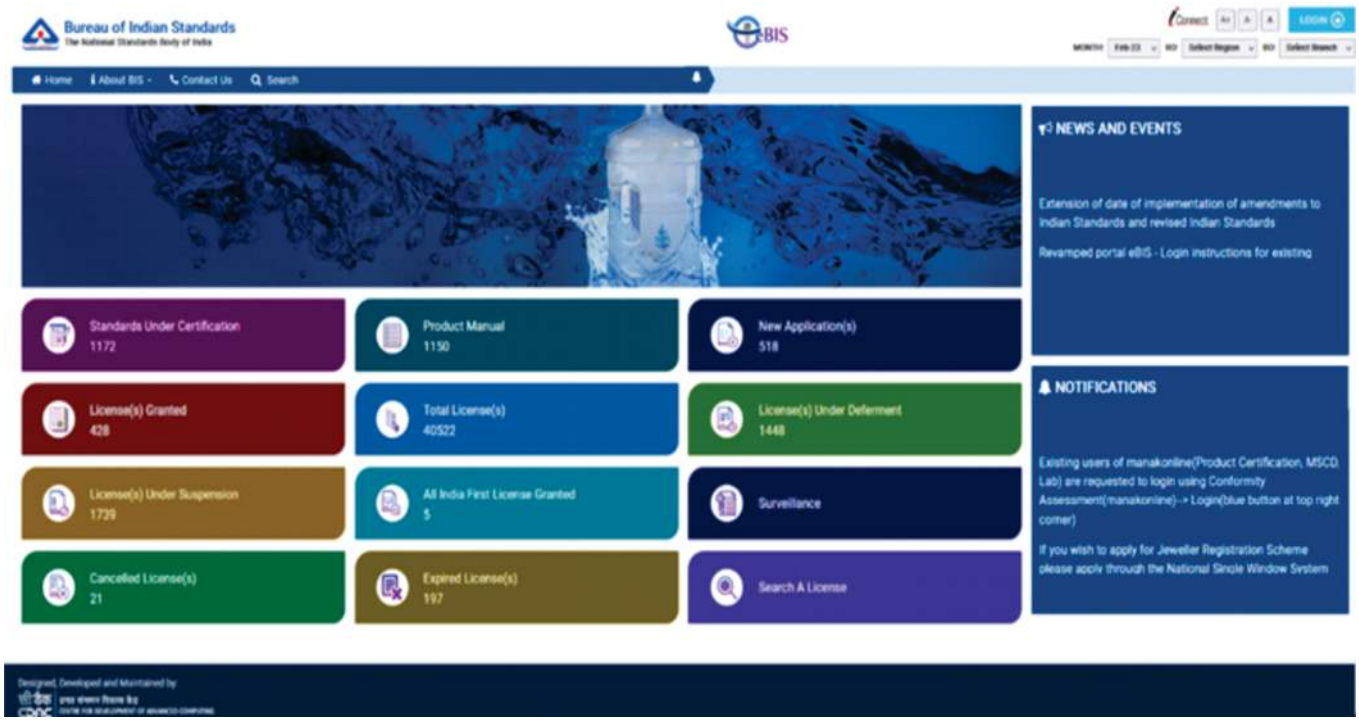
Electronic submission and scrutiny of applications submitted to the Ministry of Electronics & Information Technology (MeitY) under the Modified Special Incentive Package Scheme (MSIPS) and Electronics Manufacturing Cluster (EMC) Scheme is enabled by the e-MSIPS Application System. This Single Sign on (SSO) enabled system facilitates online submission of applications along with fee payment, valuation and monitoring of applications, configurable workflow, claim submission and disbursement. Additionally, the system provides an interactive analytical dashboard to top management stakeholders with query-based reports for performance monitoring.



e-MSIPS Dashboard

e-BIS Integrated Portal

An integrated portal of e-BIS is made accessible to all stakeholders from Industry, Consumers, Labs, and BIS under a single umbrella. e-BIS facilitates the application submission for Grant of License and associated operations for different schemes running in BIS. The system provides customized workflow for the license operation for Product Certification (ISI Mark), Hallmarking Jeweler registration and Assay & Hallmarking centres, Foreign Manufacturer etc. The Bureau provides real-time monitoring, data visualization across a variety of services through this integrated portal and Factory & Market Surveillance of ISI & Hallmarked products. The entire surveillance activity is done through a mobile app with the surveillance officers' Lat/Long location. This portal is also integrated with the National Single Window System (NSWS), e-Nivesh, Prayash, GeM, Standard Formulation, and the Consumer Affair Department. Around 5311 licenses, 37481 renewals & inclusions of licenses were issued through e-BIS. Additionally, 23754 Jewelers registration, 43439 Jeweler's surveillance and hallmarking of 11,99,24,938 items were carried out during 2022-2023.



e-BIS Portal

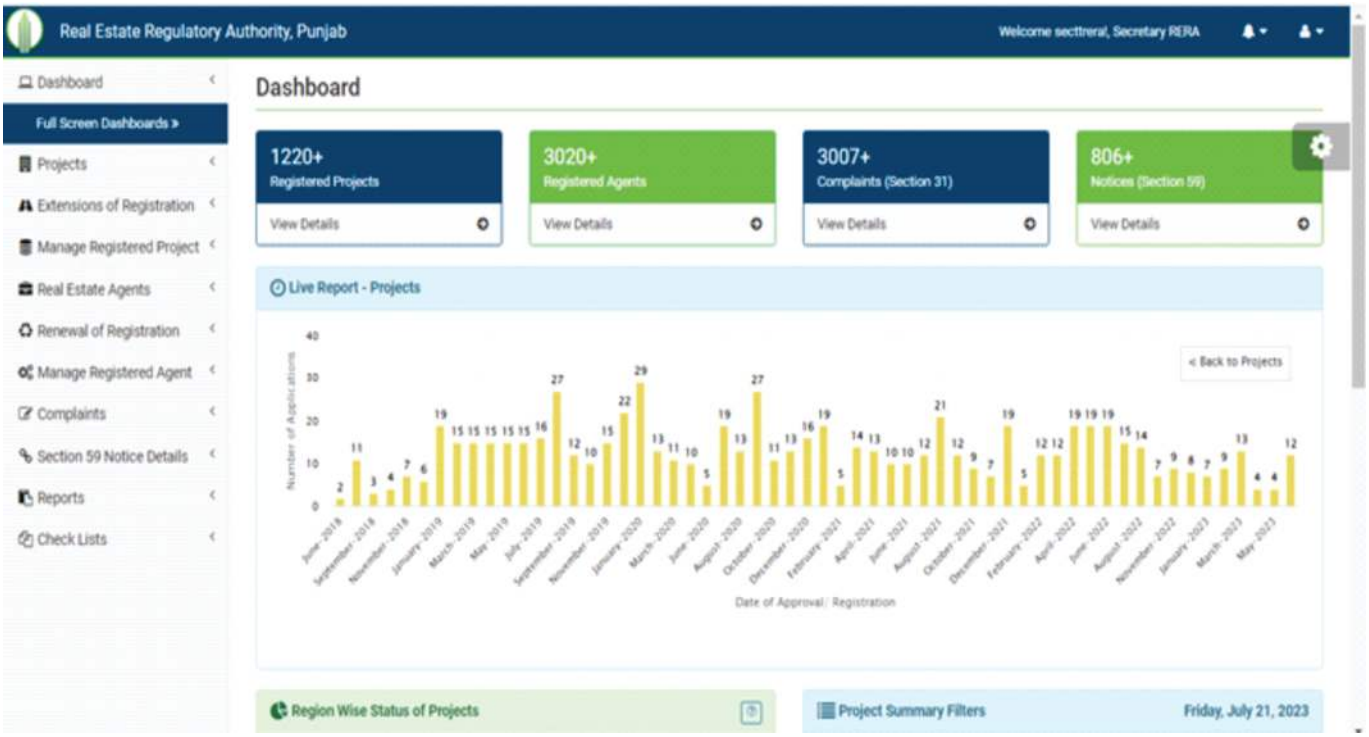
Electronic Project Proposal Management System (e-PPMS)

The Electronic Project Proposal Management System (e-PPMS) is used to manage the whole life cycle of funding R&D projects, from the online submission of project proposals for funds to the monitoring and management of projects funded by DRDO. The e-PPMS provided to DRDO has been extended during 2022-23 to support 6 more schemes: ER&IPR Grants-In-Aid, ER&IPR Seminar Symposia, ARDB Grants-In-Aid, ARMREB Grants-In-Aid, LSRB Grants-In-Aid, and NRB Grants-In-Aid.

e-PPMS Portal

Real Estate Regulatory Authority (RERA) Web-Portal

A unified and cross-functional solution was provided to Real Estate Regulatory Authority (RERA), Government of Punjab to automate state-level functions of real estate regulatory authority. The system enables an efficient analysis of real estate project data and other information, thereby facilitating effortless decision-making. The solution addresses automation of various activities, including but not limited to real estate projects, real estate agents, e-courts, complaints, and authority, among others. This solution yielded benefits to 1220 real estate projects, 3020 registered real estate agents, 4502 advocates, and 3986 promoters.



e-RERA Portal

e-PyFMS & e-HRMS

Human Resource and Financial Management System (HFMS) is a centralized web-based application for fully automated office/organization activities. HFMS helps to improve efficiency, consistency, transparency, and effectiveness in the system. HFMS system consists of verticals such as Personnel Information System (e-HRMS) and Payroll Management System & Financial Management System (e-PyFMS). The HFMS is developed as per service rules and regulations of Government of India with special business rules for medical colleges. It can also be configured for various institutes and can cater to various types of employees. HFMS has been deployed in MGIMS Sevagram, PGIMER Chandigarh and NIMS Hyderabad. During this year rollout of HRMS & Payroll has been initiated in AIIMS Delhi and AIIMS Bhubaneshwar.

Open-Source Software and ICT for Social Development

Secure BOSS OS for DSCC, Bhopal

The Secure BOSS Operating System has been meticulously tailored to meet specific requirements and has been developed for DSSC Bhopal. This solution incorporates continuous real-time monitoring as an integral component. Additionally, instance of Secure Boss complies to cyber audit policy and supports disk encryption, policy management server, auto patch and security updates, blocking of external storage media, Bluetooth etc.

Secure BOSS Student Exam Management and Assessment System

The Secure BOSS Student Exam Management and Assessment System has been developed and deployed across 6,000 schools, encompassing a total of 1,20,000 client machines. This comprehensive system incorporates continuous assessment capabilities, enabling the regular and periodic monitoring of students' learning outcomes.

Meghdoot

Meghdoot cloud has been implemented at Tamil Nadu State Data Center. It currently hosts over 160 applications and accommodates approximately 600 virtual machines (Vms). To enhance the user experience, C-DAC is in the process of developing a comprehensive portal that will facilitate the seamless launching of VMs and provide real-time monitoring capabilities for the virtual machine environment.

Vikaspedia – Phase II

Vikaspedia, as a platform facilitates the accessibility of electronic knowledge and information, and the utilization of ICT for the empowerment of the common man. The platform has implemented Indianized Domain Names (IDN) in all 22 constitutionally recognized languages of the country, according to the guidelines laid down by MeitY. The platform has 1.78+ lakh registered volunteers & 150+ institutions with almost 10.80 million users / month. Four Thematic outreach campaigns through various ICT modes have been conducted in Northern, North-eastern, and aspirational districts of the country covering a population of about 200–220 lakhs. Rollout of 8 citizen-centric services in association with Aspirational districts/other government programmes has been carried out to maximize the utility of Government schemes.

Vikaspedia

ARJUN-MIS Web Portal for Empowerment of Divyangjan

The ARJUN-MIS Portal was developed under the Digital India initiative of Indian Government. This portal is used to create a central database for Aids and Assistive devices that disabled people can get under the DEPwD ADIP scheme. This portal facilitates the integration of all implementing agencies, including National Institute, ALIMCO, NGO's Trust, and other states & regional agencies, into a single platform. It also serves as a central repository for centralized databases of disabled individuals and provides details of aids & assistance devices to beneficiaries. The system ensures that multiple aids and assistive devices are not availed from different scheme implementation agencies. It is

also helpful for disabled people to raise online grievances to the Implementing agency if any replacement or new device is required from the agency. This portal also has online video tutorials/documents about how to use and fix the issued devices.

ARJUN-MIS Portal

Knowledge & Resource Centre for Accessibility in ICT (KAI)

KAI is an initiative of the Ministry of Electronics & Information Technology (MeitY), Government of India for the preparation of Standard for Accessibility requirements for ICT products & services and to carry out training & capacity building. MeitY & C-DAC have been engaged in formulating ICT Accessibility standards along with STQC & BIS. "Accessibility for ICT Products and Services" Part I Requirements (IS 17802 Part I):2021 were gazetted by Bureau of Indian Standards (BIS) on December 24, 2021, and subsequently, Part II Determinants of Conformance (IS 17802 Part 2):2022 have been gazetted by BIS on May 10, 2022.

GIS Based Solutions

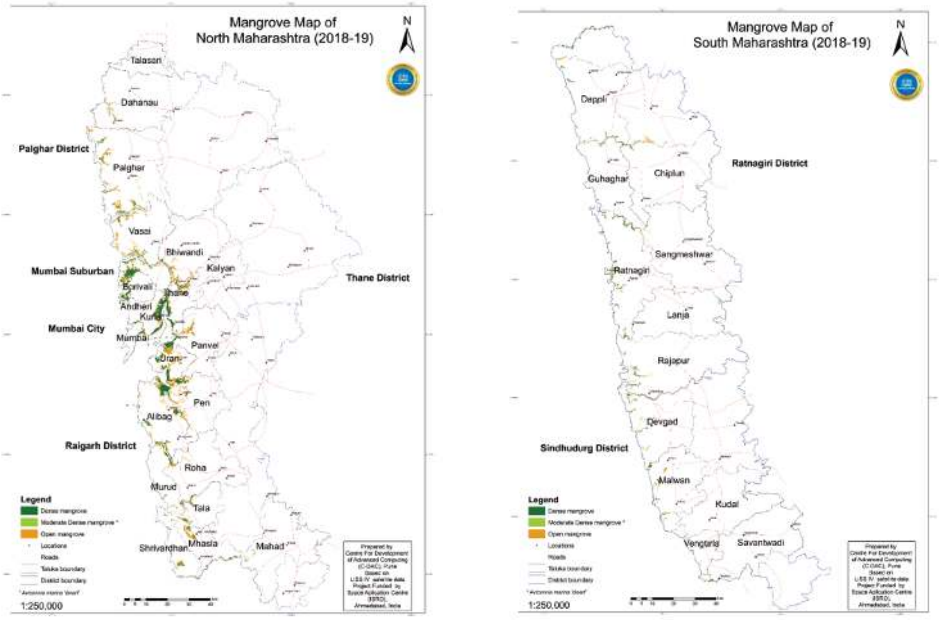
GeoSadak (Online Geospatial Transaction System)

GeoSadak is a web-based application powered by the GeoSevak (Online Geospatial Transaction System) framework of C-DAC, aligned with 'Atmanirbhar Bharat'. GeoSadak has been specifically designed and developed for the national GIS mission of the Pradhan Mantri Gram Sadak Yojana (PMGSY). GeoSadak facilitates the online collection, management, uploading, spatial data quality report, download, editing, simulation of spatial data/modeling, vehicle tracking system, creation and approval of new road / bridge proposals, and provision of geospatial data in real time. The system is being used by all the state government departments, NRIDA (Ministry of Rural Development), and PMGSY auditors for monitoring and management. More than 16,000 road and bridge proposals have been approved through GeoSadak as of March 2023. According to the Government of India's National Data Sharing and Accessibility Policy, GeoSadak provides open GIS data for public use. The Director General of NRIDA and the Additional Secretary of MoRD unveiled the Open GIS data, Geo-AI desk verification, and Field-GIS, a mobile application for creating PMGSY proposals and capturing geotagged photos as part of the platform on February 22, 2023.

GeoSadak (Online Geospatial Transaction System) for PMGSY National GIS mission (https://geosadak-pmgsy.nic.in/)

Mangrove Mapping of the Coast of Maharashtra

The initiative was intended to investigate the extent of mangroves and examine its evolution over the period in the state of Maharashtra, using the LISS III and LISS IV satellite datasets, and conduct community zonation. A mangrove map at a 1:25000 scale using data of year 2018-2019 for Maharashtra has been made available to ISRO. Furthermore, a mangrove species zonation map has also been prepared along with phenological investigations for the state of Maharashtra.



Mangrove Mapping

Healthcare Technologies

Healthcare Technologies have played a significant role during the last few years in improving the quality of life across society. C-DAC's Techno-Healthcare Solutions including Applied Healthcare Solutions & Healthcare Informatics have immensely contributed in achieving the goals of making affordable and quality Healthcare accessible to the public. Quick and easy access to these solutions on diverse platforms such as smart devices has further enhanced the spread of these solutions among doctors and medical specialists. C-DAC has also contributed to standards and best practices development for various healthcare technologies and related areas. Activities carried out by C-DAC during the year in Healthcare Technologies are elaborated below.

Health Informatics

Key Impact Initiatives

eSanjeevani 2.0

eSanjeevani is an indigenous and cost-effective telemedicine system developed as per the requirements and workflows outlined in the guidelines for Telemedicine Services in Ayushman Bharat – Health & Wellness Centres, issued by Ministry of Health and Family Welfare (MoHFW). The initiative is funded by MoHFW, Government of India. eSanjeevani 1.0 is offered in two modes (a) eSanjeevaniAB-HWC: A Doctor-to-Doctor telemedicine system at Health & Wellness Centres, to provision specialised health services in rural areas and isolated communities and (b) eSanjeevani-OPD: A Patient-to-Doctor, telemedicine system to enable people to get outpatient services in the confines of their homes. This variant was launched during the peak of COVID 19, with an aim to provide safe Doctor-to-Patient consultation.

After the successful rollout of the national telemedicine service eSanjeevani1.0, MoHFW has extended it as eSanjeevani 2.0 - Augmentation of eSanjeevani National telemedicine service. eSanjeevani 2.0 is a unified and scalable platform, offering both the modes of consultations from single platform and rolled out in February-March 2023.

The National Telemedicine Service of India has served over 107.70 million patients at over 115,000 Health & Wellness Centres (as spokes) through 15,700+ hubs and over 1100 online OPDs serviced by more than 200,000 doctors, medical specialists, super-specialists, and health workers as telemedicine practitioners, till March 2023. The landmark of 10 crore tele-consultations on eSanjeevani app was hailed by Shri Narendra Modi, Hon'ble Prime Minister of India, during 98th edition of Mann Ki Baat on February 26, 2023.

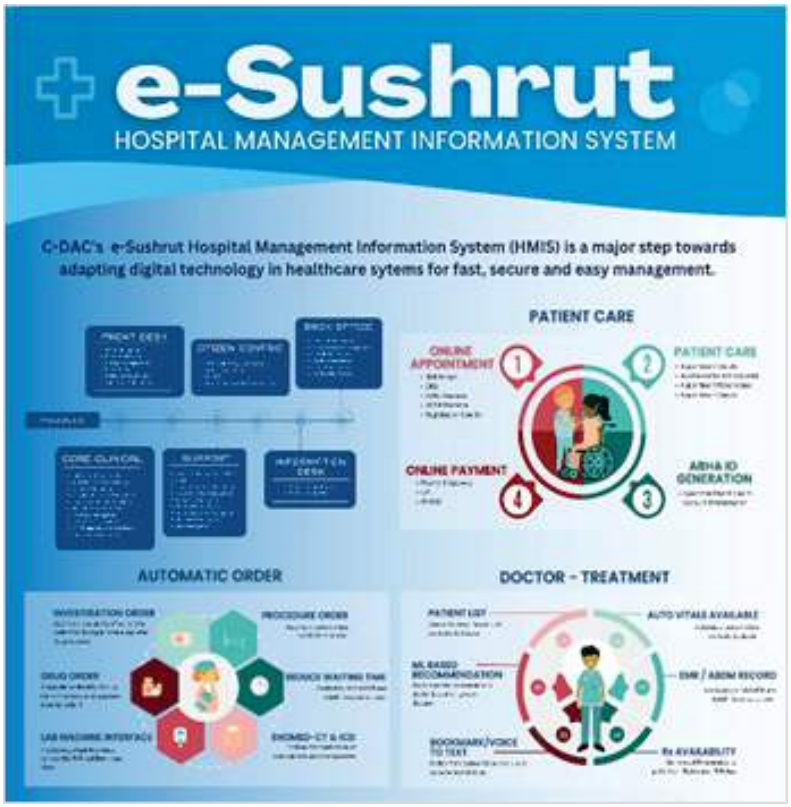
e-Sushrut

e-Sushrut Hospital Management Information System (HMIS) incorporates an integrated computerized clinical information system for improved Hospital administration and patient health care record Management. It provides an accurate, electronically stored medical record of the patient. The real-time e-Sushrut streamlines the treatment flow of patients and simultaneously empowers workforce to perform to their peak ability, in an optimized and efficient manner. During the year, C-DAC has initiated the following rollout of e-Sushrut HMIS

- State wide rollout in State of UP (450+ Health Facility-MCH/DH/CHC),
- State wide rollout in State of Telangana (102 Health Facility- MCH/DH/CHC/AH)
- State wide rollout in State of Odisha (106 UPHCs+ 11-THs+31DHHs+16CHCs+24PHCs+)
- State wide rollout in State of Goa (30+ Health Facility -MCH/DH/CHC),
- State wide rollout in State of Sikkim (6 Health Facility -DH/CHC)
- State wide rollout in State of Arunachal Pradesh (100+ Health Facility- MCH/DH/CHC/PHC)
- AIIMS Bibi Nagar and AIIMS Guwahati
- Bokaro Genera Hospital SAIL Bokaro
- Ispat General Hospital SAIL Rourkela
- 22 Health Facilities under NHPC

e-Sushrut HMIS is being rolled out in State of Maharashtra (700+ Health Facilities – DH/CHC), State of Punjab (500+ Health Facilities – DH/Mohalla Clinics), Indian Railway Hospitals (700+ Health Facilities-Central Hospitals/Divisional Hospitals/Clinics), 12 AIIMS, SAIL Bokaro, SAIL Rourkela, NIMS Hyderabad.

During the year, additional modules of Ticket Generation and Tracking Tool, Self-Registration KIOSK integrated with ABDM's Scan & Share Feature and QR Code Payment, and Offline Lab/Investigation Solution have been added in the e-Sushrut HMIS.



e-Sushrut

e-Aushadhi

e-Aushadhi Drugs and Vaccine Distribution Management System (DVDMS) is a web-based application that deals with the supply chain management of pharmaceutical stocks including drugs, sutures, and surgical items required by different district drug warehouses. The main aim of DVDMS is to ascertain the pharmaceutical needs of various district drug warehouses such that all the required materials/drugs are constantly available to be supplied to the user district drug warehouses without delay. This includes classification/categorization of items, codification of items, a quality check of these items, etc. and finally issuing drugs to the patients, who is the final consumer in the chain without any delay. Currently, 22 States, 03 UTs, 05 Central Programs and 01 Program under Ministry of Defence are using this application. This year's additions to the list include the State of Odisha, Director Insurance Medical Services (DIMS) AP, UTs of Lakshadweep & Andaman and Nicobar.

e-RaktKosh-2.0

e-RaktKosh funded by the Ministry of Health and Family Welfare (MoHFW), is a comprehensive IT solution to connect, digitize and streamline the workflow of blood banks. It has on-boarded more than 2800 blood banks on its platform. e-RaktKosh Portal is also extensively used by the citizens for requirements related to blood, blood banks' location identification, blood stock Enquiry, maintenance of donation repository etc. e-RaktKosh is integrated with various state-wide blood bank solutions & has become a single data repository for management of data regarding blood, blood-related products, blood donation camps, donor repository etc. Raktdaan Amrit Mahotsav, a nationwide voluntary blood donation drive of MoHFW, was organized from September 17, 2022 to October 01, 2022 wherein e-RaktKosh web portal was earmarked as the interface for Blood Centres/Blood Banks/Blood donation

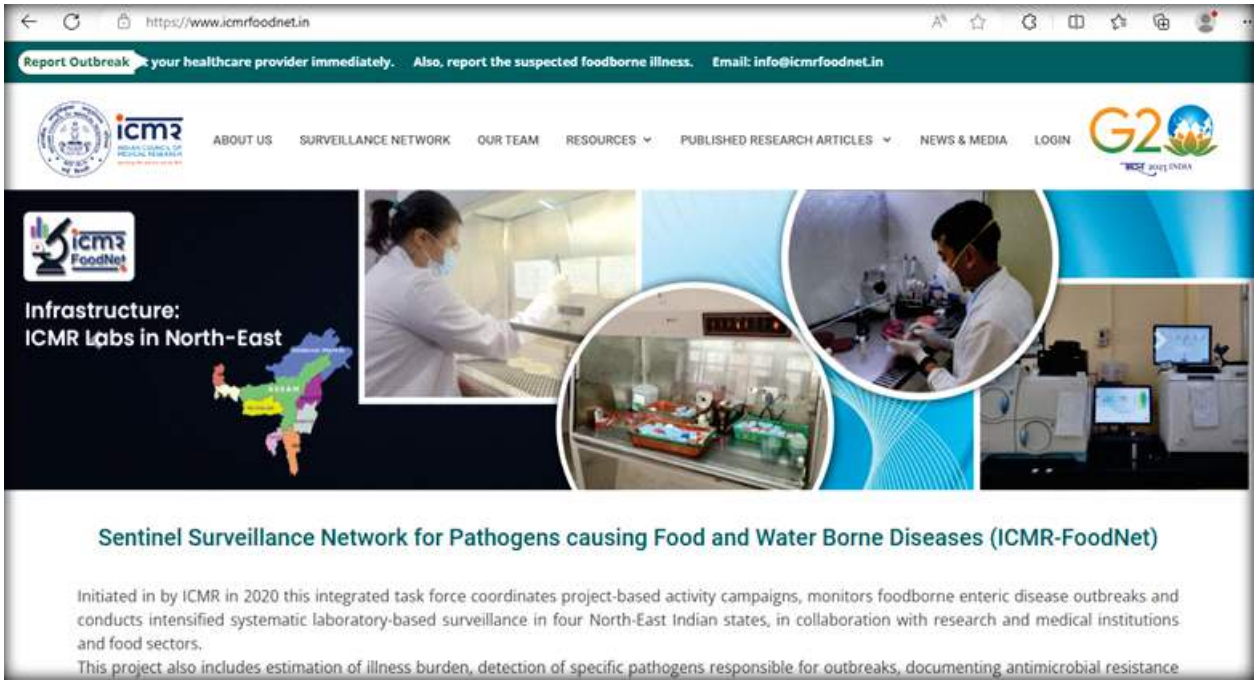
camps and voluntary donors. More than 1 Lacs blood donations were done on September 17, 2022 itself under the initiative. e-RaktKosh application has also been integrated with Paytm and Arogya Setu for Blood Stock enquiry.

e-RaktKosh Portal

System Solutions

Centralized Data Management & Analytical Platform (ICMR-FoodNet) for Surveillance of Foodborne Disease Pathogens from North-East India

C-DAC has developed a Web-based Data Repository, Retrieval, and Analytical Platform (ICMR-FoodNet) for ICMR to understand the epidemiology of foodborne diseases of public health importance across North Eastern states. The prime objective is to identify major pathogens present in food items and water sources by collecting samples from food markets, hospitals and local communities for routine surveillance and subsequent analysis which is required to investigate major outbreaks. ICMR FoodNet Digital Platform (https://icmfoodnet.in) has been inaugurated on August 03, 2022 at ICMR-RMRC, Dibrugarh, Assam



ICMR Foodnet Platform

Pharmacy and Specialization OPD module for SeHAT Phase – II

As a part of Services e-Health Assistance and Teleconsultation (SeHAT) Phase-II, two additional modules namely (a) Pharmacy Module and (b) Specialized OPD Modules are being developed. The aim is to empower clinicians and beneficiaries through seamless integration with Tele-consultation Software SeHAT.

e-Upkaran – Equipment Management and Maintenance System

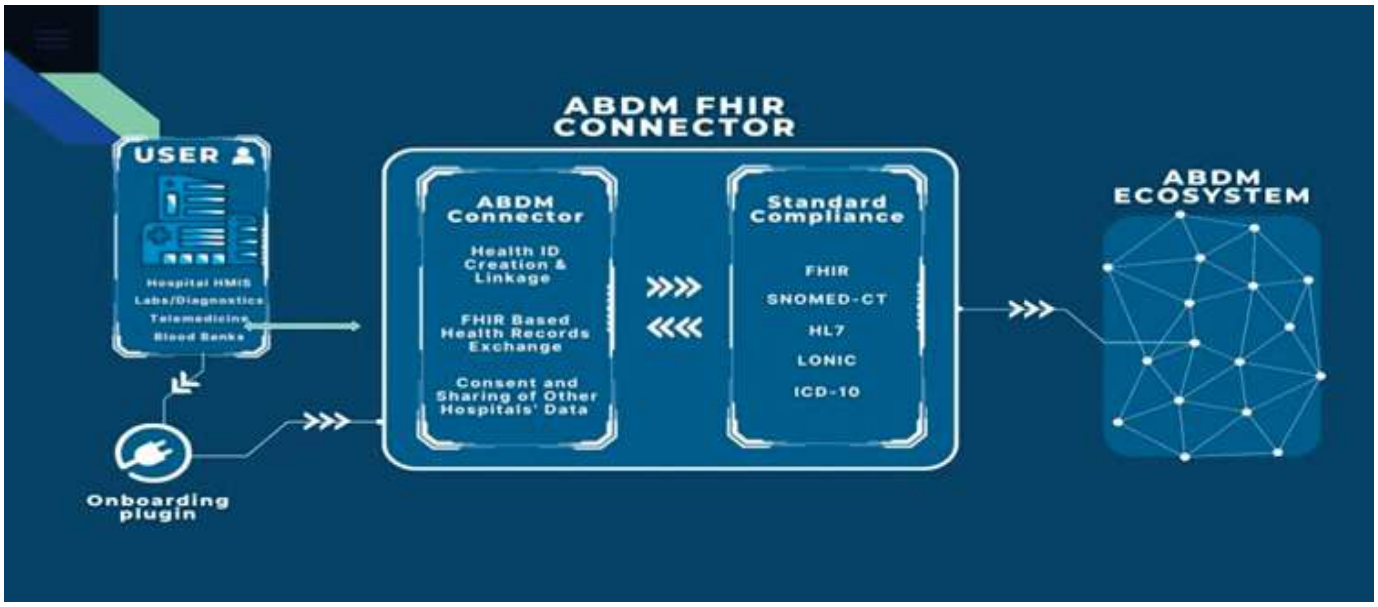
e-Upkaran is a software system to manage Medical Equipment life cycle for the equipments deployed across the States. e-Upkaran facilitates services like Equipment Inventory management, Annual Maintenance Complaint Management, Equipment servicing Condemnation etc. for Healthcare Organizations. Currently, 11 States are using this application. This year's additions to the list include State of Uttar Pradesh.

MedSIM 2.0 Online Skills Lab and Virtual Patient Cases

MedSIM is an online Healthcare Skill Laboratory providing interactive e-learning platform to support case-based medical simulations for the medical students/trainees. The Medical Simulations replicate clinical case scenarios by integrating 2D and 3D animations. MedSIM 2.0 is India's first-ever medical-grade virtual patient case simulation platform created to cater to the medical undergraduate curriculum. The initiative is in collaboration with Amrita Viswa Vidyapeetham and AIIMS Bhubaneswar.

ABDM FHIR Connector

Ayushman Bharat Digital Mission (ABDM) Fast Healthcare Interoperability Resources (FHIR) Connector is based on EHR-2016 (Electronic Health Record-2016) and FHIR standard, integrated with the ABDM ecosystem. The system provides the standardize Health Information Exchange through Open APIs. By abstracting out the technicalities of standard implementation and data exchange, the system aids the legacy as well as upcoming healthcare applications to be easily on-boarded on ABDM ecosystem. ABDM FHIR Connector supports various building blocks such as ABHA Creation & linkage, Clinical Record Linkage, Clinical Record Sharing, Scan and Share etc. ABDM FHIR connector enables all instances of C-DAC e-Sushrut (Hospital Management Information System) compliance to ABDM Millstones. The solution has been implemented at AIIMS Nagpur, AIIMS Raipur, AIIMS Bhubaneshwar, AIIMS Mangalagiri, AIIMS Kalyani, AIIMS Deoghar, AIIMS Patna, AIIMS Gorakhpur, AIIMS Bhatinda, AIIMS Bibinagar, AIIMS Rajkot, AIIMS Bhopal, AIIMS Raebareli, AIIMS Guwahati, state instances of State implementations in Punjab, Sikkim, Goa, Arunachal Pradesh, Uttar Pradesh, and Railways Hospitals etc.



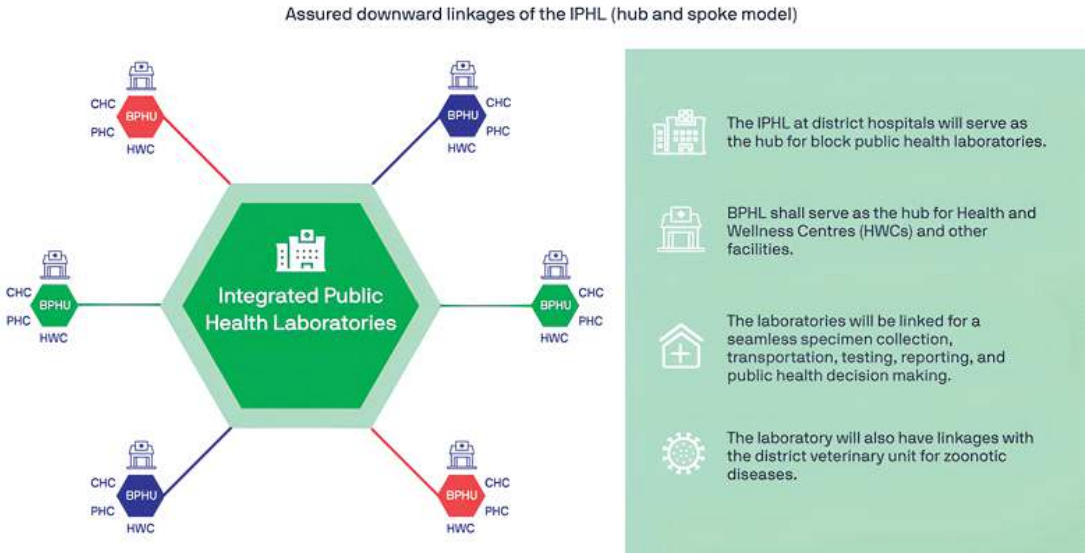
ABDM Integrations

IPHL Mobile App (A Mobile solution for Integrated Public Health Labs-Odisha State)

The National Health Mission (NHM) in Odisha State is actively implementing the Integrated Public Health Laboratory (IPHL) scheme to address healthcare challenges. The primary objective of this program is to reduce mortality,

morbidity, and Out of Pocket Expenditure (OOPE) by efficiently preventing and controlling diseases. To achieve this, the scheme emphasizes rapid and reliable screening, early detection, and laboratory diagnosis of communicable, non-communicable, and emerging diseases.

To facilitate diagnostic testing for citizens, NHM Odisha is distributing 13 different diagnostic kits at PHCs, Sub Centers and Health & Wellness centers. C-DAC's Android solution provides a platform to capture regular diagnostic reports from the Health & Wellness Centers (HWC) level. The IPHL-Analytics module of the mobile app empowers NHM officials at the state level to monitor diagnostic test results in real-time, gaining insights into disease spread throughout the state. Currently, the application is actively utilized by NHM Odisha across 1288 PHCs and 6688 Sub Centers throughout the State of Odisha, reinforcing the mission's commitment to ensuring accessible and efficient healthcare services.



IPHL Linkages

Online National Drug Licensing System: e-Governance Solution for Central Drugs Standard Control Organization

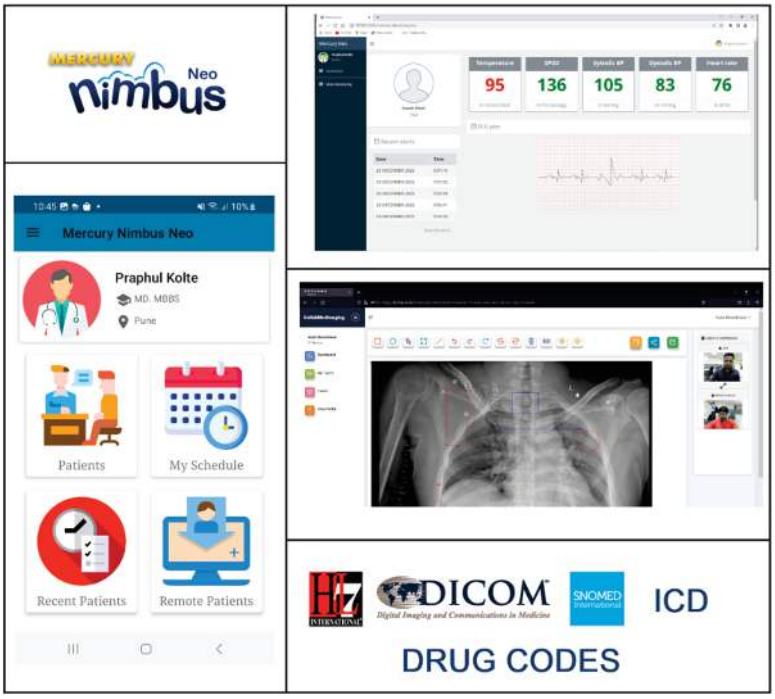
An Online National Drug Licensing System is an online interface for Applicants to submit applications, upload supporting documents, respond to queries received from State Drug Controllers, and track their application status. The user account and dashboard enable a user to track and keep a record of all the licenses held by him/her throughout the country, track the user applications, issued licenses, suspended, and cancelled licenses, details of the manufacturing facilities at each location, etc. The system also facilitates the State Drug Controllers and their officials to process the applications, interact with applicants, dispose of applications, and generating MIS reports. This also provides a Dashboard for State Drug Controller, CDSCO, and MoHFW to get the overall picture through a single window.

Telehealth Solutions

Mercury™ Nimbus Neo Telemedicine Solution

Mercury™ Nimbus Neo Suite offers reliable Telemedicine-related services by leveraging 5G connectivity. The solution is analysed using in-house developed 5G simulation environments and CEWiT, IIT Madras 5G testbed. Mercury™ Nimbus solution has been improved based on QoS parameters identified during testing. Integrated Telemedicine Service over Cloud (ITSC) and its modules were showcased at India Mobile Congress 2022 held in New Delhi during Oct 01-04, 2022 and Telemedicon 2022 held in Kochi, Kerala during Nov 10-12, 2022.

Mercury™ Nimbus solution has been deployed at a total of 19 locations of NTPC and 06 speciality hospitals, 30 district hospitals & 13 e-ICU locations in Odisha. Approximately 33,500 patients are benefited from using Mercury™ Telemedicine Solution in NTPC and Odisha state.



Mercury™ Nimbus Dashboard

Sugam Swasthya

A web-based interface with Android Mobile Application named Sugam Swasthya – an integrated platform for telediagnosis has been developed to capture different diagnostic parameters (ECG, Heart Rate, Blood Pressure, Digital Stethoscope, Temperature, Spo2, Blood Sugar, Lipid Profile, Haemoglobin & Fetal Doppler) of patients from an interface diagnostics device. This platform is designed to collect data from patients and store it for future reference. Additionally, the collected data can be transmitted to doctors to seek their advice and facilitate the diagnosis and prescription generation. The collected sample report is shared with patient via SMS link. The platform is live in remote areas of three districts (Varanasi & Gorakhpur in UP and Kamjong in Manipur) since October 2022 and as of now, a total of 30,777 patients have been screened. The initiative is in collaboration with IITM Pravartak and has been funded by Technology Information, Forecasting and Assessment Council (TIFAC).

Tech Enabled Continuum of Care Model for Non-communicable Diseases (NCDs) in Amethi, Uttar Pradesh

The initiative intends to establish a tech-enabled assisted telemedicine model by connecting Spokes (CHCs/ DH) to the Hub (KGMU) for providing focused quality care on NCDs. The hub and spokes will be strengthened with telemedicine hardware and software along with integrated Internet of Things (IoTs)/ Point of Care (PoCs) devices for seamless transmission and relay vitals from spokes to hub.

Teleconsultation module for ECHS

ECHS is a publicly funded Medicare scheme for ex-servicemen and pensioners & their eligible dependents. Teleconsultation module for ECHS aims to provide Healthcare services to ECHS beneficiaries in their homes. Under the initiative, safe and remote video-based clinical consultations between a doctor in a hospital and a patient confined within his or her home will be enabled.

Assistive Research in Health

DISAAA: Assessment Tool for Autism

DISAAA, an Automatic Assessment Tool, has been developed to detect traits of Autism using Visual Attention (both Attention Analysis and Eye Gaze), Facial Expression and Vocal Emotion Recognition. The tool is based on Deep Learning based Artificial Intelligence (AI) technique for classification and Machine Learning based algorithms for accurate quantification of intensity (degree) of attention, expression, and emotion. The system helps in determining the cognitive level of a child and assists in improving the cognitive aspect through the affective components of

emotion of people with Autism Spectrum Disorder (ASD). Under the initiative, three ICT based labs at NIEPID Kolkata, Noida and Secunderabad to collect data from the children with autism for analysis have been setup and deployed. Key Features include (a) Autism Screening Mobile App (b) Digitised Indian Scale for Autism Assessment (ISAA) (c) a system for capturing eye gaze, movement, visual attention, and facial expression from children with autism based on stimuli (d) an analytics suite drawing inference regarding presence of Autistic traits based on ISAA parameters and (e) Report Generation. The Autism Assessment Tool has been launched by Shri Alkesh Kumar Sharma, Secretary, MeitY on March 25, 2023.

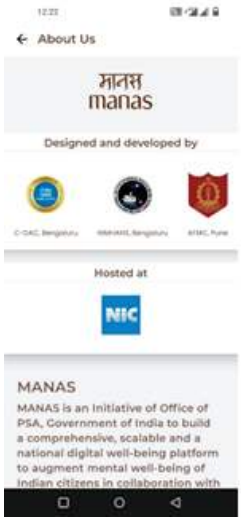
DISAAA

MANAS – Mental health and normalcy augmentation system phase II

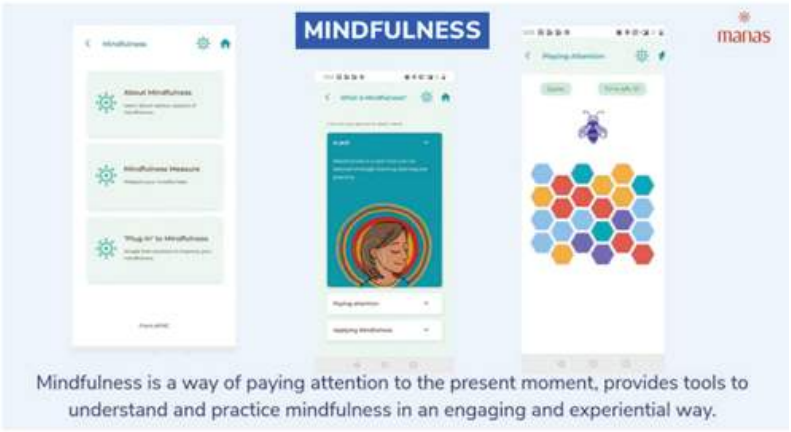
MANAS is a comprehensive, scalable, national digital wellbeing platform, initiative by O/o Principal Scientific Advisor, Government of India to augment the mental well-being of Indian citizens for the age group of 15 to 35 years. MANAS citizen app has been developed by C-DAC with a bilingual responsive user-friendly interface, plug and play architecture to integrate scientific and evidence-based mental well-being contents developed by NIMHANS Bengaluru and AFMC Pune. MANAS dashboard is developed for content workflow management and visualization board for exploratory statistical analysis. MANAS is supported by the Ministry of Health and Family welfare (MoHFW), Government of India to outreach the mental well-being programmes by conducting MANAS Mitra webinar series. MANAS can be used for Self-evaluation of the mental well-being of individual using WHO scale.

Various versions of MANAS App have been rolled out in NIMHANS Bengaluru, AFMC Pune, CIP Ranchi, NMHP Raipur, LGBRIMH Tezpur etc. across India for validation and usage. The App has also been rolled out for the students of The Maharashtra University of Health Sciences (MUHS), Nashik, by Shri Bhagat Singh Koshyari, Governor of Maharashtra in the presence of Dr. Ketaki Bapat - O/o PSA GoI and Lt. gen Madhuri Kanitkar, VC, MUHS on November 11, 2022. It has also been rolled out in State of Jharkhand under mental wellness initiative on November 16, 2022.

9 Awareness webinars were conducted in coordination with nodal agencies and Rural Technology Action Group (RuTAG) members (IIT Bombay, IIT Delhi, IIT Guwahati, IIT Kanpur, IIT Kharagpur, IIT Madras, and IIT Roorkee).



MANAS- App



MANAS- Mindfulness feature

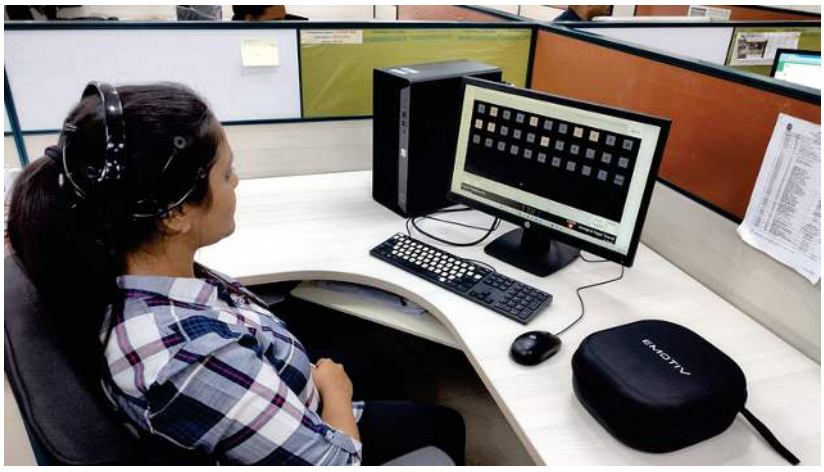
A Multi-Modal Neuro-Physiological Framework for Behaviour Analysis

The aim of the initiative is to employ a Multimodal Neuro-Physiological framework by insider threat detection and second level of interrogation on suspect for inner cordon security purpose. Key development activities include Neuro methods by Brain signal analysis for Lie / abnormality / Malicious pattern detection; Multimodal bio-signal (EEG, ECG, EOG, Eye Tracking, GSR, facial analysis) in fusion methods for stress, anomaly and suspicious behaviour detection; dash-board as a data analytics, event-reporting and monitoring tool on web & mobile and Creation of comprehensive primary dataset for Indian population with targeted modalities. Collaborating agencies include INMAS DRDO and as domain expertise - RML Hospital Delhi & CFSL Delhi.

AI in Healthcare

A Brain Machine Interface enabled Assistive System for children with special needs

The aim of the initiative is to design, develop and deploy a Computational framework as a Brain Machine Interface (BMI) enabled Assistive communication system for persons with special needs. It covers aspects from core research to multidisciplinary neuro-cognitive computing for medical science for the betterment of life. Key objectives of the framework include audio integrated standalone system to cater the basic requirement of dependent persons; P300 odd-ball paradigm based BCI web browser with a speller of English and Devanagari Script support; and alert / warning generation system to cater the emergency cases. The design-paradigm is being supported by domain experts considering targeted sample candidates on specific criteria. An assessment & validation procedure will be carried out in the form of training & workshop. This initiative is in collaboration with AIIMS Delhi and GMT Thiruvananthapuram.



Brain Machine Interface enabled Assistive System

AI in Oncology

The initiative has been jointly conceived by C-DAC and AIIMS Delhi for harnessing big data and advanced computing to provide personalized diagnosis and treatment for Cancer patients (iOncology.ai). It aims to establish a methodology for early detection of the India-centric common cancers by interrogating the medical and non-medical data sets using AI technology. Key outcomes include development of web-based platform for screening of cancer patients and AI based data analytics models powered by HPC for cancer risk prediction and prognosis, as well as classification/ segmentation/ characterization of cancer (Breast Cancer, Ovarian Cancer) for modalities like MRI Images/ Histopathology Images/ Mammographic Images/ USG Images. The system has been deployed at AIIMS Delhi in June 2022.

AI in Oncology

iMedDesk - AI Assisted Healthcare Services Framework

iMedDesk - AI Assisted Healthcare Services Framework aims to develop a mechanism for helping patients seeking information regarding medical or healthcare services at hospitals and aiding doctors to enable them to cater a greater volume of patients in healthcare. It will provide assistance through intelligent mobile interfaces that support text and audio input.

Multi Modal Analytics Framework for Machine-Assisted Diagnosis of Paediatric Pneumonia

Under this initiative, AI based system for assisting in the detection of paediatric pneumonia using auscultation sounds has been developed. Under the guidance of PGIMER specialists and with the active users, over 1000 samples of auscultation have been collected. The AI model estimates paediatric pneumonia with over 90% accuracy using the auscultation sounds.

Standards and Compliance

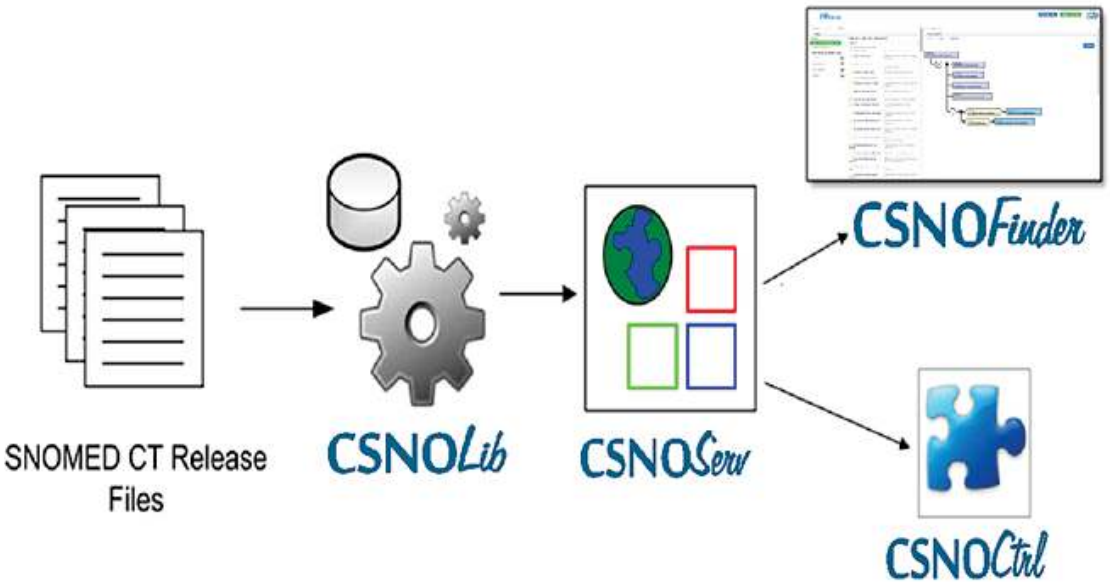
C-DAC's Toolkit for LOINC (CLNtk) v1.5

C-DAC's Toolkit for LOINC is a specially designed FOSS toolkit for easy access and integration of LOINC (Logical Observation Identifiers Names and Codes) standards in health care applications. LOINC is an international standard for identifying health measurements, observations, and documents. CLNtk enables LOINC based health records and reports sharing, integration of standard codes in healthcare applications, hospitals/clinics in processing and analysing health records in a standardized manner, and assist Laboratory Management Systems (LMS). The LOINC toolkit (CLNtk v1.5) was released on July 22, 2022.

CLNtk_v1.5 Architecture

SNOMED CT Toolkit (CSNOtk) v7.5

CSNOtk is a specially designed toolkit for easy access and integration of SNOMED CT in healthcare applications. SNOMED CT is comprehensive clinical healthcare terminology provided by SNOMED International. The Toolkit version 7.5 released on November 30, 2022 supports more API parameters to support received filtered and precise search results.

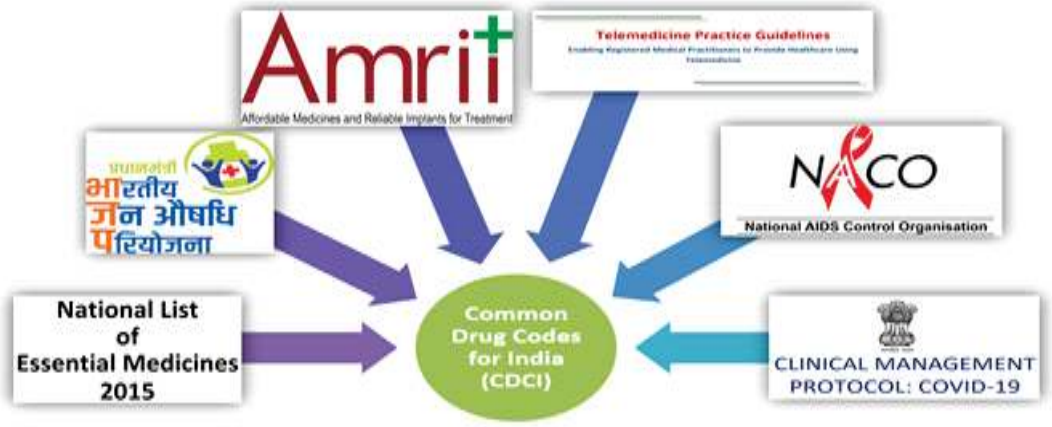


CSNOtk v7.5 Toolkit components

Common Drug Codes for India (CDCI)

Common Drug Codes for India (CDCI) is a set of files that integrate with SNOMED CT Global Medical Terminology files and content for use in any data entry, analysis, or record exchange in healthcare systems/applications. The release covers generic medicines, supplier, and branded medicine concepts, which when used along with SNOMET CT International Release covers all medicines from major government programs and medicines used in major health organizations/institutes from India. The latest release of extension is synchronous with February 2023 SNOMED CT International Edition and offers a total of 8400+ Generic and 52000+ Branded Medicines. The Common Drug Codes for India package was updated on June 03, 2022, July 15, 2022, August 30, 2022, October 14, 2022, January 13, 2023 and March 17, 2023. National Health Authority (NHA) of India has envisaged CDCI be used in listing Drugs over

Drug Registry (ABDM Building Block) and drug information exchange in health records. The Terminology Integrated Package is freely available to all the SNOMED CT Affiliates in India. Conservatively, 150+ healthcare applications deployed in different states and used by many clinicians/hospitals have integrated CDCI. The Flat Files Package is free for use under Creative Commons Attribution 4.0 International Public License and available for download on https://www.nrces.in



CDCI Coverage

India AYUSH Extension

Ministry of AYUSH, Government of India has initiated an effort for developing standardized clinical terminology for Ayurveda, Siddha, and Unani systems of medicine as National Extension to SNOMED CT. The extension will be used to capture, retrieve, share, and analyze clinical data in Electronic Health Records (EHR) of these domains. The India AYUSH extension is developed under the National Resource Centre for EHR Standards (NRCeS) project, supported by the Ministry of Health and Family Welfare (MoHFW), Government of India for documenting essential clinical information for Ayurveda, Siddha, and Unani systems of medicine. The content of this extension is developed by Central Council for Research in Ayurvedic Sciences (CCRAS), the Central Council for Research in Siddha (CCRS), and the Central Council for Research in Unani Medicine (CCRUM), Ministry of AYUSH, Government of India

India AYUSH Extension of SNOMED CT Clinical Terminology

Compliance Validation of Health Solutions under ABDM as Technical Partner in Collaboration with NABH-QCI

The initiative funded by the National Accreditation Board for Hospitals (NABH) and in collaboration with The National Health Authority (NHA) & Quality Council of India (QCI) aims to validate and grade HMIS/ LMIS/ Clinic software solutions that have been integrated with Ayushman Bharat Digital Mission (ABDM) Sandbox. As a technical partner, C-DAC shall be conducting digital assessment of health solutions for this pilot assessment. Each solution will be evaluated by individual assessors independently and a single combined report will be submitted to NABH for each health software solution towards certification.

Education and Training

C-DAC's Education and Training programmes are envisioned to create skilled manpower in the country by providing quality training programmes in the field of ICT. This includes state-of-the art tools and technologies in Education and Training, National Initiatives of MeitY including FutureSkills PRIME, Work Based Learning (WBL) & PMGDISHA, Online Examination Tools & services, Post Graduate Diploma Programs, and Collaborative Training Initiatives. Below are the details of major activities carried out during the year.

e-Learning System and Solutions

MeghSikshak 3.0

MeghSikshak is an indigenously developed learning platform to deliver online learning courses. The platform supports user management, course management, content delivery, assessment, discussion forum, certificate generation, analytics, and other communication & collaboration services. MeghSikshak is available both in the cloud and on-site, with multilingual support. MeghSikshak has been deployed at various organizations including Punjab Police Academy, C-MET Hyderabad and CSTC in the National Defence University, Mongolia.

Meghsikshak 3.0

MEeT (Medical Education with e-Technology) Virtual Teaching Platform

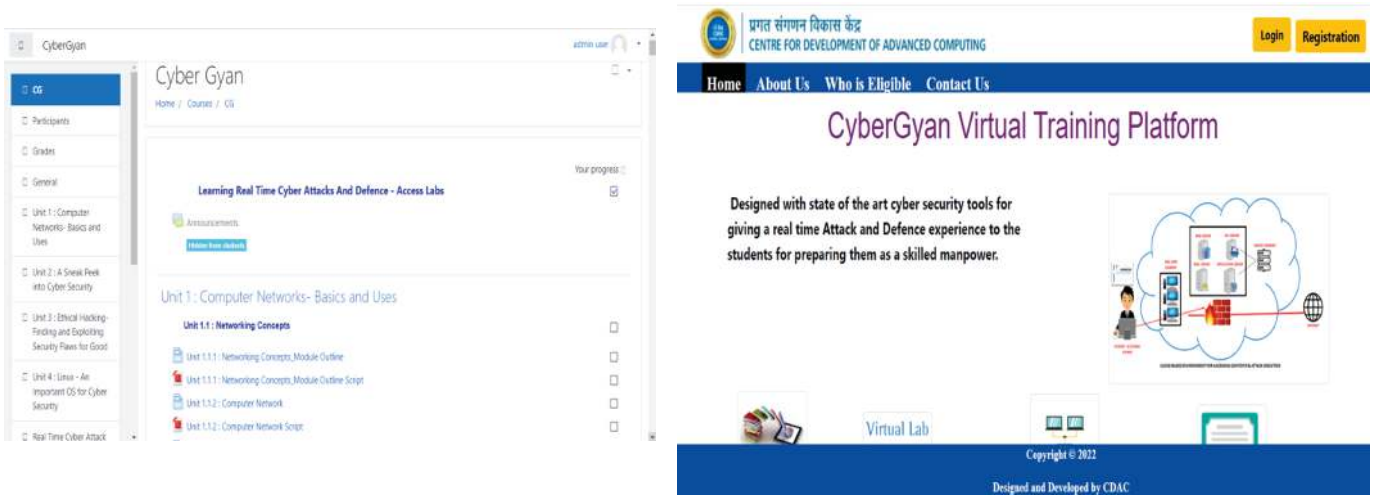
In collaboration with All India Institute of Medical Sciences (AIIMS), New Delhi, a Medical Education with e-Technology (MEeT) platform is developed and deployed by C-DAC. 12 e-courses in distinct areas of Medical Science have been developed and are being delivered through the Virtual Teaching Portal and Learning Management system. The courses contain video lectures, animated explanations, self-assessments, and other interactive aspects such as discussion forum, feedback, and more.

3243 students have enrolled for various courses offered as part of MEeT. The learning platform is extensively utilized by students from 8 North East medical colleges and 108+ medical colleges in other states like Telangana, Bihar, Andhra Pradesh, Tamil Nādu, Orissa, Uttar Pradesh, Rajasthan, Karnataka, Gujarat, etc. During this period, 3 webinars and 3 workshops have been conducted, which were attended by 570 medical fraternities. The MEeT mobile app offering e-courses in medical science education, Pandemic-related awareness knowledge and action Supported Health Management Amongst Youth (PRAKASHMAY) trainings were launched on December 08, 2022 during a workshop at Tripura. 3,73,756 students had undergone PRAKASHMAY training from various North Eastern regions (NER) and other medical colleges. It has established linkages with 64 subject-matter experts (SMEs) and 208 medical colleges across the country.

MEeT Virtual Teaching Platform Mobile Application

Cyber Gyan Self-Paced Learning Facility

A portal has been developed to impart self-paced learning based cyber security training. It includes an approved curriculum from academia and industry, an e-lab facility in a simulated/emulated virtual environment, and real-time cyber-attacks-based exercises. All these are facilitated to learn cyber security in a game-type situation. The Cyber Gyan virtual training facility has been set up with the Hyper-Converged Infrastructure (HCI) platform. This platform is equipped with Software Defined Networking (SDN) for the automated creation and management of virtual networks. For the advanced level course content, a total of 50 real-time cyber-attack-based scenarios have been conceptualized and developed, while 15 scenarios have been automated. Also, the basic level e-Learning course content was developed and around 68 master trainers from the North Eastern region were trained.



CYBER GYAN

e-learning platform for students of EMRS under the Ministry of Tribal Affairs

System to provide a tablet-based comprehensive learning environment is offered to Eklavya Model Residential School (EMRS) students. The e-Learning Management System (ELMS) can handle different types of learning materials like PDFs, audio, videos, and online labs. Students can use the ELMS Android App on their tablet to access these study materials. ELMS also provides support for the Hindi language and has been made live with NCERT

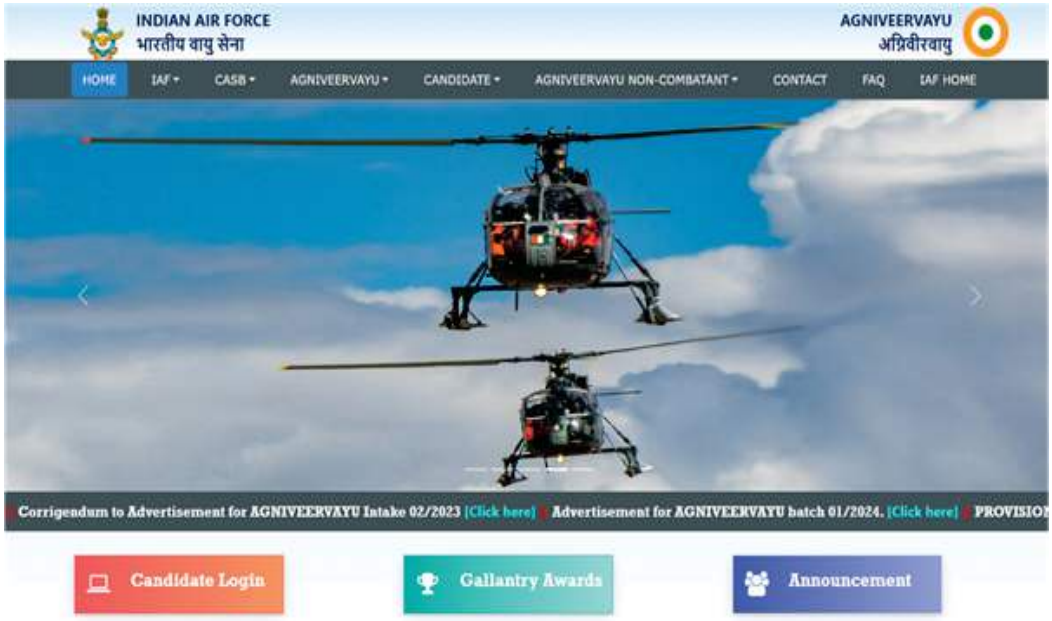
content from class 6 to class 12. The ELMS application has been implemented on eight smart boards, 150 Android tablets, and 36 desktops belonging to three EMRS schools, namely EMRS Borgaon Bazar, EMRS Dewada, and EMRS Ajmer Saundane of state of Maharashtra. There are 90 teachers from 22 states and different Eklavya Model Residential Schools across India which are registered on this portal.

Platform for Key Stage Assessment (KSA)

The new National Education Policy proposes that the Central Board of Secondary Education should conduct a nationwide test (KSA - Key Stage Assessment) for numerical and literary skills of students in classes 3, 5 and 8. The platform to conduct the mock exams for Grade-5 and Grade-8 has been developed by C-DAC as part of the pilot program. Around 3.5 lakh students took part in the mock test from 1,888 CBSE schools in 28 states and 8 union territories including 336 districts, and 39 CBSE international schools from 11 countries.

Registration Portal for AgniveerVayu (Indian Air Force)

The portal, which was launched by Shri Rajnath Singh, Hon'ble Minister of Defence of India on June 14, 2022, was designed to facilitate the registration of Indian and Nepalese youth as part of the Agnipath Scheme. The portal was launched with the aim of enabling them with the registration process to fulfill their aspirations of joining the Armed Forces and serving the Nation. This portal was used by 10.32+ lacs candidates to register for the AgniveerVayu exam.



AgniveerVayu Portal

Online Portal for Navodaya Vidyalaya Samiti Schools

The development of a portal to facilitate the admission process for class XI students to Navodaya Vidyalaya Samiti Schools was undertaken by C-DAC. This role-based portal provides the facility of registration and result processing, as well as the option to select the streams. The portal was used by around 38000 applicants for admission in the year 2022-23. A similar portal was provided to facilitate admission to class IX students with the functionality of application registration, admit card generation, and centre allocation. The portal also offered the possibility for an administrator to obtain state, regional, and block-specific information about the individuals who had registered as candidates. Around 1.81 lakh candidates registered for seeking admission in class IX during 2022-23.

OLabs NextG: Next Generation Online Labs (Olabs)

The next generation of OLabs, in collaboration with Amrita Vishwa Vidyapeetham, Kerala, was conceived to broaden the scope of the existing activities to benefit more students and enhance the overall lab experience for them. As part of this initiative, C-DAC made 50 new labs for different subjects from Grade 6 to Grade 12. 200 online labs were integrated on Diksha Platform and 700 teachers were trained in online labs via online mode. "Setting up of 200 Virtual Labs" was inaugurated by Shri Amit Shah, Hon'ble Minister of Home Affairs of India, on July 29, 2022 in the

program marked for completion of 2 years of NEP 2020. OLabs mobile app (version 1) was also hosted on Mobile Seva App Store.

Olabs: NextG

Shaala Darpan: e-Governance solution for school and office automation

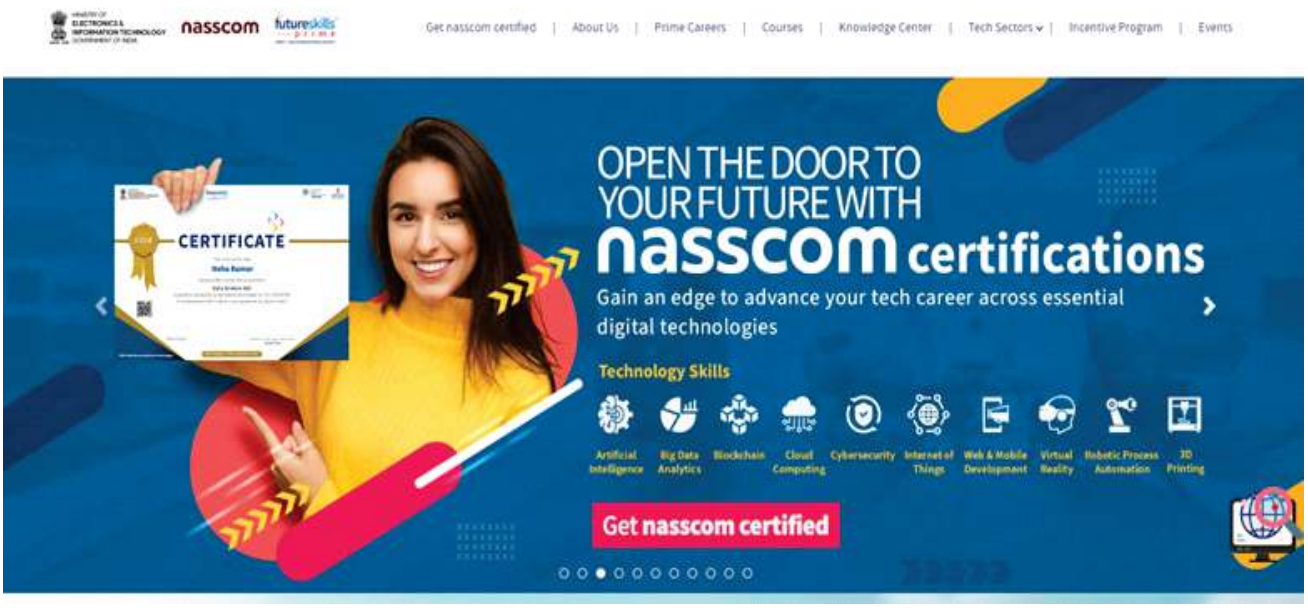
Shaala Darpan is an indigenously developed solution for school and office automation. The system has been rolled out in Jawahar Navodaya Vidyalayas (JNVs), managed by Navodaya Vidyalaya Samiti, and has been running since 2019 in the 649 residential JNVs, 8 regional offices, 8 non-profit institutions, and the headquarter.

The system has a wide range of functions and holds almost 3 lakh student records, 22000 worker records, 1.5 lakh APARs of NVS officers, and over a lakh property return filed through the system. The system additionally provides a grievance redressal feature, and over 150 grievances have been resolved through it.

National Initiative

FutureSkills PRIME

FutureSkills PRIME (Programme for Re-Skilling/Up-Skilling of IT Manpower for Employability) provides an up-skilling/re-skilling ecosystem in emerging and futuristic technologies to facilitate continuous enhancement of skills as well as knowledge of IT professionals in line with their aspirations and aptitude. The re-skill/up-skill training in Deep Skilling Course, Bridge Course, Foundation Course, Government Official Training Program, and Training of Trainers Program in 10 emerging technologies such as 3D Printing/Additive Manufacturing, Blockchain, Cyber Security, Internet of Things, Artificial Intelligence, Robotic Process Automation, Social & Mobile, Big Data Analytics, Cloud Computing and Augmented Reality/ Virtual Reality is conducted by C-DAC/NIELIT/NASSCOM Centers/content providers across the nation through Hub-n-Spoke mode. Over 5.83 lakhs+ candidates have signed up on the platform and over 1.81 Lakh+ course enrolments have been done. 60.15 Lakh+ Digital Fluency Badges issued on FutureSkills PRIME Platform and 7800+ candidates enrolled and 1160+ candidates completed the Blended Learning Bridge Courses through Resource Centres. Future Skills PRIME Platform was showcased at Digital India Week 2022 held in Gandhinagar, Gujarat from July 04-09, 2022.

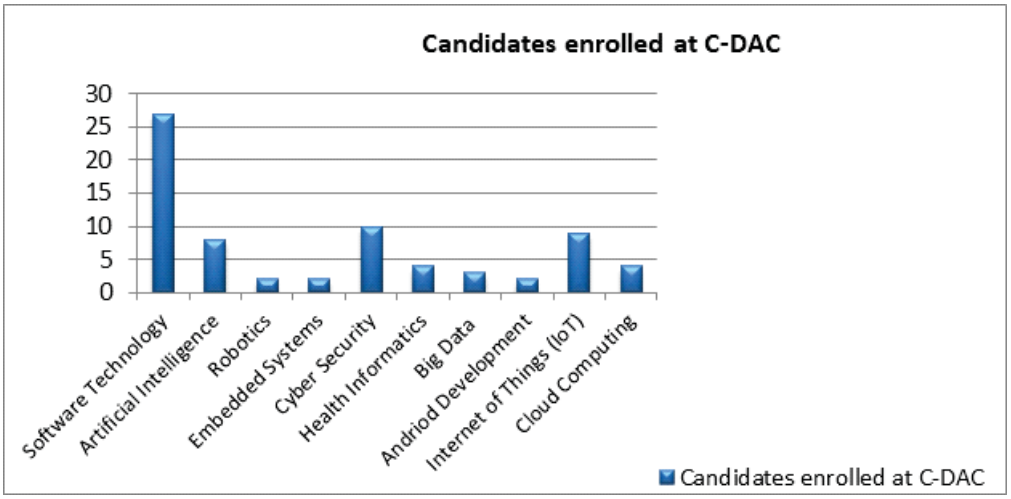


Future Skill PRIME Program

Work Based Learning Programme

The Work-Based Learning (WBL) programme is a unique scheme for fresh Graduates Engineers to acquire direct practical experience and exposure on latest Information Technology, Electronics, and related areas. The Scheme is specifically devised for the Graduate Engineers of Scheduled Caste (SC), Scheduled Tribe (ST), Women and Economically Weaker Section (EWS), keeping in view the social / economical background. The scheme provides an opportunity for candidates to get exposed to various Design/ Developmental/ Research activities being carried out by MeitY Institutions in the State-of-the-art Technologies. The candidates enrolled under this programme are gaining practical experience and exposure in Information Technology, Electronics, and related areas.

C-DAC as Project Management Unit (PMU) has launched WBL Programme at seven Organizations of MeitY. In the first year of WBL Programme, more than 450 candidates are deployed under 81 units of the Ministry of Electronics & Information Technology (MeitY) organizations named- C-DAC, CERT-In, CMET, ERNET, NIELIT, STQC and SAMEER. Candidates undergoing the WBL Programme would be issued certificates after successful completion and provided with a monthly stipend of Rs. 10,000. Across C-DAC, 70 candidates are undergoing work-based learning in various technology areas.



Work based Learning – Candidates enrolled at C-DAC

PMGDISHA

C-DAC continues to be involved in the PMGDISHA initiative as an assessment and certification body. The goal of the initiative is to ensure that at least one person in each household is digitally literate in order to interact with the digital world, such as digital payment and engagement services. 13.8 lakhs citizens were proctored around the country during the year 2022-23.

Skill Development and Enhancing Employability for SC/ST Candidates

Financial aid to facilitate skill development in the IT/ITES sector for enhancing the employability of unemployed youth in the SC/ST category through a residential training program was taken up by C-DAC. Candidates were taught IT/ITES courses such as Helpdesk Attendant, CRM Domestic Voice, CRM Domestic Non-Voice, Data Entry Operator, Engineer-Technical Support (Level-1), Web Developer, Associate-CRM, Software Developer, Sales & Pre-Sales Analyst, and Associate-Analytics. The training for NSQF Level 4 & 5 courses is done at SSC, NASSCOM Certified Smart Empanelled Centers, and Level 7 courses are done at C-DAC Centers. About 530 candidates availed this opportunity and got trained in the nine IT/ITeS sector, with 388 certified and 242 placed.

Online Examination Tools and services

Online Examination System for Air Force

Online examination system is a comprehensive recruitment system to facilitate end to end examination for the recruitment of officers through Air Force Common Admission Test (AFCAT) & Scheduled Test for AgniveerVayu Recruitment (STAR) exam.

The AgniveerVayu exam for recruitment of Agniveer in the Indian Air Force was conducted through an indigenous developed software. During the July 2022 cycle, approximately 7.69 lakh candidates registered, and 5.70 lakh candidates appeared for the exam at 250 centres in over 70 cities under the Agnipath scheme. In January 2023, the AgniveerVayu exam was held in 180 locations spanned over 70+ cities.

AFCAT in online format was conducted for selection of candidates in Flying Branch and Ground Duty Officers (Technical & Non-Technical) during August 2022. Around 1.29 lakhs candidates registered for the exam which was at 192 centres across 99 cities. About 1.14 lakhs candidates registered for February cycle for which exam was held in 180 centres spanned over 100 cities.

C-DAC has also signed MoU with Indian Air Force for a period of 05 years from Oct 2022 – Dec 2027. The upgraded version of the system will offer additional features for online registration, paper generation, biometrics, exam software, etc. with end-to-end exam conduction capability across India. The system will also support conducting exams for 75,000 – 1,00,000 candidates per day.

AFCAT Online Examination System

Comprehensive Recruitment & Online Examination System for ICG

The entire recruitment process of the Indian Coast Guard (ICG) is fully automated through the implementation of a comprehensive recruitment solution and the conduct of online examinations. 2.64 lakhs candidates registered for the ICG Sailors exam, which was conducted at 180+ centres across 70+ cities in November 2022. In the same cycle, the Assistant Commandant Exam was conducted at around 120 centres across 50+ cities, for which around 16,000 candidates registered. During the March 2023 cycle, 1,40,049 candidates registered for the ICG-Sailors exam and 15,771 candidates registered for the ICG-Officers i.e. Assistant Commandant exam.

ICG Online Examination System

Recruitment Exam for National Institute of Biologicals (NIB)

C-DAC built exam software was used to conduct the recruitment exam of nearly 2912 candidates for National Institute of Biologicals (NIB) for the post of Assistant – I and Assistant – II. Exam was conducted across 10 centres in Delhi.

Post Graduate Diploma Programs

C-DAC's Advanced computing Training School (ACTS) has trained and placed students through Diploma courses conducted online through a network of its affiliated Authorized Training Centers (ATC). The Advanced computing Training School (ACTS) of C-DAC offered the following 6 months Diploma courses in a hybrid mode (offline and online), conducted twice in a year.

- Online Diploma in Big Data Analytics (e-DBDA)
- Online Diploma in Embedded Systems Design (e-DESD)
- Online Diploma in IT Infrastructure, Systems and Security (e-DITISS)
- Online Diploma in Mobile Computing (e-DMC)
- PG-Diploma in Artificial Intelligence (PG-DAI)
- PG-Diploma in VLSI Design (PG-DVLSI)
- PG-Diploma in HPC System Administration (PG-DHPCSA)
- PG Diploma in Advanced Computing (PG-DAC)
- PG Diploma in Advanced Secure Software Development (PG-DASSD)

- Post Graduate Diploma in Robotics and Allied Technologies (PG-DRAT)
- FinTech & Blockchain
- Cyber Security & Forensics
- HPC Application Programming

More than 4700 students have availed PG Diploma courses from C-DAC and its Authorized Training Centers (ATC).

Postgraduate Programs

C-DAC has conducted M. Tech (IT, CSE, VLSI), MBA, MBA(IT) and MCA Programme, approved by All India Council for Technical Education (AICTE), Delhi and affiliated with Guru Gobind Singh Indraprastha University (GGSIPU), Delhi. The objective of these programs was to generate synergy between education, research and product development based on latest trends. A total of 157 students passed out their respective formal degree programme during the year 2022-23 and 85% of them got placement in companies of IT and Electronics Sector.

Collaborative Training Initiatives

Training Programmes

- As part of International Training Programmes under ITEC and eITEC scheme of MEA, specialized training programme was organized for 282 officials from more than 40 countries.
- C-DAC conducted IT trainings for seventy (70) officers of DRDO in Certificate in ASP.Net, Certificate in Database Management System (SQL & NoSQL), Certificate in Software Validation and Testing and Certificate in Java (Core + Advanced).
- C-DAC conducted certificate programs in HTML, JavaScript, PHP, and Drupal framework for twenty (20) numbers of officers from UPSC, New Delhi.
- C-DAC conducted "Certificate in Software Development Using ASP.NET" for twenty-six (26) personnel of Emerson Technologies, Pune.
- C-DAC conducted "Certificate course on Cyber and Communication Network Security" for thirty (30) personnel of NTPRIT, Ghaziabad
- C-DAC conducted "Certificate Course in Microsoft Office" for twenty-seven (27) personnel of Power Grid.
- C-DAC conducted "Certificate in Application Development" for twenty-five (25) officers of Town Planning and Evaluation Department.
- C-DAC conducted IT trainings for one hundred and fifty (150) personnel of HQ Southern Command in Certificate in Cyber Security, Certificate in Cyber Audit and Certificate in Network Administration in Bhopal, Secunderabad, Jodhpur, and Pune.

Outreach Initiatives

The Products, Services, and Outreach team has been created to promote and capitalize on new business opportunities through effective outreach. The team's mission is to lead multi-center commercial projects, develop effective go-to-market strategies and methodologies, and unlock the team's vast potential for wealth creation.

To expand C-DAC's reach, various engagement models have been developed in accordance with the governing council's approved commercialization policy. These models encourages all centers to bring their products and services to market in a systematic and organized manner, resulting in significant benefits and ensuring the successful monetization of our research and innovations. The models are as follows:

- Collaborative Innovation Model
- Transfer of Technology
- Contract R&D
- Expression of Interest for Marketing Consulting Agencies
- Request for Proposal

COLLABORATIVE INNOVATION MODEL

We have created an Intent of Association for Collaborative Innovation with private entities, including startups. This will allow us to take our research output to market by tailoring the product to meet market demands.

TRANSFER OF TECHNOLOGIES

Government-funded science and technology (S&T) organizations are required to maximize the transfer of their knowledge and expertise to industry, thereby contributing to the country's technological self-reliance, industrial growth, and economic development. It is essential to disseminate the fruits of their research to various sectors of the economy and create mechanisms for effective transfer, as this will have a synergistic impact on the nation. Therefore, it is incumbent on leading R&D organizations like C-DAC to maximize technology transfer to Indian industry.

C-DAC has undertaken technology transfer (ToT) for a variety of products and services, including: AC EV Charger, Rudra Server, AI-based Air Quality Monitoring System, Aqua-Suraksha, CerviSCAN Product Suite, E-Glancer, a Digital Forensic Kiosk (DFK), MSBC DAC, a device for early detection and screening of breast cancer, Digital Controller Technology for Solar PV, C-DAC Urban Traffic Controller Equipment, Traffic Signal Monitoring and Management Software and Smart Energy Meter.

These ToT initiatives are helping to promote the development of indigenous technologies and products, and are contributing to the growth of the Indian economy.

EXPRESSION OF INTEREST FOR MARKETING CONSULTING AGENCIES

To increase the commercial presence of C-DAC by deploying, selling, and promoting its products, solutions, services, and technologies across various thematic areas, an Expression of Interest (EoI) for empaneling a Consulting Agency for C-DAC was released. Deloitte Touche Tohmatsu India LLP, Mahindra Defense Systems Limited, and RailTel Corporation of India Limited were successfully empaneled to collaborate with C-DAC and expand its reach.

Similarly, an EoI for Technology and Development Partners for Quantum Technologies and Associated Areas was released, and agencies were empaneled.

PRODUCT & SERVICES SALES THROUGH GEM

Since the PS&O team was formed, we have placed a special emphasis on publishing our products on the GeM platform. We are pleased to announce that we have successfully published 37 products and services on the GeM platform, generating a business turnover of INR 150 Lakhs. Some of the products we have published include: IoT Research Lab Kit, USB Pratirodh, Cloud Administrator, Secured ISOC, e-Hastakshar, Secured BOSS Open-Source OS, Go-Translate, MeghSikshak - eLearning Software, Rice Grain Analyzer, COPS SCADA Lab Kit, Tarang - Digital Hearing Aid, Meghdoot Cloud Suite, Interface board for Raspberry Pi

We are committed to continue publishing our products on the GeM platform and expanding our reach to a wider audience.

In addition to the above, partial list of noteworthy business projects executed are Electronics Radar & Development Establishment (LRDE), PARAM Utkarsh Services, Tamil Nadu State Data Centre Cloud , Creative Content Development and Social Media Management for SVEEP (CEO Punjab), Development of Pharmacy and Specialization OPD module for SeHAT Phase - II , Veterinary NOC portal for DAHD (Department of Animal Husbandry and Dairying), eSushrut HMIS- Implementation in various hospitals and Public Health Centers, Geospatial Solutions for PMGSY, Go-Translate Localization framework for MoRTH & Ministry of Micro, Small and Medium Enterprises (MSME), Election Commission of India, Implementation of Cloud based SCADA System at KWA Cherthala Taluk, Alappuzha, Software Simulator System for Communication Equipment [SSSCE], Implementation of a Unified Mobile App for Highway Users (Rajmarg Yatra App), Vehicle Tracking and Monitoring system-Meghalaya, Vessel tracking system for Indian Navy, Cyber Security and Information Security Services, Cyber Forensic products and analysis, Online, e-Sign Services, Online Exams for Defense Forces, MeghSikshak - an e-learning Platform, IoT based Lab Kits.

We also are undertaking appreciable efforts for capacity building through our ACTS training initiative pan C-DAC in niche domains.

C-DAC participated in Digital India Week 2022, Bengaluru Tech Summit, Technology showcase to Hon'ble Home Minister for NATGRID, UP Global Investors Summit & Trade Show Global Assistive Technology Expo & Conference, DefExpo, Industry Interaction Event at C-DAC Chennai, DSCI - Cyber Security R&D Roadshow, Cocreation Conclave on Cyber Security Technologies at C-DAC, Noida, SETS Roadshow on Cyber Security Solutions for Government Organizations, Annual Indian Defence Conclave, DIGIPOL 2023, Digital India Conference of State IT Ministers to name a few for exhibiting state of the art technologies and products. Product showcase was also arranged for the Parliamentary Committee (Standing Committee on Communications and Information Technology) visit in C-DAC Innovation Park.

Industry engagement was arranged with Maha Mumbai Metro Operation Corporation Ltd, IBI group to showcase PAN C-DAC technological strengths in areas of Smart Cities, Cyber Security and Forensics etc.

International Collaborations/Initiatives

With support from the Ministry of External Affairs (MEA), C-DAC extends its expertise in ICT to collaborating nations and nurtures its ICT centres. During the year, the following activities were carried out as part of this initiative:

- Namibia Centre of Excellence in ICT (IN-CEIT) & HPC at The Namibia University of Science and Technology (NUST) in Windhoek is currently in operation. Three (3) advanced training programs have been conducted and trained 250 students from industry, government organizations, Ministries, and universities. INCEIT signed an MoU with the Ministry of Defense regarding technology training, An MoU between NUST and the Namibia Statistics Agency (NSA) was signed to include the usage of the HPC at INCEIT as a service for NSA Data Analytics and INCEIT is establishing itself as a first-class research hub for various sectors in Namibia and the entire Southern African Development Community (SADC) region as many Masters and Ph.D. Scholars are using the HPC for their research work.
- Training activities have been completed for more than 67 participants with 4 certificate courses by C-DAC experts along with assistance from Niue experts at Niue Centre of Excellence in IT (CEIT) at Alofi.
- Certificate courses in eight (8) Technology areas in IT/ICT were conducted at India – Syria NexGen Centre of Excellence in IT (NexGen IS-CEIT) at Damascus. 3 (three) Syrian Trainers have completed training in the batch from September 2021 to March 2023 under the ITEC scheme of MEA. The Project was completed in February 2023 and was handed over to the Government of Syria.
- Under the project, "setting up of India – Argentina Centre of Excellence in IT (IA-CEIT) in Buenos Aires", installation & commissioning of IT Infrastructure along with the delivery of Courseware & Reference Books has been completed in August 2022 at IA-CEIT. The deployment of PARAM Shavak VR (Supercomputer in a Box) was completed at the site in September 2022
- Setting up the entire IT & non-computing infrastructure and deploying indigenously developed Cyber Forensics Software & Tools have been deployed at Cyber Security Training Centre (CSTC). Hon'ble Minister of Defence of India, Shri Rajnath Singh inaugurated CSTC at National Defence University (NDU) in Ulaanbaatar, Mongolia on September 6, 2022.
- Under the project, "Setting up of India – Solomon Islands Centre of Excellence in IT at Honiara" (IS-CEIT), the training of 3 (three) Master Trainers from Solomon Island National University (SINU) in C-DAC's Post Graduate Diploma in Advanced Computing (PG-DAC) and Post Graduate Diploma in Big Data Analytics (PG-DBDA) in an online mode has been completed in September 2022. The course material and C-DAC e-Mentor (e-Learning & Learning Management System) along with LILA (Learning Indian Languages through Artificial Intelligence) has been delivered to SINU/ IS-CEIT in February 2023.
- Indian Technical Economic Cooperation (ITEC) Programme reaches out to 160 partner developing countries for extended capacity building. e-ITEC Courses are conducted in online mode for all partner developing countries for extending capacity building by premier institutes. 40 Candidates from 20 Countries across the world were trained in Certificate Course in Blockchain Development Technology.

Patents

Patents Awarded

1. "Method and System for Dynamic Adaptation of Program Execution on Different Target Hardware", Inventor(s): Shamjith K. V., Mangala N., Deepika H. V., Prachi Pandey, B. B. Prahlada Rao, N. Sarat Chandra Babu, Patent No. 415299, India, Awarded, December 23, 2022.
2. "Multichannel Wireless Personal Area Network (W-PAN) Gateway Device and An End Device", Inventor(s): David Selvakumar. A, Kaushik Nanda, Kiran Nayak, Haribabu Pasupuleti, Patent No: 185/CHE/2015, India, Awarded, November 2022.
3. "Method and System for Authenticating a User Using a Personal Authentication Device (PAD)", Inventor(s) : Sarala Narayan Sreekanth; Varghese Nobby; Pratap Singh Vaibhav; P. Gopinath Kumar Uttam; Nanda Kaushik; Sasidharan Indu; Venkatesan Karthika; P Haribabu, Chinese Patent No. ZL201910585905.2, Awarded on October 11, 2022.
4. "A Two-Factor Password-Based Authentication Method for Web Users", Inventor(s): Mohammed Misbahuddin, Zia Saquib, P. Premchand, A. Govardhan, Patent No: 398510 / 1112/CHE/2012, India, Awarded on June 3, 2022.
5. "A System and Method for Wirelessly Controlling Illuminance", Inventor(s): Pitchiah Raja, Thevar, Irene Sabarimuthu, Dhivya Govindasamy, Rekha Gunasekaran, Patent Np. 413880, India, Awarded on December 8, 2022.
6. "An Artificial Intelligence System for a Bedroom Environment Based On Sensed Parameters From a Bed", Inventor(s): Raja Thevar Pitchiah, Kumar Dheeraj, Vasudevan Arunkumar, Patent No. 424123, India, Awarded on March 6, 2023.
7. "System and Method for Planning Origin-Destination Flow by Optimally Using GPS", Tapas Saini and Dr. Srikanth S. V., Patent No: 402980, India, Awarded on August 4, 2022
8. "Electronic Voting Apparatus and System Thereof", P. R. Lakshmi Eswari, Mahesh Patil, Himanshu Pareek, 4250/CHE/2013, India, Awarded on December 14, 2022
9. "E-tongue device for characterization of taste and quality of water, tea, and other food and beverages", Dr. Nabarun Bhattacharyya, Prof. Basudam Adhikari, Mr. Jayanta Kumar Roy, Mr. Devdulal Ghosh, Mr. Subrata Sarkar, Mr. Subhankar Mukherjee, Mr. Rabindranath Kanjilal, Mr. Ravi Sankar, Mr. Manmatha Mahato, Mr. Tridib Kumar Sinha, Ms. Jyoti Singh, Mr. Hirak Kumar Dey, Awarded Patent no- 407248, September 21, 2022
10. "Apparatus and Methodology for Measurement of Obnoxious Odorant Concentrations and Odour Intensity in Pulp A and Paper Industry", Dr. Nabarun Bhattacharyya, Arun Jana, Devdulal Ghosh, Jayanta Kumar Roy, Rabindranath Kanjilal, Ravi Sankar, Amritasu Das, Dr. R. A. Pandey, Sharvari Deshmukh, Dr. Satish. R. Wate, Patent No- 402507, July 29, 2022
11. "An apparatus for multi-crop quality assessment and a method thereof", Dr. Amitava Akuli, Abhra Pal, Tamal Dey, Gopinath Bej, Sabyasachi Majumdar, Rabindranath Kanjilal, Jayanta Kumar Roy, Dr. Nabarun Bhattacharyya, Patent No. 411791, November 18, 2022
12. "Apparatus for detection of sporozoal infection in silk moth and methodology therefor", Dr. Amitava Akuli, Abhra Pal, Tamal Dey, Dr. Nabarun Bhattacharyya, Rabindranath Kanjilal, Ravi Sankar, Suryakant, Patent No. 415323, December 23, 2022
13. "An apparatus for in-situ alveolar breath analysis", Dr. Hena Ray, Alokesh Ghosh, Dr. Arunansu Talukdar, Angshuman Chakraborty, Tarun Kanti Ghosh, Parthasarathi Biswas, Mr. Rabindranath Kanjilal, Dr. Nabarun Bhattacharyya, Patent No. 408488, October 06, 2022
14. "Image identifying and comparing system for identifying and/or comparing facial images", Kunal Chanda, Debasis Mazumdar, Soma Mitra, Munmun Chakraborty, Indian Patent No: 413685 of 14.05.2013, Awarded, December 06, 2022.

15. "Process for automatic facial expression recognition and a system therefor", Kunal Chanda, Washef Ahmed, Debasis Mazumdar, Soma Mitra, Patent No: 421328, Awarded, February 13, 2023
16. "Automatic speaker recognition system using voice biometric and method therefor", Debasis Mazumdar, Soma Khan, Joyanta Basu, Granted, Patent No. 419112, India, January 24, 2023.
17. "A System for Determination of Dominant Dosha", Ms. Lakshmi Panat, Dr. Ganesh Karajkhede and Ms. Swapna Yenishetti, 416510, India, Awarded, January 03, 2023.
18. "A Near Lossless Pre-processing Approach for Atmospheric Data Compression", Inventor: Sahidul Islam, Patent No. US 11,341,098 B1, United States, Accepted for Publication on April 09, 2022 at the United States Patent and Trademark Office (USPTO).
19. "Apparatus to determine Shape and Size Massacuitie Crystals and Method to Operate said apparatus", Jerry Daniel J., Sreedhanya L. R., Sreeja D., Murugan S., Kichu S., Patent No. is 202241076385, December 28, 2022
20. "A device for determining Sucrose Concentration in a Solution and a method thereof", Dr. Rominus Valsalam, Sindhu R., Lajitha C.S., Arun Krishnan, Patent No. 407924, Awarded, September 29, 2022.
21. "A Method for Optimizing Target Resolution and Transmission Power of an Acoustic/Ultrasonic Based Mobility", Byju C, James Varghese, Aravind C.R., Harikrishnan C. S., Patent No. 402557, India, Awarded, July 29, 2022.

Patents Filed

1. "Methods and Systems for Retrieving Location of a User Within a Premise", Inventor(s): Dhivya G., Hariharan K., Sayantani Bhattacharya, Patent No. 202211030307, India, Filed on May 26, 2022.
2. "System and Method for Controlling a Plurality of Luminaires", Inventor(s): Dhivya G., Hariharan K., Lokeshwar S., Patent No. 202211031538, India, Filed on June 1, 2022.
3. "System and Method for Autonomous, Non-contact Infection Screening", Sayantani Bhattacharya, Dhivya G., Poonguzhali P., Patent No. 202241069332, Filed on December 1, 2022
4. "Apparatus for Monitoring Effectiveness of Fumigation System and Method Thereof", Ravi Sankar, Tarun Kanti Ghosh, Devdulal Ghosh, Sabyasachi Majumdar, Angshuman Chakraborty, Dr. Hena Ray, Alokesh Ghosh, Filed, Patent Application no- 202231062911, November 3, 2022
5. "System For Driver Assessment and Onboard Warnings Using Multisensor Instrumented Vehicle", Vishnu Sasidharan, Nimmy Mathew, Sreenath Vipin, Divya Minilekshmi Harikumar, Rajesh Kalluvettamkuzhi Ramachandran, Dr. Ramaswamy Sivanandan, Patent No. 202241075174, India, Filed, December 24, 2022
6. "Power Efficient and An Economical Ultrasonic System for Sewage Depth Measurement and Method Thereof", Titus A. Chazhoor, Byju C., Aravind C. R., Harikrishnan C. S., Patent No. 202241034170, Filed, June 15, 2022.

Copyrights

Copyrights Awarded

1. "FPGA IP Core (RTL Design) for Deserialization and Pixel Ordering for CMOS Image Sensors with Sub LVDS Interface", Jerry Daniel J., Lajith C. S., Lijo Thomas, Anju Mohan, Copyright Registration No. SW-15454/2022, Awarded, May 24, 2022
2. "Embedded C Based Application Software for Collecting NTC Thermistor Sensor Data for Thermal Sensor Based Monitoring System for the Early Detection and Screening of Breast Cancer", Anupama P., Jithin S., Copyright Registration No. SW-15915/2022, Awarded, November 18, 2022
3. "Application software for Data Collection and Analysis of Thermal Sensor Based Monitoring System for The Early Detection and Screening of Breast Cancer", Lekshmi G., Manju B. K., Rakesh G., Anupama P., Copyrights Registration Number - SW-15914/2022, Awarded, November 18, 2022.

4. "Acoustic Data Acquisition and Analysis Utility", Joby Thomas, Parvathi M. S., Copyright Registration No. 26995/2022-CO/SW, Filed, December 23, 2022
5. "Echo Sounder Control and Communication Firmware", Shibu R. M., Rajesh R., Arun Gopalakrishnan, Abhijith M. S., Copyright Registration No. 31012/2021-CO/SW, Awarded, April 6, 2022.
6. "PRI Live Monitoring and CDR Generation System", Dhanya V.S., Rajesh Kumar R., Copyright Registration No. SW-15919/2022, India, Awarded, November 8, 2022.

Copyrights Filed

1. Smart Eye - A Vision Inspection System for Identification And Removal Of Foreign Particles During Black Tea Processing, Tamal Dey, Gopinath Bej, Abhra Pal, Sabyasachi Majumdar, Dr. Amitava Akuli, Tapas Sutradhar, Jayanta Kumar Roy, Alokesh Ghosh, Dr. Nabarun Bhattacharyya, Copyright No. SW-15903/2022 dated October 20, 2022
2. "Silk Content Estimation in Cocoons", Gopinath Bej, Abhra Pal, Tamal Dey, Sabyasachi Majumdar, Dr. Amitava Akuli, Alokesh Ghosh, Dr. Nabarun Bhattacharyya, Copyright No. 30124/2021-CO/SW dated July 21, 2022
3. "Onboard Driver Assistance and Warning Software", Nimmy Mathew, Divya M. H., Sreenath Vipin, Vishnu S., Rajesh K. R., Dr. R Sivanandan, Copyright Application No. SW-15230/2022 India, Filed, December 19, 2022.

Awards and Recognitions

1. C-DAC, Chennai received the certificate of appreciation for the 5G Hackathon, Phase III award for the idea "Collaborative Live Video Analytics for Large Camera Deployments using 5G" at Communications Ministers Conclave, Hotel Taj Palace, New Delhi on March 22, 2023. Shri Ashwini Vaishnaw, Minister of Railways, Communications and Electronics & Information Technology, Government of India, and Ms. Doreen Bogdan-Martin, Secretary General, ITU presented the award to the contributing team.

2. The "Blockchain enabled eVoting application" has bagged the "Technology Sabha Award 2022" under the "Blockchain" category, for the innovative use of Blockchain technology to offer distinct benefits to the stakeholders in Telangana. The Award, instituted by the Express Group, was received by the representatives of the ITE&C Department of Telangana during the 32nd edition of Technology Sabha (eGovernance Summit) held during August 25-27, 2022 at Kolkata, West Bengal.

3. eSanjeevani, National Telemedicine Service of India received the Global Digital Health Innovation Award 2022 during Global Digital Health Summit held in New Delhi during October 28-29 2022
4. C-DAC received the "Elets Innovation Awards" for "mSeva AppStore: The National AppStore" under the category of "Digital Governance Initiative" at 'Elets Atma Nirbhar Bharat Summit' in New Delhi on April 19, 2022.

5. C-DAC received the "8th Digital Transformation Award" for mSeva AppStore was received. The National AppStore under the category of "mGovernance Initiative of the Year" at Guwahati on December 9, 2022.

6. C-DAC Pune has been awarded Geospatial Excellence Award 2022 for GeoSadak under the GeoSmart Infra 2022 category during GeoSmart Infra 2022 conference held on September 5 & 6, 2022 at Holiday Inn, Aerocity, New Delhi. GeoSadak is an Online Geospatial Transaction System developed for PMGSY National GIS, and is powered by the GeoSevak framework of C-DAC. The award was presented by Gen. (Dr) Vijay Kumar Singh, PVSM, AVSM, VSM (RETD), Hon'ble Union Minister of State, Ministry of Road Transport and Highways during the event.

Events/Conferences

1. 3rd session of the National Platform for Disaster Risk Reduction (NPDRR) was inaugurated by the Hon'ble Prime Minister of India at Vigyan Bhawan, New Delhi during March 10-13, 2023. "Extension of ERSS (Dial 112) for Disaster Emergencies" was demonstrated and showcased under the projects of NDMA.

2. As a part of "Semicon India Future Design", 1st Roadshow for DLI Scheme was organized at Karnavati University, Gandhinagar, Gujarat, on October 17, 2022.

3. 2nd Design Linked Initiative (DLI) Roadshow on Semicon India Future Design to stimulate the next-gen Semiconductor Designers and promote the culture of Co-development and joint ownership of IPs with active industry participation was conducted at IISc Bangalore on February 24, 2023.

4. Chief Minister of Himachal Pradesh, Shri Jai Ram Thakur inaugurated a new vehicle location control centre and vehicle location tracking mobile app at Peterhof in Shimla on July 19, 2022.

5. Chief Minister of West Bengal, Smt. Mamata Banerjee inaugurated a new vehicle location control centre and vehicle location tracking mobile app at Multilevel Parking Space, Alipore, Kolkata on January 9, 2023.

6. Chief Minister of Kerala, Shri Pinarayi Vijayan launched Vidhya Vahan in the presence of Transport Minister of Kerala, Shri Antony Raju, Transport Commissioner and Additional Transport Commissioner at Thiruvananthapuram on January 4, 2023.

7. Tamil Nadu DGP, Dr. C. Sylendra Babu inaugurated the Centre of Excellence in Emergency Response Support System at NIT Trichy on February 1, 2023.

8. Accelerating Biology 2023 conference was organized to address the challenges in the area of In-silico Drug Discovery and Repurposing at Pune during February 28, 2023 to March 2, 2023.

9. Conference for launch of InTranSE2 Products and connect Industry stakeholders and technology partners was organized in collaboration with IIT Madras, IIT Bombay, IISc Bangalore at Delhi during April 7-8, 2022.

10. 3rd International Conference on Emerging Trends and Technologies on Intelligent Systems ETTIS-2023 was organized in collaboration with Petroleum-Gas University of Ploiesti, Romania and the University of Haute-Alsace, France at C-DAC Noida during February 23-24, 2023.
11. Cadre Specific Training Programme (Induction training) for officials from MeitY and its associated organizations were conducted at C-DAC Noida during November 2022 to February 2023.

12. MANAS app was rolled out at Maharashtra University of Health Sciences (MUHS), Pune in collaboration with AFMC Pune, O/o PSA Government of India, MUHS Maharashtra and C-DAC Bangalore on November 11, 2022.

13. International Conference on Public Key Infrastructure and its Applications (PKIA 2022) with an objective to provide a platform for presenting novel ideas from academia and industry on traditional and emerging topics and new paradigms in the areas of PKI, with a clear connection to real-world problems, systems, or applications, in collaboration with Controller of Certifying Authorities (CCA) was organized at Bangalore during September 9-10, 2022.

14. Meeting with Mr. Brad Smith - President, Microsoft Corporation, top officials of Microsoft Asia and Microsoft India, Mr. Rama Vedashree, CEO DSCI and other dignitaries, stakeholders and participants of CyberShikshaa initiative was organized for "CyberShikshaa: Skilling and Empowering Women in Cybersecurity" at C-DAC (Knowledge Park), Bangalore on September 2, 2022.

15. AI symposium followed by 24-hackathon on "AI for Social Good" was conducted in collaboration with IEEE Bangalore Section during June 11-12, 2022 at C-DAC, EC, Bangalore.

16. Workshop on C-DAC Software Suite for HPC Users to create awareness and use of HPC products available on PARAM was conducted on March 28, 2023 at IISc Bangalore.

17. As a part of "Capacity Building for Human Resource Development in Unmanned Aircraft Systems (Drone and Related Technology)" initiative of MeitY, Bootcamp Training program on Unmanned Aerial Systems (Drone Electronics) was conducted during March 16-20, 2023 at University BDT College of Engineering (UBDTCE), Davanagere.

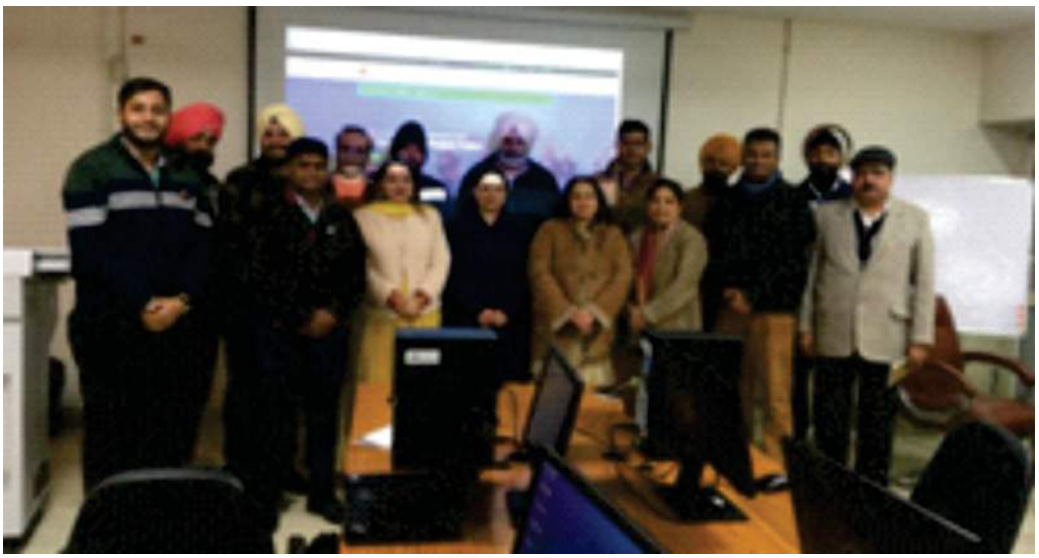
18. Quantum Techade: Co-creation and Collaboration Summit 2023 to epitomize the progress of the nation in the field of Quantum Technologies was organized at Mysuru, Karnataka during March 10-12, 2023.

19. Think Parallel Workshop 2023 on Parallel Programming Human Resource development and NSM Tools Promotion was conducted at C-DAC Knowledge Park, Bengaluru during January 30, 2023 to February 3, 2023.

20. Hands-on Workshop on DIR-V VEGA Microprocessor & Ecosystem for exploring synergies to adopt C-DAC's Indigenously designed Vega Processor in Smart Metering Solutions for various Government Smart City Projects was conducted at C-DAC, Electronic City, Bangalore on January 4, 2023. CEO and Technical Managers from various MSME & Start-up companies involved in manufacturing, design & development of smart metering solutions participated in the same.
21. Rollout of MANAS App in the Jharkhand state has been carried out at Central Institute of Psychiatry (CIP), Ranchi, Jharkhand on November 16, 2022 in collaboration with CIP Ranchi, NHM Jharkhand, O/o PSA Government of India, MoHFW Government of India, NIMHANS and C-DAC Bangalore.

22. Promotion and Capacity building Karyashala for ML/DL application enablement on PARAM Utkarsh HPC system was conducted in collaboration with SERB, DST during July 18-22, 2022 at C-DAC Bangalore.
23. Ideation Round Table Meeting on "Technologies for Smart Cities: Empowering Indian Industry with smart solutions" was conducted on June 17, 2022 at C-DAC Bangalore. Top level executives/representatives from various Smart City Authorities, Urban Local Bodies, Utilities, Start-Ups/MSME and Senior Officers from MeitY participated in the meeting.
24. As a part of Quantum Outreach Program, "Quantum Computing and Communication" Workshops were conducted during June, July and September 2022 at C-DAC EC Bangalore.

25. Online workshop titled "Bio-Brain-Behavior al-Bridging -Unlocking (B4U) – 2023" to understand and address cognitive, psychological or physiological problems related to bio-brain-behavioural aspects was conducted during February 16-17, 2023.
26. As a part of FutureSkills PRIME programme, Online Faculty Development Program in Blended Learning and related aspects including approaches & Use Cases was conducted in collaboration with E&ICT Academy IIT Guwahati, Assam during November 7-13, 2022.
27. Online National Workshop on Architecting Blockchain Applications using National Blockchain Framework was conducted for Sensitizing various state and central Government departments on November 7, 2022.
28. Hands on Workshop on IoT Device Security (HaK-IoT 2023) was conducted at Hyderabad during March 20-24, 2023 which included Commercial-Off-The-Shelf (COTS) IoT devices that are popularly used in day-to-day activities.
29. Hands on Training Program was organized to train different stake holders of Punjab Police Academy (PPA) on MeghSikshak management & usage at Maharaja Ranjit Singh Punjab Police Academy (PPA), Phillaur, Punjab during January 23-25, 2023.



30. Users' Awareness Workshop on Vision Guided AI Enabled Robotic Apple Harvester was conducted in collaboration with IIT Kharagpur and CIPHET Ludhiana at SKUAST-K, Shalimar, Srinagar on October 19, 2022.
31. Users Meet on "Bio-Sensors for Aquatic Ecosystem" was organized to raise awareness among those involved in fishing about unmonitored, unregulated pesticide use and bacterial illnesses in fish at Guwahati, Assam in collaboration with ICAR-CIFRI, Barrackpore, IIT, Hyderabad & ICAR-CIFRI, RC, Guwahati on July 20, 2022.
32. As a part of the "Knowledge & Resource Centre for Accessibility in ICT (KAI)" initiative of C-DAC & MeitY, Train the Trainer Workshop was organized on June 15-16, 2023 at C-DAC Kolkata.

33. Workshop on "Application of Information Technology in Autism" was organized to bring together the academicians, professionals, researchers and other stakeholders from disability rehabilitation and IT field in collaboration with NIEPID at C-DAC Noida and C-DAC Kolkata on October 31, 2022 and November 11, 2022 respectively.

34. Capacity Building programs to enhance the livelihood of Artisans and Weavers of BTC using ICT Tools & Technologies were conducted at Mushalpur, Baksa, Adabari and Kokrajhar during January 18-19, 2022.

35. Online Cyber Security Training on "Management of Digital Hygiene: Staying Secure in CyberSpace" was organized in collaboration with Department of Science and Technology (DST) for Scientists & Technologists

working in Government Sector during August 22-26, 2022.

36. Towards creating awareness about e-Governance solutions developed by C-DAC amongst Central/State Government departments, various workshops were conducted during September 2022 to March 2023 at Mumbai, Dehradun, Bhopal, Guwahati and Chennai.
37. For introduction of new services in e-Governance solutions developed by C-DAC, a workshop was organized at ITDA, Dehradun and Habitat Centre, New Delhi on December 13, 2022 and January 31, 2023 respectively.
38. "Workshop on Online Labs (Olabs)" was conducted for students to review the developed labs / Prototypes and give suggestions / Feedback to enhance the respective lab at C-DAC Mumbai on January 18, 2023.
39. Online workshop on "Security and Secure Coding" was conducted in collaboration with IIT Bhilai during June 22-23, 2022.
40. National workshop on "Medical Education with e-Technology" was conducted in collaboration with AIIMS, Delhi for creating awareness and proliferation of the e-courses being developed and offered through the MEeT LMS and mobile app, to various medical colleges of NER states and also across the country at AGMC, Tripura on December 8, 2022.
41. Workshop on Blockchain in Government Applications was conducted in collaboration with Department of Information Technology, Government of Bihar towards implementing Blockchain-based applications in Government functions at Patna on June 04, 2022.

42. Workshops on Digital Transformation Technologies was conducted in collaboration with Bihar Institute of Public Administration & Rural Development (BIPARD) at Patna, Gaya and Rajgir during June to October 2022. More than 1000 government officials including IAS, BAS, Registrar, Sub-Election Officers, and other allied services officials were trained on Advanced Technologies driving Digital Transformation.
43. Cyber Security Awareness and Training Workshop for MSMEs and Women Entrepreneurs was organized in collaboration with Consumer Unity & Trust Society (CUTS) at Darjeeling, Gangtok and Arunachal Pradesh on November 07, 2022, November 09, 2022 and February 25, 2022 respectively.

44. Faculty Development Program on High Performance Computing and Artificial Intelligence was organized in collaboration with Department of Information Technology, Government of Bihar at C-DAC Patna during October 17-21, 2022. Assistant Professors from all Government Engineering Colleges of Bihar attended the same.
45. Conference on "High Performance Computing (HPC) for Computational Fluid Dynamics (CFD)" was conducted at Indian Institute of Technology Bombay (IITB) during May 17-20, 2022.
46. Workshop on SNOMED CT content development for India AYUSH Extension was organized in collaboration with Central Council for Research in Ayurvedic Sciences (CCRAS), the Central Council for Research in Siddha (CCRS), and the Central Council for Research in Unani Medicine (CCRUM), Ministry of AYUSH, Government of India at C-DAC Pune during May 17-20, 2022.

47. Online training on EHR Standards awareness proliferation was conducted in collaboration with Healthcare Automation Collaboration Team (HACT) and Hospital Tech (HIT) during June 2022.
48. Workshop on ABDM integration with Health Applications for Interoperability Standards Implementation was organized in collaboration with NIC at National Institute of Health and Family Welfare, New Delhi on January 18, 2023.
49. Online Capacity Building Workshop on Forest Fire Monitoring and Management in collaboration with IIT – Kharagpur and DST, Sikkim was conducted during January 17-18, 2023.
50. Online National capacity building workshop for capturing PMGSY proposals using Field-GIS mobile application and Web GIS solutions S was organized in collaboration with NRIDA (MoRD) and various states on March 22, 2023.
51. Workshop on Geospatial Education - Current Trends and Transformation was organized in hybrid mode in collaboration with SIG Pune ISRS - Pune Chapter, ISG - Pune Chapter, and EarthSight Foundation at C-DAC Pune on March 30, 2023.

52. Various DoLR training Workshop for system Integrators were conducted at C-DAC Pune during November 2022 and January 2023.
53. As part of the Cyber Security Awareness Month, workshop on Cyber Security was organized in collaboration with Department of Animal Husbandry, Government of Kerala at Live Stock Training Centre, Government of Kerala during October 19-21, 2022.
54. Workshop on Cognitive Radio for Strategic Applications was organized in collaboration with CC&BT Group, MeitY to showcase the proof-of-concept model of Cognitive Radio test bed developed by C-DAC to users & industry at Thiruvananthapuram on January 20, 2023.
55. National workshop for Awareness and Capacity Building on Automation of Children HelpLine and Women HelpLine was organized at Thiruvananthapuram during December 15-16, 2022.

Research Papers/Publications

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69. Lavanya Palani , Swati Singh , Balaji Rajendran , Bindhumadhava B S and S D Sudarsan, "Optimized Algorithms for Quantum Machine Learning Circuits", Lecture Notes in Networks and Systems (LNNS) Springer, Rourkela, Odisha, Pages 1-10, 2023
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71. Manavalan, Janakiraman and Sumit Kumar Saurav, "Converting 2D Geospatial files into OpenFOAM supported 3D Stereolithography files using Free and Open Source Software Tools – Challenges and Opportunities", ESI 10th OpenFOAM Conference, ESI Group of CFD, November 2022
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73. G. Dhivya, K. Hariharan, S. Bhattacharya, P. Poonguzhali, M. Vaibhav and S. Lokeshwar , "NLoS-VICINITY: A Non-Line of Sight Approach for Visible LIght Communication based INdoor PosITioning System", 25th International Conference on Advanced Communication Technology (ICACT), IEEE Xplore, Pyeongchang, Republic of Korea, Pages 89-95, 2023
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78. Shubhashi Gupta, Priyanka Jain and Naveen Kumar Jain, "Multimodal Analysis of Human Behaviour Using Physiological Signals", 9th Annual Conference of Cognitive Science (ACCS9), 2022
79. Priyanka Jain, N. K. Jain, Dr. Hemant Darbari and Virendrakumar C. Bhavsar, "A parsing tool for short linguistic constructions", Speech and Language Technology for Low-resource Languages (SPELLL) 2022, Springer Nature, 2022
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83. N. Satyanarayana and V. Harish, "Performance study for improving throughput in Hyperledger Fabric Blockchain Platform", IEEE Global Emerging Technology Blockchain Forum, IEEE, Virtual, USA, 2022
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97. Priyesh Ranjan, Sudeep Rai, Amit Kumar Ateria, Ashutosh Kumar and Amarjeet Singh Cheema, "e-Visit Using Dynamic QR Code with Application Deep Linking Capability: Mobile-App-Based Solution for Reducing Patient's Waiting Time", Proceedings of Emerging Trends and Technologies on Intelligent Systems: ETTIS 2022, Springer Nature Singapore, Noida, India, Pages 85-93, 2022
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101. Kanti Singh, Archana Singh, Lakshmi Kalyani and Hari Mohan Pandey, "Implementation of Threats Detection Modeling with Deep Learning in IoT Botnet Attack Environment", 6th International Conference on Information & Communication Technology for Intelligent systems (ICTIS-2022), Springer, Online, Part of the Smart Innovation, Systems and Technologies book series (SIST, Volume 312), October 2022
102. Dr. Arti Noor, "Holistic Cyber threat hunting using network traffic intrusion detection analysis for Ransomware attacks", Proceedings of International Conference on Information Security, Privacy and Digital Forensics (ICISPD 2022), National Forensic Sciences University Goa, India, December 2022
103. Ravi Payal and Dr Amit Prakash Singh, "Model for Home Automation System Through FPGA", International Conference on Recent Advances in Computing Sciences-2022, Online, Punjab, November 2022
104. Ravi Payal and Dr Amit Prakash Singh, "Analysis of Kogge-Stone and Ladner Fischer Parallel Prefix adder using Verilog HDL", International Conference on Research Advances in Engineering and Technology, Kerala, Online, December 2022
105. Santosh Kumar, "A Survey on Indian Sign Language Translation using Artificial Intelligence", 3rd International Conference on Emerging Trends and Technologies on Intelligent Systems, C-DAC Noida, 2023
106. Akash Suman, Tushar Fegade and Shailendra Singh Narwariya, "Tele-Education using Virtual Reality", TELEMEDICON 2022, Telemedicine Society of India (TSI), November 2022
107. Madhura Deo, Bhumika Khawshi and Shailendra Singh Narwariya, "Tele-ICU monitoring for Clinical parameters", TELEMEDICON 2022, Telemedicine Society of India (TSI), 2022
108. Arpit Kahndelwal, Tushar Fegade and Shailendra Singh Narwariya, "Real-Time Collaboration on Medical Images", TELEMEDICON 2022, Telemedicine Society of India (TSI), 2022
109. Ameya Patil, Tushar Fegade and Shailendra Singh Narwariya, "Empower Telemedicine solution for 5G Network", TELEMEDICON 2022, Telemedicine Society of India (TSI), 2022
110. Achyut Patil, Manisha Mantri and Gaur Sunder, "Common Drug Codes for India (CDCI)", SNOMED CT Expo 2022, SNOMED International, September 2022
111. Sharma SK, Mantri MD and Sunder G., "Role of technology in building Resilient health system for chronic and lifestyle diseases", 21st Annual Conference of Indian Society of Psychiatric Nurses on theme: resilience in health and illness: Role of nurse", Bihar, July 2022
112. Manisha Mantri and Sayali Pophalkar, "Accelerating LOINC adoption and implementation towards building a standardized Health ecosystem", LOINC Conference 2022, Regenstrief Institute, Virtual, October 2022
113. Swapna Yenishetti, Lakshmi Panat and Aishwarya Bharambe, "Detection of Breast Cancer and Segmentation of Abnormalities Using Deep Learning and Image Processing Techniques", International Journal for Research Trends and Innovation, Volume 7, Issue 8, Pages 1599-1607, August 2022
114. Shashi Pal Singh, Ajai Kumar, Ritu Tiwari and Sanjeev Sharma, "AI Based Multi-Label Data Classification of Social Media", Proceedings of International Joint Conference on Advances in Computational Intelligence", Springer, Singapore, Pages 329–341, 2022
115. Shashi Pal Singh, Ajai Kumar and Kanishka Pundir, "Deep Neural Based Machine translation using RNN for Indian Languages", Lecture Notes in Networks and Systems series of Springer Print ISSN 2367-3370, Springer, Cuttack, Odisha, 2022
116. Shashi Pal Singh, Ajai Kumar, Aarti Saxena and Richa Verma, "Machine Translation Evaluation", Lecture Notes in Networks and Systems, Springer, Jaipur, India, 2022
117. Shraddha Amit Kalele, Shashi Pal Singh, Prashant Chaudhary, Lenali Singh, Ajai Kumar and Pulkit Joshi, "A Hybrid Approach Towards Machine Translation System for English–Hindi and Vice Versa", Lecture Notes in Networks and Systems book series, Springer, Pages 523–532, 2022
118. Prashant Chaudhary, Pavan Kurariya, Shashi Pal Singh, Jahnavi Bodhankar, Lenali Singh and Ajai Kumar, "Intelligent Virtual Research Environment for Natural Language Processing (IvrE-NLP)", Smart Trends in Computing and Communications, Volume 396, Springer, Pages 453–465, 2022

119. Pavan Kurariya, Prashant Chaudhary, Jahnavi Bodhankar, Lenali Singh, Ajai Kumar and Hemant Darbari, "vTAG: Virtual Lab for Tree-Adjoining Grammar based research", 7th International Conference on Information and Communication Technology, (ICTCS-2022), Chandigarh, India, Pages 5, 2022
120. Pavan Kurariya, Ankita Bhargava, Srikanth Sailada, N. Subramanian, Jahnavi Bodhankar and Ajai Kumar, "Experimentation on usage of PQC Algorithms for eSign", IEEE International Conference on Public Key Infrastructure and its Applications, PKIA 2022, Bangalore, India, Pages 6, 2022
121. Samyak Jain, Neelkumar K. Shah, Pavan Kurariya, Neeti Vohra, Sachin Nandukar, Niteshkumar Harne, Mohammad Aziz Maalik, Jahnavi Bodhankar, Dr. Ajai Kumar and Chebolu Indraveni, "Smart Contract - Security Assessment Integrated Framework (SC-SIF) for Hyperledger Fabric", 7th International Conference for Convergence in Technology (I2CT), IEEE, Pune, Maharashtra, India, 2022
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124. Dr. Ajai Kumar, Manish Kumar Gupta, Surya Vikram and Siddharth Dhawan, "Handwritten OCR for word in Indic Language using Deep Networks", SPIN 2023, IEEE, Amity University, Noida, 2023
125. Dr. Ajai Kumar, Kishor Patil, Neha Gupta and Damodar Magdum, "TOWARDS MODI SCRIPT PRESERVATION: TOOLS FOR DIGITIZATION", 3rd International Conference on Natural Language Processing and Computational Linguistics (NLPCL 2022), AIRCC publishing Corporation, London, United Kingdom, Pages 55-67, July 2022
126. V. Vidya, K. Saly and C. Balan, "Forensic Acquisition and Analysis of Webpage", 2nd International Conference on Intelligent Technologies (CONIT), IEEE, Hubli, India, Pages 1-6, 2022
127. Dija S, "Blockchain-Based Cyber Forensics Chain of Custody Management with Hyperledger Fabric", 12th International Conference on Recent Trends in Communication and Computer Networks, Grenze Scientific Society, Chennai, Pages 35-39, 2022
128. Jerry Daniel J, Byju C, Rakesh G and Lekshmi G, "Web-based Manhole Overflow Prediction System Using Ultrasonic Level Sensors and Expert System", International Conference on "Machine Learning, Big Data, Cloud and Parallel Computing: Trends, Perspectives and Prospects" (Com-IT-Con-2022)", IEEE, Faridabad, Pages 5, May 2022
129. Harikrishnan B and Shibu R M, "Persistent Memory-based Storage Node for HPC Domain", SNIA Persistent Memory and Computational Storage Summit 2022, SNIA, Virtual, Pages 23, 2022
130. Parvathy S.R., Deepak Jayan P., Nimmy Pathrose, Rajesh K.R., Lekshmy Janardhanan R, James Varghese, Vishnu S., Nimmy Mathew and Sujith B. Kallara, "Red Palm Weevil Detection System for Early Warning and Mitigation of Crop Loss", International Conference on Connected Systems & Intelligence (CSI'22), IEEE, Thiruvananthapuram, 2022
131. Lakshmaiah Alluri and Hemant Jeevan Magadum, "Shared Cycle and Vehicle Sharing and Monitoring System", 11th International Conference on System Modeling & Advancement in Research Trends (SMART), IEEE Xplore, Virtual, Pages 5, December 2022
132. Jose Stephen, "Web Based Automated Transcription Tool for Emergency Response Domain", International Conference on Intelligent Solutions for Emergency Response and Disaster Management (ISERDM-2023), NIT Trichy, 2023

Invited Talks

1. Dr. S. D. Sudarsan, "Challenges and Prospects for Quantum Technology Development", First International Quantum Communication Conclave, Vigyan Bhawan, New Delhi, March 27, 2023
2. Dr. S. D. Sudarsan, "Eighth International Conference on Computing, Communication and Security (ICCCS 2023), Baba Farid Group of Institutions (BFGI), Bathinda, March 4, 2023
3. Vivek Gavane, "HPC for Lifesciences using BRAF facility", 7th International Conference on Data Management, Analytics & Innovation, Defence Institute of Advanced Technology, (Deemed to be University), Girinagar, Next to Khadakwasla Dam, Pune, Maharashtra 411025, January 19, 2023.
4. Sunitha Manjari Kasibhatla, "Bioinformatics overview and role of HPC", 7th International Conference on Data Management, Analytics & Innovation, Defence Institute of Advanced Technology, (Deemed to be University), Girinagar, Next to Khadakwasla Dam, Pune, Maharashtra 411025, January 19, 2023.
5. Amit Saxena, "Big Data in Bioinformatics", 7th International Conference on Data Management, Analytics & Innovation", Defence Institute of Advanced Technology, (Deemed to be University), Girinagar, Next to Khadakwasla Dam, Pune, Maharashtra 411025, January 19, 2023.
6. Vinod Jani, "HPC driven molecular simulations for Drug discovery", 7th International Conference on Data Management, Analytics & Innovation, Defence Institute of Advanced Technology, (Deemed to be University), Girinagar, Next to Khadakwasla Dam, Pune, Maharashtra 411025, January 19, 2023.
7. Ruma Banerjee, "Comparative Genomics using HPC", 7th International Conference on Data Management, Analytics & Innovation, Defence Institute of Advanced Technology, (Deemed to be University), Girinagar, Next to Khadakwasla Dam, Pune, Maharashtra 411025, January 19, 2023.
8. V Karthika, "Mental health and normalcy augmentation System", IEEE International Conference for Women in Innovation, Technology and Entrepreneurship, IISc Bangalore, December 1, 2022
9. Santosh Sam Koshy, "IoT in Agriculture: Needs, Case Studies & Challenges", International Conference on Reimagining Rainfed Agro-Ecosystems – Challenges & Opportunities (ICRA-2022), CRIDA, Hyderabad, September 22, 2022
10. Dr. Lakshmi Kalyani, "Cyber Forensics", International Conference on Cyber Crimes, Cyber Laws & Cyber Attacks (ICCC), Virtual Conference, November 23-25, 2022.
11. Dr. Dittin Andrews, "Cyber Security Challenges and Research Opportunities", 9th International Conference on Advances in Computing and Communication Engineering (ICACCE - 2023), Valencia, Cypus (Online), September 22, 2022.
12. Binu P. J., "Telemedicine and Mobile Telemedicine System implemented by C-DAC Trivandrum", International Conference on Telemedicine - TELEMEDICON-2022, Amrita Institute of Medical Sciences and Research Centre, Kochi, September 10, 2022.
13. Dr. S. D. Sudarsan, "Control & Measurement Electronics and Calibration", Symposium on Quantum Computing Ecosystem (Q-Symp): Basic Building Blocks, C-DAC Pune, January 30, 2023
14. Shanmukesh Pudi, "Cyber Security: General awareness, CEA Guidelines, Role of CERT-In, NCIIPC, CERT-GO, MEITY & CISO ", Power System Operation for the Load Despatch Operators, NPTI Bengaluru, September 26, 2022 and February 17, 2023
15. Rajesh Kalluri, Mahendra Lagineni, Shanmukesh Pudi and Siddharth Rao M, "OT/ICS/SCADA Security for OT System Engineers", Virtual, June 14-17, 2022
16. Dr. R. C. Saritha, "Mental health and Normalcy augmentation system (MANAS)", World championship yoga sports day 2022, Bangalore, December 3, 2022
17. V Karthika, "e-Saadhya - An e-learning system for children with autism and mild mental retardation", World championship yoga sports day 2022, Bangalore, December 3, 2022
18. V Karthika, "Mental health and normalcy augmentation System", An awareness programme for Naval Officers, Naval Provost School, Goa, July 26, 2022
19. Dr. Balaji R, "Internet Security for All", Cyber Security Awareness, NISER Bhubaneshwar, January 6, 2023
20. Dr. Balaji R, "Cyber Security in the Metaverse World", IETE Zonal Seminar, IETE Bangalore, September 18, 2022

21. Dr. Balaji R, "Recent Attack Trends in Cyber Security", CISF Unit, UIDAI Bengaluru, January 16, 2023
22. Dr. Balaji R, "Cryptography, Digital Signatures and PKI", Cyber Surakshit Bharat – CISO Deep Dive Training, Online, June 22, 2022
23. Prachi Pandey, "System Software products/tools for HPC", NSM HPC Workshop, NIT Trichy, December 23, 2022
24. Deepika H V, "Talk on HPC Softwares – CAPC and ParaDE", Workshop on High-Performance Computing (HPC), IIT Roorkee, May 5, 2022
25. Kaushik Nanda, "Smart Energy Meter and Advanced Metering Infrastructure", Seminar on 'Smart Grid Technologies' at NIT Trichy, Online, December 8, 2022
26. Kaushik Nanda, "IoT: Trends, Opportunities & Challenges", Seminar on 'IoT', PES University, Bengaluru, November 29, 2022
27. Harikrishnan V S, "Emerging Image and Video Analytics Applications in deep learning Era", Winter Summit on Smart Computing and Networks (IEEE WiSSCoN 2023), Anna University, March 15, 2023
28. Vivek Nainwal, "Introduction to QSim", Course on Quantum Technologies, DRDO RCI Lab Hyderabad, June 15, 2022
29. Chebolu Indraveni, "Cyber Crimes and Safety", Employee Cyber Security Awareness Event for Shipping Corporation of India Ltd., Mumbai, Online, May 13, 2022
30. Chebolu Indraveni, "Need for safety with respect to Digital games", ISEA Workshop in association with NCERT, Online, August 3, 2022
31. Chebolu Indraveni, "OWASP top 10 Web Applications Security", Expert talk in a webinar by Future Skills Prime, Online, April 4, 2022
32. Tapas Saini, "Overview of Artificial Intelligence – Tools and Techniques", Application of Artificial Intelligence and Sensor-based Technologies in Agriculture, MANAGE, Hyderabad, June 20, 2022
33. Tapas Saini, "Artificial Intelligence", Cohort Networking & Capacity Building Program, ICAR - NAARM, Hyderabad, November 4, 2022
34. P. R. Lakshmi Eswari, "Blockchain Technology", Workshop on Blockchain in Government Applications, C-DAC, Patna, June 4, 2022
35. P. R. Lakshmi Eswari, "Blockchain Technology", National Workshop on Architecting Blockchain Application using National Blockchain Framework, Hyderabad, November 7, 2022
36. P. R. Lakshmi Eswari, "Blockchain Technology", Shakticon 2023 Conference, Online, January 21, 2023
37. P. R. Lakshmi Eswari, "Overview of National Blockchain Framework", Blockchain Industry Meet, Online, February 1, 2023
38. P. R. Lakshmi Eswari, "C-DAC's Cyber Security and Blockchain initiatives", DIGIPOL 2023 - Global Expo and Training on Home Land Security and Defense, Hyderabad, March 6, 2023
39. Jyostna G., "National Blockchain Framework and Applications", Five-Day workshop on Blockchain Technology, Online, February 3, 2023
40. T. Sai Gopal, "Ransomware Analysis", Mitigating Risks of Malware, Online, June 13, 2022
41. Venkat R. Kodimelan and Himanshu Sahu, "Mobile Application Testing Strategies & OWASP Mobile Top 10 Vulnerabilities", Developer's Workshop, C-DAC Mumbai, June 16, 2022
42. Venkat R. Kodimela, "Mobile Application Testing Strategies, CISO Forum Meeting, IDRBT, Hyderabad, September 13, 2022
43. Venkat R. Kodimela, "Mobile Application Testing Strategies", UCBCISO Forum Meeting, IDRBT, Hyderabad, September 19, 2022
44. Dr. S. V. Srikanth, "Advanced IoT Initiatives in Agri and Allied Sectors", Social Media for Agricultural Extension, Online, June 21, 2022
45. Dr. S. V. Srikanth, "Introduction to Internet of Things (IoT) and IoT Examples and Case studies", Application of Artificial Intelligence and Sensor-based Technologies in Agriculture, Online, June 22, 2022
46. Dr. S. V. Srikanth, "IoT in Agriculture", IoT & the Future of Indian Agriculture, NAARM, Hyderabad, July 28, 2022
47. Dr. S. V. Srikanth, "IoT Device Pentesting: In & Out of the Box", Webinar on IoT Security (WISE)-2022, Online,

May 30, 2022

48. Dr. S. V. Srikanth, "The IoT Pentesting", IoT & Cybersecurity, Online, June 15, 2022
49. Santosh Sam Koshy, "Securing the IoT System and Networks", Stryker Annual Tech Show, Online, April 28, 2022
50. Santosh Sam Koshy, "IoT in Agriculture: Case Studies in Pest & Disease Forewarning", Faculty Development Program, Online, September 6, 2022
51. Santosh Sam Koshy, "Securing the IoT Systems and Networks", Hardware Security Symposium, Online, January 13, 2023
52. Santosh Sam Koshy, "Application of IoT in Agriculture", Training Program on "Impactful ICT Applications and Technologies in Agriculture, Online, NAARM Hyderabad, February 7, 2023
53. Yumnam Kirani Singh, "Digital Archiving of Traditional Handlooms of Manipur", Manipur International Textile Expo (MANITEX 2022), Imphal, November 13, 2022
54. Dr. Hena Ray, "AI based Robotic vision", Workshop on Artificial Intelligence & Its Applications, NCSM, Kolkata, November 23, 2023
55. Alokesh Ghosh, "AI in Livestock Management", National conference on Innovations in Animal genetics and Breeding for sustainable productivity of livestock Poultry, ICAR-DPR, Hyderabad, December 3, 2022
56. Alokesh Ghosh, "IoT and Robotics in Agriculture", Training program on eExtension in Agriculture, MANAGE, Hyderabad, February 22, 2023
57. Alokesh Ghosh, "Applications of AI in Robotics", Workshop on Artificial Intelligence & Its Applications, NCSM, Kolkata, November 23, 2023
58. Dr. Amitava Akuli, "Electronic Trading of Agriculture Commodities with Special Reference on ENAM", ICTs in Agricultural Marketing, Online, December 5-7, 2022
59. Dr. Amitava Akuli, "e-Quality – Electronic Quality Assessment Solutions for Agricultural Commodities For NAM", National workshop on "e-Quality Assessment Solutions for Agricultural Commodities", ICAR-Indian Agricultural Research Institute, New Delhi, December 8, 2022
60. Ritesh Mukherjee, "Importance and Application of AI/ML in Agriculture and allied sector" and "Application of Big Data in Agriculture", Training programme on 'eExtension in Agriculture and Allied Sector', MANAGE, Hyderabad, February 24, 2023
61. Dr. Joyanta Basu, "AI in Speech Processing: Speech production and its application", Workshop on AI & Its Applications, National Council for Science Museum (NCSM), Kolkata, November 22, 2023
62. Sourav Mitra, "Relevant sections of IT Act 2000 & IPC", Training programme on "Cyber Crime Awareness course for Police Officers", CID, Kolkata, November 11, 2022 and November 24, 2022
63. Sonia Dosanjh, "Applications of AI in Audio Forensics to meet the future challenges", Online workshop by Central Forensics Laboratory, Chandigarh, May 5, 2022
64. Sanjay Madan, "CUDA Architecture", 'CEP course' by Defence Geoinformatics Research Establishment (DGRE), Chandigarh, Online, June 24, 2022
65. Gulbadan Khehra, "Reinforcement Learning and its applications", 'CEP course' by Defence Geoinformatics Research Establishment (DGRE), Chandigarh, Online, June 24, 2022
66. Kapil Kant Kamal, "Mobile Apps Testing and Insights on National AppStore", Urban Cooperative Banks CISO Forum, IDRBT, September 19, 2022
67. Kapil Kant Kamal, "National AppStore", Chief Information Security Officers (CISO) of all National banks, IDRBT, September 13, 2022
68. Kapil Kant Kamal, "National AppStore", State Government, Department of Andhra Pradesh, ITE&C Department, Government of Andhra Pradesh (GoAP), August 29 and 30, 2022
69. Dr. M. Sasikumar, "Presentation and demonstration on Virtual labs-Olabs", Webinar on "Virtual labs: Types and Exemplars", hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch Channel, September 27, 2022
70. Vaibhav Singh, "Presentation and demonstration on Virtual labs – Olabs", Webinar on "Explorating Virtual Labs for Mathematics", hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch channel,

September 29, 2022

71. Dr. M. Sasikumar, "Presentation and demonstration on Virtual labs – Olabs", Webinar on "Explorating Virtual Labs for Languages" CIET NCERT, Online mode, hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch channel, September 30, 2022
72. Suman Ninoriya, "Demonstration of one lab from each subject of OLabs", Webinar on "Demonstration of Virtual Lab Experiments on DIKSHA and ePathshala AR Content", Online mode, hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch channel, December 29, 2022
73. Priyanka Monde, "Demonstration of one lab from each subject of OLabs-Webinar on "Demonstration of Virtual Lab Experiments on DIKSHA and ePathshala AR Content" CIET NCERT, Online mode, hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch channel, December 30, 2022
74. Vaibhav Singh and Karishma Ghodpage, "Demonstration of Mathematics labs of OLabs", Webinar on "Virtual Labs for Mathematics with special reference to their pedagogical usage" CIET NCERT, Online mode, hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch channel, February 15, 2023
75. Suman Ninoriya and Priyanka Monde, "Demonstration of Language labs of OLabs", Webinar on "Virtual Labs for Mathematics with special reference to their pedagogical usage" CIET NCERT, Online mode, hosted on Youtube "NCERT official", SWAYAM Prabha DT TV Kishor Manch channel, February 17, 2023
76. Dr. M Sasikumar and Priyanka Monde, "Presentation and demonstration on Virtual labs - Olabs.-Virtual labs (Online labs)- Perspective, need and scope", Offline mode, Nehru Science Centre, Worli Mumbai, February 23, 2023
77. Praveen Srivastava, "Connected Health System to achieve Universal Health Coverage", National Workshop on Telemedicine & AI for Healthcare, IIT Kanpur Outreach Campus, Sector 62, NOIDA, July 2, 2022
78. Jitendra Singh and Partha P. Chattaraj, "Introduction of eAushadhi and Upkaran – Digital Inventory", Aapoorti 2022 Scientific Sessions, AFMSD, Lucknow, September 21, 2022
79. Dr. Arti Noor, "Cyber Attacks and Implications", CEP, DRDO, Delhi, September 14, 2022
80. Rekha Saraswat, "Network Security", CEP, DRDO, Delhi, September 14, 2022
81. Dr. Kalpana Johari, "Quantum Computing, The Way Forward", Celebration of Ada Lovelace Day at Miranda House by CompuAda, Computer Science Society of Miranda House, October 11, 2022
82. Aditya Kumar Sinha, "Digital Transformation to Democratize Financial Service", FinTech & Credit Expo 2022, Kolkata, September 9, 2022
83. Ritesh Dhote, "Cyber Space & need for Cyber Security Ecosystem at Educational Institutes", Workshop for AF School principals and executive directors", AF Auditorium, Subroto Park, New Delhi, November 22, 2022
84. Aditya Kumar Sinha, "Future Farming using Precision Agriculture", Conference on Future of Farming for Food & Nutrition Security by Chamber of Commerce, Bihar Chapter, Patna, September 07, 2022
85. Aditya Kumar Sinha, "R&D Goals by Interlinking Application, Research, Technology and Capacity Building in Advanced Computing", Inaugural function of NERC 2022 at IIT Guwahati, Patna, May 20, 2022
86. Manisha Mantri and Ms. Sayali Phophalkar, "FHIR Implementation Discussion for ABDM Open–House", Webinar hosted by NHA for ABDM sandbox users, Virtual, April 4, 2022
87. Manisha Mantri and Achyut Patil, "Open House session on SNOMED CT", Webinar hosted by NHA for ABDM integrators, Virtual, April 25, 2022
88. Manisha Mantri, "EHR Standards for India and NRCeS Activities", Specialized Training Program in Healthcare Information Technology" as part of, Indian Technical and Economic Cooperation (ITEC), Virtual, May 27, 2022
89. Sayali Phophalkar, "Introduction to NRCeS, Healthcare Data Standards & its adoption in ABDM", ABDM Orientation Workshop for Joint Directors/Directors, IIT and Hotel VITS, Mumbai, June 8-10, 2022
90. Suresh Sharma, "Electronic Health Record and EHR Standards for India 2016", DGHS-ECHO First training workshop on Digital Healthcare for Nurses", Virtual, July 9, 2022
91. Achyut Patil, "Common Drug Codes for India (CDCI)", SNOMED CT Expo 2022, Virtual, September 29, 2022
92. Manisha Mantri, "Global Framework on Health Data Governance", AeHIN General Meeting and Conference 2022, Virtual, October 10, 2022
93. Suresh Sharma and Achyut Patil, "Data Analytics with SNOMED CT", Gokhale institute of Politics and

Economics (GIPE), Virtual, October 11, 2022

94. Manisha Mantri and Sayali Phophalkar, "Accelerating LOINC adoption and implementation towards building a standardized Health ecosystem", LOINC Conference 2022, Annecy, France, Venue-Virtual, October 27, 2022
95. Gaur Sunder, "Telemedicine/Digital Health Standards", Telemedicon 2022 at AIMS, Kochi, Virtual, November 12, 2022
96. Manisha Mantri, "EHR Standards for India & AYUSH Standardization Initiatives", Workshop on Scope and Application of artificial intelligence in Traditional Medicine, Ministry of Ayush, Government of India, Virtual, February 24, 2023
97. Suresh Sharma, "Role of Nurses in promoting mental health – Life span approach", 22nd Annual Conference of ISPNCON-2023, organized by Institute of Nursing Education, Directorate of Health Services, Government of Goa, Institute of Nursing Education Auditorium, Bambolim, Goa, February 24-26, 2023
98. Gaur Sunder, "Clinical Research in Era of Interoperable Health Systems", 16th Annual Conference of the Indian Society for Clinical Research (ISCR), New Delhi, February 25, 2023
99. Ruma Sudipta Banerjee, "Introduction to Bioinformatics", India-Namibia CEIT (Centre for Excellence in IT) workshop, Online, April 14, 2022
100. Ruma Sudipta Banerjee, "Introduction to Bioinformatics", India-Tanzania COEIT workshop, Online, June 30, 2022
101. Ruma Sudipta Banerjee, "Reference mapping and variant calling", Workshop on NGS for National Institute of Virology (NIV) Scientists, Online, December 13, 2022
102. Neeraj Bharti, "NGS File formats and usage of reference mapping and variant calling tools", Workshop on NGS for National Institute of Virology (NIV) scientists, Online, December 13, 2022.
103. Dr. Uddhavesh Sonavane, "Ayurveda - Data Science and Omics", 9th World Ayurveda Congress, Online, August 22, 2022
104. Lakshmi Panat, Dr. Ganesh Karajkhede, "IT in Ayurveda: "Ayusoft" a Case study", IEEE, EMBS, Kerala Section, Online, June 24, 2022
105. Lakshmi Panat, "AI Innovations for Oncology", National Symposium on Health data and Artificial Intelligence, CMC Vellore, Vellore, Tamil Nadu, March 17-18, 2023
106. Shubhanshu Gupta, "Indian Accessibility Standards", India EU Workshop on Inclusive Design and Standardization, Satish Dhawan Auditorium, IISC Bangalore, November 28, 2022
107. Dr. Manoj K. Khare, "Cloud and IT Infrastructure for Geospatial Implementation", Geospatial Leadership Summit (IGLS) 2022 - "Geospatial Technologies Supporting Economic Development", New Delhi, April 25, 2022
108. Dr. Manoj K. Khare, "C-DAC's geomatics Solutions", Geo-Enabling The Global Village: Pre Event leading to the Second United Nations World Geospatial Information Congress, Online, April 19, 2022
109. Dr. Manoj K. Khare, "Applications of geospatial technology for UN Sustainable Development Goals", Summer School in Geospatial Science and Technology (Level 2) May 23 - June 11, 2022
110. Sajeevan G., "National implementation of Online Geospatial Transaction System", Second United Nations World Geospatial Information Congress, Hyderabad International Convention Centre (HICC), Hyderabad, October 12, 2022
111. Dr. Manish P. Kale, Measuring Carbon Sequestration by Applying Remote Sensing, Workshop on Carbon off-setting due to Plantation under MGNREGS, National Institute of Rural Development & Panchayati Raj, October 18, 2022
112. Dr. Manish P. Kale, "Forest Fire Spread Simulation", National Level Workshop on Remote Sensing and GIS: Applications and Modelling in Research Sponsored by DST SERB under High End Workshops (Karyashala) Scheme organized by The Department of Geography, S.N.D.T. Women's University, Pune Campus, C-DAC, innovation Park, Pune, February 27, 2023
113. Dr. N. Subramanian and Dr. Manish P. Kale, "Forest Fire Spread Simulation over 5G Environment", IEEE Future Networks World Forum, October 12-14, 2022, Montreal, Canada, Online, October 14, 2022
114. Dr. Manoj Chavan, "Fire Dynamics Simulator data preparation", National Level Workshop on Remote Sensing and GIS: Applications and Modelling in Research Sponsored by DST SERB under High-End Workshops

(Karyashala) Scheme organized by The Department of Geography, S.N.D.T. Women's University, Pune Campus, February 27, 2023

115. Biju C., PMGSY National GIS, GRRIS, GeoSadak, GeoSevak, National Level Workshop on Remote Sensing and GIS: Applications and Modelling in Research Sponsored by DST SERB under High End Workshops (Karyashala) Scheme organized by The Department of Geography, S.N.D.T. Women's University, Pune Campus, February 27, 2023
116. Dr. Yogesh Kumar Singh, "Early warning system for flood prediction", ISERDM-2023, NIT Trichy, January 10, 2023
117. Dija S., "Cyber Forensics", Mid-career Training Program of IPS Officials at SVP NPA Hyderabad, November 25, 2022
118. Dija S., "Cyber Forensics: Emerging Areas & Challenges", KTU Sponsored 5-day workshop on "Recent Advancements in Computational Forensics, Techniques and Tools, Alappey, Kerala, February 20, 2023
119. Sreeja S. C., "Safety of Woman in Cyber Space", 'Mahilalayam' Program in All India Radio, Trivandrum, October 27, 2022
120. Dija S., "Cyber Forensics: Emerging Areas & Challenges", KTU Sponsored 5-day workshop on "Security in Computing", Trivandrum, February 21, 2023
121. Dija S., "Cyber Forensics Initiatives of C-DAC, DigiPol – Global Expo on Police and Defense, Hyderabad, March 6, 2023
122. Dija S., "Cyber Safety for Women", Women's Day Celebration, CUSAT, Cochin, Online, March 8, 2023
123. Dija S., "Cyber Safety for Women", Women's Day Celebration, ICAI, Trivandrum", March 16, 2023
124. Dr. Dittin Andrews, "Panel Discussion: Incident response for Working Professionals", IEEE Computer Society Colloquium 2023, IEE Kerala Chapter, February 25, 2023
125. Dr. Dittin Andrews, "Emerging Trends in Cyber Security", IEEE Computer Society Colloquium 2023, IEEE Kerala Chapter, February 25, 2023
126. Dr. Dittin Andrews, "Panel Discussion: technological Solutions and Directions to Secure Cyberspace", Amrita Cyber Nation (ACN) 2022, Amrita Vishwa Vidyapeetham, Chennai, October 1, 2022
127. Dr. Dittin Andrews, "Recent Trends in Cyber Security", Industrial Collaboration Programme, Government Engineering College, Palakkad, January 10, 2023
128. Dr. Dittin Andrews, "Vulnerability Analysis and Security Auditing", Workshop for Government Officers, Kerala State IT Mission, November 28, 2022
129. Dr. Dittin Andrews & Senthilkumar K. B., "Cyber Secure E-Infrastructure", e-Governance Standards and Guidelines State Level Awareness Workshop for Government of Kerala, Ministry of Electronics and Information Technology, January 20, 2023
130. Dr. Dittin Andrews, "Cyber Security Essentials", Cyber Jaagarookta Diwas, Indian Rubber Board, May 4, 2022
131. Senthilkumar K. B., "Building a Secure IT infrastructure", Indian Express - Technology Sabha, Cochin, February 25, 2023
132. BYJU N. B., "Online Learning and Computational Challenges in Digital Pathology", Online Industry Academia Workshop on Artificial Intelligence in Health Care, Online, October 21, 2022
133. Hemant Jeevan Magadum, "TSDSI CDAC Status report on Intelligent Transport systems", Collaboration on ITS Communication Standards (CITS), 2022, Virtual, September 23, 2022
134. Hemant Jeevan Magadum, "C-DAC CoSMiC Common Service Layer", IoT / M2M TRIP Forum, Virtual, December 14, 2022
135. Hemant Jeevan Magadum, "TSDSI CDAC Status report on Intelligent Transport systems", Collaboration on ITS Communication Standards (CITS), 2023, Virtual, March 17, 2023

Human Resource Development

The C-DAC Human Resource Department is responsible for developing new policies and/or revising existing policies for reaping the optimum potential in the area of human resources across the centres, as well as the management of HR activities in line with organisation's policies/priorities and Projects.
In C-DAC Human Resource plays very important role in revising & restructuring policies based on current HR trends and Organisational need. Accordingly, a few initiatives were taken place in last year.

Accomplishments and Initiatives during the year 2022 – 23

1. **Just In Time (JIT) recruitment:**
   This initiative is derived to facilitate faster selection process, as manpower is required to execute the time bound projects of C-DAC without any delay. This initiative helped to bring down the turnaround and lead time required to complete a recruitment cycle. Also, this initiative made the application process easy for prospective candidates to apply for a position in C-DAC.

2. **Succession Planning:**
   This intervention was initiated to create a path for retiring employees to hand off their years of hard-earned knowledge to the right successor. It was also opined that it is imperative to have appropriate back up for key resources in live project as unforeseen separation of such key resources are impacting the project delivery immensely. The succession planning has ensured that C-DAC has the right leaders in place, without any gaps.

   Succession planning process is a robust system to ensure that key roles in project should always have a backup to ensure seamless continuity of project delivery.

3. **Retention/Comeback Scheme:**
   This intervention is proved to be very useful to regain trained and skilled work force of contract employees directly engaged by C-DAC, wherein attrition rate is high.

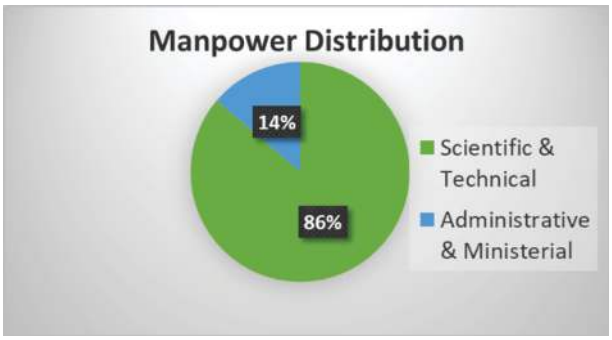
   This initiative facilitated return of Contract on Consolidated Pay (COCP) employees even after the separation on resignation, availability of ready-to-deploy/trained manpower and helped in curbing recruitment costs & time.

4. **Centralised Training:**
   Centralised training consists of small modules and structural courses on soft skills, technical and non-technical topics. Imparted 3100 man-days of training during the year. Which is in addition to the centre level project specific trainings.

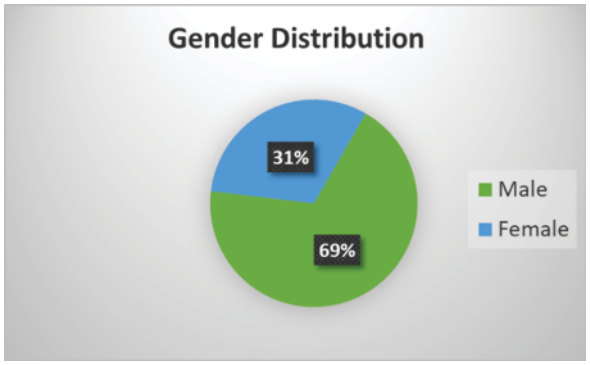
5. **Leadership Coaching workshop:**
   Conducted a Group Coaching workshop for selected leaders. After successful completion of assessment and personal coaching by the renowned leadership coaches.

Manpower Distribution

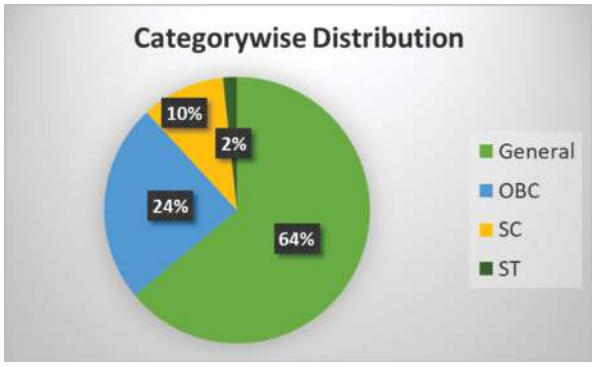
Functional Distribution – C-DAC has 3776 employees as on March 2023, spread across 12 centres and Corporate Office. The functional composition of the workforce is as shown below:



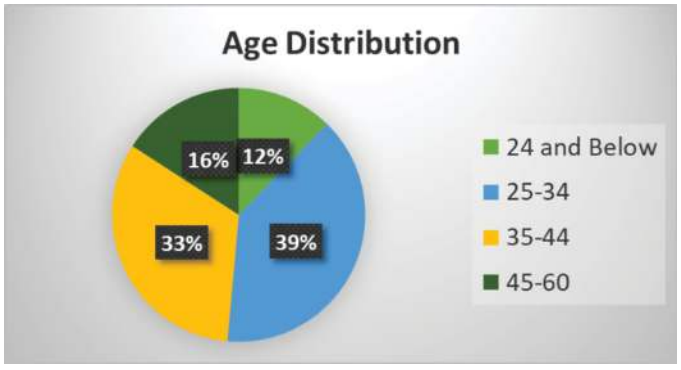
Gender Distribution – C-DAC has been paying due attention to gender equality in employment. Female employees account for 32 percent of the total C-DAC workforce which is higher than national average in the sector. The proportion of women in the senior executive positions also is encouraging in C-DAC.



Category Distribution – As a law-abiding model employer, C-DAC has ensured adequate representation of Scheduled Caste (SC), Scheduled Tribes (ST) and OBC members. C-DAC obliges the national priority in fair terms and has significant representation of the reserved categories. It is pertinent to note that Group A S&T positions are exempted from the purview of reservation orders.



Age Distribution – Since C-DAC always retained itself in the growth and expanding track, it retains an impressive age distribution among its employees. 51 percent of the employees are below the age of 35 years and has an average age of 34.2 years.



Legal

Legal Department renders effective legal Advice in defending cases, reports and correspondence, drafting reply, review of legal documents, as required from time to time.

The Department advises in the matter of preferring of appeals in the various Tribunals, Courts and taking recourse to other legal remedies.

The Key Activities of the Corporate Legal are as follows:

- All centres of C-DAC and Corporate office has a Legal department, which take up all the Legal issues relating to employees of C-DAC, vendor and other parties.
- During the financial year (April 22 – March 23) approx. 57 court cases were dealt at various CATs, High Courts, Tribunals, Courts and Arbitrators etc. These cases are mostly related to service matters of C-DAC centres.
- In addition to above, Legal department also drafted/vetted various MoUs / Agreements to be signed with various stake holders. During the period (1st April 2022 – 30th July 2023), approx. 400 MoUs / Agreements were vetted / drafted and re-vetted by the Corporate Legal Department.
- Corporate Legal Department coordinates with MeitY, the Advocates appearing on behalf of C-DAC and the various C-DAC Centres for the court cases and provides critical inputs supported by relevant judgments pronounced by various courts of India.

RTI

C-DAC is a Public Authority as provided in section 2(h) of the RTI Act. Request for information under RTI Act can either be filed at any of the locations of C-DAC or can be submitted online through the portal rtionline.gov.in. Mandatory disclosures as per the guidelines of section Sec 4(1)(b) have been published in the RTI module on C-DAC's website. The same is updated on monthly basis.

During the financial year 2022, total 472 applications were received which were duly processed.

Vigilance Matters taken up during the year 2022-23:

Total 20 complaints have been received in this year. 09 complaints were disposed off during the year; rest are under due consideration.

Vigilance Operations and Functions:

As per the guidelines of the Central Vigilance Commission, Vigilance Awareness Week was observed in all C-DAC Centres during 31st October 2022 to 6th November 2022. The observation of Vigilance Awareness Week commenced in all centres on 31st October 2022 with 963 employees, 11 customers and 137 citizens taking the integrity pledge with the theme of " Corruption Free India for a Developed Nation". Employees also took the online pledge through the website "http://pledge.cvc.nic.in/" hosted by Central Vigilance Commission. All C-DAC Centres observed the Vigilance Week with overwhelming response by displaying Banners and posters related to vigilance awareness. Lecture sessions, essay writing competitions, quiz competitions, talks, debates, panel discussions were organized to create awareness about corruption among the employees. As part of Vigilance Awareness week surprise visits were conducted in various departments to check whether the proper processes/ procedures are being followed in C-DAC Centres.

● A special lecture was organised in Kolkata centre on the topic "Necessary measures to eradicate Corruption and make a corruption free India". ● A sensitization session was conducted to educate employees on the organization's policies/ preventive vigilance measures in Mumbai Centre. ● Mohali Centre conducted an expert talk on Preventive Vigilance on 7th November, 22. An essay writing competition & quiz were also organised. ● At Noida Centre, a 2 hours session on "Preventive Vigilance Measures" was organized for employees. A drawing competition for all the employees and their family members was also organized on 31st October, 22. ● Thiruvananthapuram Centre organized a talk on the theme of "Corruption Free India for a Developed Nation". ● Officers from Vigilance Unit, MeitY visited C-DAC Pune from 23rd January, 23 to 25th January, 23 for sensitizing the offices and employees of Pune Centre on vigilance-related aspects. They interacted with the officers and the observations/shortcomings were informed for the necessary action.

Financials

Gogate & Company
Chartered Accountants

INDEPENDENT AUDITOR'S REPORT

To,
The Members,
Centre for Development of Advance Computing,
C-DAC Innovation Park, 2nd Floor, Panchavati,
Pashan, Pune-411008

Report on the Consolidated Financial Statements

Opinion

We have audited the accompanying Consolidated Financial Statements of **Centre For Development of Advance Computing, (C-DAC),** (Hereafter referred as "C-DAC ") which comprise the consolidated Balance sheet as at 31st March, 2023 and the consolidated Income and Expenditure Account and consolidated Receipts and Payments Accounts for the year then ended, and summary of significant accounting policies and other explanatory information (hereinafter referred to as "the consolidated financial statements") in which are incorporated the accounts for the year ended on that date audited by the Centre's auditors of the Centre's of the C-DAC located at (Bengaluru, Chennai, Corporate Office, Delhi, Hyderabad, Kolkata, Mohali, Mumbai, Noida, Patna, Pune, Silchar and Thiruvananthapuram).

In our opinion and to the best of our information and according to the explanations given to us, the aforesaid consolidated financial statements give the information in the manner so required to the extent applicable and give true and fair view in conformity with the accounting principles generally accepted in India, of the state of affairs of the Centre as at 31st March, 2023, and its consolidated surplus and its consolidated receipts and payments for the year ended on that date.

Basis for Opinion

We conducted audit in accordance with standards on auditing issued by institute of Chartered Accountants of India. Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Consolidated Financial Statements section of our report. We are independent of the Centre in accordance with the Code of Ethics issued by the Institute of Chartered Accountants of India (ICAI) together with the independence requirements that are relevant to our audit of the consolidated financial statements under the provisions of the Act and the Rules made there under, and we have fulfilled our other ethical responsibilities in accordance with these requirements and the ICAI's Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion on the consolidated financial statements.

GOGATE & COMPANY ★ FRN NO. 121744W ★ CHARTERED ACCOUNTANTS

Flat No. 201, 3rd Floor, Ideal Square, Nav-Swarajya Housing Society,
S. No.129, CTS 786, Ideal Colony, off Paud Road, Kothrud, Pune - 411038.
T : +91 7020917128 ▪ E : gogateandco@gmail.com ▪ Branches : Pune, Mumbai, Kolhapur & Sangli

Management's Responsibility for the Financial Statements

The Centre's management is responsible for the preparation of these consolidated financial statements that give a true and fair view of the consolidated financial position, consolidated financial performance and consolidated receipts and payments of the C-DAC in accordance with the accounting principal generally accepted in India.

The management of the Centre's of C-DAC is responsible for the maintenance of adequate accounting records, safeguarding the assets of the Centre, for preventing and detecting frauds and other irregularities, selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the consolidated financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

In preparing the consolidated financial statements, the management of the Centre's of C-DAC is responsible for assessing the Centre ability to continue as a going concern and using the going concern basis of accounting unless management either intends to liquidate the Centre's of C-DAC or to cease operations, or has no realistic alternative but to do so.

The management of the Centre's of C-DAC is also responsible for overseeing the financial reporting process of the Centre's of C-DAC.

Auditor's Responsibilities for the Audit of the Consolidated Financial Statements

Our objectives are to obtain reasonable assurance about whether the consolidated financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Standard on Auditing (referred as SAs) will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these consolidated financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the consolidated financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that Is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal controls.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the ability of the Centre to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the consolidated financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's However, future events or conditions may cause the Centre to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the consolidated financial statements, including the disclosures, and whether the consolidated financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

- Obtain sufficient appropriate audit evidence regarding the consolidated financial information of the entities or business activities within the Centre to express an opinion on the financial statements. We are responsible for the direction, supervision and performance of the audit of the consolidated financial statements.

Materiality is the magnitude of misstatements in the consolidated financial statements that, individually or in aggregate, makes it probable that the economic decisions of a reasonably knowledgeable user of the financial statements may be influenced. We consider quantitative materiality and qualitative factors in (I) planning the scope of our audit work and In evaluating the results of our work; and (ii) to evaluate the effect of any identified misstatements in the consolidated financial statements.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

Report on Other Requirements

Based on our audit and on the consideration of the report of the Centre auditors on separate financial statements, referred in the other Matters paragraph above we report, to the extent applicable, that:

a. We have sought and obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit of the aforesaid consolidated financial statements

b. In our opinion, proper books of account relating to preparation of the aforesaid consolidated financial statements have been kept so far as it-appears from our examination of those books.

c. The Consolidated Balance sheet, the Consolidated Income and Expenditure Account and Consolidated Receipts and payments Accounts Statement dealt with by this Report are in agreement with the relevant books of account maintained by the Centre.

d. Reporting on the adequacy of Internal Financial control over Financial Reporting of the C-DAC and the operating effectiveness of such controls, is not applicable,

e. With respect to the emphasis of matter included in the Auditor's Report, in our opinion and to the best of our information and according to the explanations given to us:

i. The consolidated financial statements disclose the impact of pending litigations on the financial position of the C-DAC.

ii. The C-DAC did not have any material foreseeable losses on long-term contracts including derivative contracts.

iii. There were no amounts which were required to be transferred to the Investor Education and protection Fund by the C-DAC and its Centre's incorporated in India.

For M/s. Gogate & Co.(FRN: 124144W)
Chartered Accountants

CA Umesh Gogate
Partner (Membership No. 109574)
ICAI-UDIN:23109574BGWYJP4846
Place: Pune
Date: 10th August, 2023.

CONSOLIDATED BALANCE SHEET AS AT 31st March 2023

Amount in ₹

Particulars	Schedule	2022-23	2021-22
CORPUS/CAPITAL FUND AND LIABILITIES			
Corpus/Capital Fund	1	8,00,33,37,367	5,85,87,96,883
Reserves and Surplus	2	4,02,56,23,568	3,80,01,86,315
Earmarked and Endowment Funds	3	2,22,87,74,662	10,87,64,25,880
Secured Loan from Bank		-	-
Current Liabilities and Provisions	4	6,43,78,03,780	4,58,22,80,021
Branch & Divisions		-	-
Total		**20,69,55,39,377**	**25,11,76,89,099**
ASSETS			
Fixed Assets			
Acquired out of Own Funds	5	48,41,38,879	39,49,36,323
Acquired out of Grant in Aid	6	1,84,68,94,807	1,91,71,59,761
Acquired out of Project Grants	7	2,17,87,28,762	1,88,30,26,555
Investments-Others		4,32,857	5,05,000
Current Assets, Loans & Advances	8	16,18,53,44,072	20,92,20,61,460
Miscellaneous Expenditure		-	-
Total		**20,69,55,39,377**	**25,11,76,89,099**
		-	-

Significant Accounting Policies, Notes to Accounts and Schedules form an integral part of the Financial Statements.

Indira Pasupathy
Director Finance

Sunil Misar
Registrar (I/C)

Magesh Ethirajan
Director General

AS PER OUR REPORT OF EVEN DATE
FOR AND ON BEHALF OF
M/S. Gogate & Co. (FRN: 124144W)
Chartered Accountants

CA Umesh Gogate
Partner (Membership No.109574)
ICAI-UDIN:23109574BGWYJP4846
Place : Pune , Date : 10th August, 2023

CONSOLIDATED INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31st March 2023

Amount in ₹

Particulars	Schedule	2022-23	2021-22
INCOME			
Income from Sales/Services	9	5,04,01,49,348	4,60,34,44,305
Grants/Subsidies	10	2,51,33,73,486	2,14,25,68,231
Fees/Subscription	11	1,11,36,92,219	92,99,70,167
Interest Earned	12	39,73,91,513	28,14,35,204
Other Income	13	6,51,98,140	1,34,67,104
Prior Period Income		1,54,60,780	1,58,98,581
Increase/(decrease) in stock of Finished Goods and Work-in-progress	14	51,86,29,328	(42,04,74,615)
TOTAL (A)		**9,66,38,94,814**	**7,56,63,08,977**
EXPENDITURE			
Establishment Expenses	15	4,23,99,45,736	3,57,92,65,157
Purchases	16	98,02,46,066	61,62,43,186
Direct Expenses	17	1,13,56,56,562	65,46,30,771
Expenses on Courses	18	44,56,35,939	39,06,08,300
Other Administrative Expenses	19	68,89,55,729	61,89,97,758
Prior Period Expenses		1,29,72,202	17,29,79,614
Depreciation (corresponding to Schedule 5)		8,89,71,063	6,16,33,473
TOTAL (B)		**7,59,23,83,297**	**6,09,43,58,259**
Transferred to / (from) Balance of Mission Grants		(3,55,74,009)	(32,15,067)
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/CAPITAL FUND		**2,10,70,85,526**	**1,47,51,65,785**
SIGNIFICANT ACCOUNTING POLICIES	20		
NOTES TO ACCOUNTS	21		

Significant Accounting Policies, Notes to Accounts and Schedules form an integral part of the Financial Statements.

Indira Pasupathy
Director Finance

Sunil Misar
Registrar (I/C)

Magesh Ethirajan
Director General

AS PER OUR REPORT OF EVEN DATE
FOR AND ON BEHALF OF
M/S. Gogate & Co. (FRN: 124144W)
Chartered Accountants

CA Umesh Gogate
Partner (Membership No.109574)
ICAI-UDIN:23109574BGWYJP4846
Place : Pune , Date : 10th August, 2023

Amount in ₹

Particulars	2022-23	2021-22
Schedule 1 - Corpus/Capital Fund		
Balance as at the beginning of the year	5,85,87,96,883	4,38,36,31,363
Add: Surplus as per Income & Expenditure Account	2,10,70,85,526	1,47,51,65,785
Less : Own contribution to Core / Projects and Other Adjustments / Transfers	(3,74,54,958)	265
Less : Corporate Office Contribution	-	-
Balance as at the year - end	**8,00,33,37,367**	**5,85,87,96,883**
Schedule 2 - Reserves and Surplus		
1. Capital Reserve :		
As per last Account	3,80,01,86,315	3,12,87,42,898
Addition during the year	1,51,35,80,468	1,77,79,51,702
Less : Deductions during the year	1,28,81,43,215	1,10,65,08,285
Total	**4,02,56,23,568**	**3,80,01,86,315**
Schedule 3 - Earmarked/Endowment Funds		
1. Balance of Core Grants		
a) Opening balance of the funds	6,50,10,804	6,82,25,871
b) Additions to the Funds		
I) Donations/Grants	2,50,00,00,000	2,17,00,00,000
II) Income from Investments made on account of funds	-	-
III) Other additions (C-DAC Contribution and Other Income)	3,23,91,137	7,52,85,546
Total (b)	2,53,23,91,137	2,24,52,85,546
Total (a)+(b)	2,59,74,01,941	2,31,35,11,417
c) Utilization/Expenditure towards objectives of funds		
I) Capital Expenditure		
Fixed Assets	1,84,32,737	10,25,90,624
Others	-	-
Total I	1,84,32,737	10,25,90,624
II) Revenue Expenditure		
Salaries, Wages and Allowances etc.	2,29,76,69,330	1,77,27,61,372
Componants, Consumables and Other Direct Expenses	1,06,81,875	75,42,058
Travel	1,73,99,677	67,08,969
Contingencies, Overheads and Other Administrative Expenditure	22,31,94,642	35,88,97,589
Total II	2,54,89,45,524	2,14,59,09,988
Total (c)	2,56,73,78,261	2,24,85,00,612
Net Balance as at Year - End (a+b-c) Total 1	3,00,23,680	6,50,10,805
Projects wise Allocated Core Grant Projects (Details as per Annexure 1)		
d) Opening balance	(14,42,65,033)	(17,57,89,128)
e) Additions to the Funds		
I) Donations/Grants	-	-
II) Income from Investments made on account of	-	-
III) Other additions (C-DAC Contribution and Other	4,09,91,206	6,24,48,360
Total (e)	4,09,91,206	6,24,48,360
Total (d)+(e)	(10,32,73,827)	(11,33,40,768)

Amount in ₹

Particulars	2022-23	2021-22
f) Utilization/Expenditure towards objectives of		
I) Capital Expenditure		
Fixed Assets	92,01,466	3,09,24,265
Others	-	-
Total I	92,01,466	3,09,24,265
II) Revenue Expenditure		
Salaries, Wages and Allowances etc.	-	-
Componants, Consumables and Other Direct Expenses	-	-
Travel	-	-
Contingencies, Overheads and Other Administrative Expenditure	-	-
Total II	-	-
Total Expenditure (f)	92,01,466	3,09,24,265
g) Refund / Transfer and Other Adjustments	-	-
Net Balance as at Year - End (d+e-f-g) Total 2	(11,24,75,293)	(14,42,65,033)
Core Grant Balance as at Year - End (Total 1 + Total 2) Total 3	(8,24,51,613)	(7,92,54,228)
2. Grants for Funded Projects (Details as per Annexure 2)		
a) Opening balance of the funds	10,94,87,14,692	9,30,14,79,147
b) Additions to the Funds		
I) Donations/Grants	6,15,13,00,102	7,15,44,31,389
II) Income from Investments made on account of funds	26,34,70,886	35,75,89,003
III) Other additions (C-DAC Contribution and Other Income)	4,91,68,530	10,58,59,461
Total (b)	6,46,39,39,518	7,61,78,79,853
Total (a)+(b)	17,41,26,54,210	16,91,93,59,000
c) Utilization/Expenditure towards objectives of funds		
I) Capital Expenditure		
Fixed Assets	1,48,60,82,832	1,64,47,20,651
Others	-	-
Total I	1,48,60,82,832	1,64,47,20,651
II) Revenue Expenditure		
Salaries, Wages and Allowances etc.	1,48,71,27,552	1,34,94,11,368
Componants, Consumables and Other Direct Expenses	1,78,19,36,766	1,34,52,63,046
Travel	26,75,19,716	4,53,95,316
Contingencies, Overheads and Other Administrative Expenditure	1,03,53,29,205	93,47,49,399
Total II	4,57,19,13,239	3,67,48,19,129
Total (c)	6,05,79,96,071	5,31,95,39,780
d) Refund / Transfer and Other Adjustments	9,05,05,82,821	65,11,04,528
Net Balance as at Year - End (a+b-c-d) Total 4	2,30,40,75,318	10,94,87,14,691
3. Employee and Other Funds:		
As per last Account	69,65,417	60,02,901
Addition during the year	1,85,540	9,62,516
Less : Deductions during the year	-	-
Total 5	71,50,957	69,65,417
Grand Total (Total 3+ Total 4+Total 5)	**2,22,87,74,662**	**10,87,64,25,880**

Annexure 1 of Schedule 3 **Projects wise Allocated Core Grant**

(Attached to and forming an integral part of Balance Sheet)

Amount in ₹

Sr.No.	Name of the Project	Opening Balance	Grants Received During the year	Interest Earned	Other Income & CDAC's Contribution During the year	Capital Expenditure	Salary, Wages Allowances etc.	Componants, Consumables and Other Direct Expenses	Travel	Contingencies, Overheads and Other Administrative Expenditure	Total Expenses	Refund / Transfer & Other Adjustments	Closing Balance
1	Building Fund	(14,42,65,033)	-	-	4,09,91,206	92,01,466	-	-	-	-	92,01,466	-	(11,24,75,293)
2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**(14,42,65,033)**	**-**	**-**	**4,09,91,206**	**92,01,466**	**-**	**-**	**-**	**-**	**92,01,466**	**-**	**(11,24,75,293)**

Annexure 2 of Schedule 3 **Funded Projects**
(Attached to and forming an integral part of Balance Sheet)

Amount in ₹

Sr.No.	Name of the Project	Opening Balance	Grants Received During the year	Interest Earned	Other Income & CDAC's Contribution During the year	Capital Expenditure	Salary, Wages Allowances etc.	Componants, Consumables and Other Direct Expenses	Travel	Contingencies, Overheads and Other Administrative Expenditure	Total Expenses	Refund / Transfer & Other Adjustments	Closing Balance
1	**Bangalore Centre**												
	MeitY Projects	3,03,66,030	10,40,30,268	-	49,37,840	60,14,179	4,76,13,983	70,52,974	57,83,445	9,23,86,421	15,88,51,002	1,24,58,511	(3,19,75,375)
	Other Agency Projects	1,45,96,223	90,81,243	22,107	-	5,79,671	74,71,370	86,500	6,707	1,26,48,692	2,07,92,940	13,62,146	15,44,487
	Total Bangalore Centre	4,49,62,253	11,31,11,511	22,107	49,37,840	65,93,850	5,50,85,353	71,39,474	57,90,152	10,50,35,113	17,96,43,942	1,38,20,657	(3,04,30,888)
2	**Chennai Centre**												
	MeitY Projects	(16,46,000)	-	-	-	-	76,53,408	-	-	-	76,53,408	-	(92,99,408)
	Other Agency Projects	-	-	-	-	-	-	-	-	-	-	-	-
	Total Chennai Centre	(16,46,000)	-	-	-	-	76,53,408	-	-	-	76,53,408	-	(92,99,408)
3	**Corporate Office**												
	MeitY Projects	-	-	-	-	-	-	-	-	-	-	-	-
	Other Agency Projects	-	-	-	-	-	-	-	-	-	-	-	-
	Total Corporate Office	-	-	-	-	-	-	-	-	-	-	-	-
4	**Delhi Centre**												
	MeitY Projects	(10,26,407)	3,58,25,000	-	-	-	2,30,78,615	1,15,71,200	7,91,422	34,15,884	3,88,57,121	9,245	(40,67,773)
	Other Agency Projects	12,78,25,807	4,36,16,592	-	-	-	1,62,64,029	4,09,12,617	27,85,583	30,791	5,99,93,020	-	11,14,49,379
	Total Delhi Centre	12,67,99,400	7,94,41,592	-	-	-	3,93,42,644	5,24,83,817	35,77,005	34,46,675	9,88,50,141	9,245	10,73,81,606
5	**Hyderabad Centre**												
	MeitY Projects	16,50,67,265	6,83,38,000	35,39,503	-	3,03,05,171	9,61,01,381	2,35,09,517	1,42,83,774	1,80,52,813	18,22,52,656	(54,48,201)	6,01,40,313
	Other Agency Projects	6,55,81,099	3,71,49,000	-	-	97,62,802	5,49,48,705	59,34,750	1,43,83,272	72,26,872	9,22,56,401	17,31,382	87,42,316
	Total Hyderabad Centre	23,06,48,364	10,54,87,000	35,39,503	-	4,00,67,973	15,10,50,086	2,94,44,267	2,86,67,046	2,52,79,685	27,45,09,057	(37,16,819)	6,88,82,629
6	**Kolkata Centre**												
	MeitY Projects	12,92,070	13,52,34,000	-	11,00,000	2,25,20,216	4,40,99,422	3,21,90,899	55,29,511	2,83,64,248	13,27,04,296	49,21,774	-
	Other Agency Projects	2,58,79,101	1,42,98,222	12,481	-	9,55,237	1,67,34,298	30,65,186	13,31,826	15,33,161	2,36,19,708	15,76,761	1,49,93,335
	Total Kolkata Centre	2,71,71,171	14,95,32,222	12,481	11,00,000	2,34,75,453	6,08,33,720	3,52,56,085	68,61,337	2,98,97,409	15,63,24,004	64,98,535	1,49,93,335
7	**Mohali Centre**												
	MeitY Projects	7,99,17,343	18,19,63,000	14,47,468	8,68,176	51,49,494	2,86,05,364	1,83,42,064	9,57,68,426	1,72,80,453	16,51,45,801	10,52,21,496	(61,71,310)
	Other Agency Projects	61,61,45,708	39,48,264	1,87,58,691	1,04,112	3,50,93,565	14,56,95,605	41,29,742	16,92,663	15,81,01,254	34,47,12,829	7,78,186	29,34,65,760
	Total Mohali Centre	69,60,63,051	18,59,11,264	2,02,06,159	9,72,288	4,02,43,059	17,43,00,969	2,24,71,806	9,74,61,089	17,53,81,707	50,98,58,630	10,59,99,682	28,72,94,450
8	**Mumbai Centre**												
	MeitY Projects	22,70,444	14,22,78,000	29,637	-	1,73,41,965	7,31,52,918	16,60,094	41,31,913	3,94,61,828	13,57,48,718	2,55,30,615	(1,67,01,252)
	Other Agency Projects	-	2,57,26,000	3,03,222	-	7,52,754	87,69,869	1,49,651	5,37,490	21,80,737	1,23,90,501	23,61,737	1,12,76,984
	Total Mumbai Centre	22,70,444	16,80,04,000	3,32,859	-	1,80,94,719	8,19,22,787	18,09,745	46,69,403	4,16,42,565	14,81,39,219	2,78,92,352	(54,24,268)
9	**Noida Centre**												
	MeitY Projects	53,04,08,478	16,17,56,151	88,85,716	-	8,18,32,626	10,40,23,835	1,18,45,465	93,24,513	19,14,16,260	39,84,42,699	28,71,41,880	1,54,65,766
	Other Agency Projects	3,35,35,326	8,40,22,940	3,25,732	-	6,38,890	6,25,96,102	65,979	2,28,612	91,59,429	7,26,89,012	1,62,83,783	2,89,11,203
	Total Noida Centre	56,39,43,804	24,57,79,091	92,11,448	-	8,24,71,516	16,66,19,937	1,19,11,444	95,53,125	20,05,75,689	47,11,31,711	30,34,25,663	4,43,76,969
10	**Patna Centre**												
	MeitY Projects	-	60,80,000	-	-	-	13,20,000	1,15,747	-	-	14,35,747	46,44,253	-
	Other Agency Projects	-	-	-	-	-	-	-	-	-	-	-	-
	Total Patna Centre	-	60,80,000	-	-	-	13,20,000	1,15,747	-	-	14,35,747	46,44,253	-
11	**Pune Centre**												
	MeitY Projects	2,02,02,24,054	1,59,41,50,285	2,88,80,842	-	1,10,06,12,819	39,56,50,952	37,62,53,114	8,27,85,685	14,89,40,549	2,10,42,43,119	1,93,19,49,202	(39,29,37,140)
	Other Agency Projects	6,40,27,32,715	3,01,91,56,237	19,98,64,344	2,29,37,759	5,30,50,034	8,12,73,321	97,20,30,280	76,53,064	26,39,53,861	1,37,79,60,560	6,19,84,65,161	2,06,82,65,334
	Total Pune Centre	8,42,29,56,769	4,61,33,06,522	22,87,45,186	2,29,37,759	1,15,36,62,853	47,69,24,273	1,34,82,83,394	9,04,38,749	41,28,94,410	3,48,22,03,679	8,13,04,14,363	1,67,53,28,194
12	**Silchar Centre**												
	MeitY Projects	-	-	-	-	-	-	-	-	-	-	-	-
	Other Agency Projects	-	-	-	-	-	-	-	-	-	-	-	-
	Total Silchar Centre	-	-	-	-	-	-	-	-	-	-	-	-
13	**Thiruvananthapuram Centre**												
	MeitY Projects	82,19,22,960	42,02,99,000	9,25,098	1,92,20,643	11,56,24,727	25,95,34,634	26,55,77,630	1,91,65,217	4,28,92,787	70,27,94,995	46,07,51,615	9,88,21,091
	Other Agency Projects	1,36,22,476	6,43,47,900	4,76,045	-	58,48,682	1,25,39,741	74,43,357	13,36,593	(17,16,835)	2,54,51,538	8,43,275	5,21,51,608
	Total Thiruvananthapuram Centre	83,55,45,436	48,46,46,900	14,01,143	1,92,20,643	12,14,73,409	27,20,74,375	27,30,20,987	2,05,01,810	4,11,75,952	72,82,46,533	46,15,94,890	15,09,72,699
	Total MeitY Projects	**3,64,87,96,237**	**2,84,99,53,704**	**4,37,08,264**	**2,61,26,659**	**1,37,94,01,197**	**1,08,08,34,512**	**74,81,18,704**	**23,75,63,906**	**58,22,11,243**	**4,02,81,29,562**	**2,82,71,80,390**	**(28,67,25,088)**
	Total Other Agency Projects	**7,29,99,18,455**	**3,30,13,46,398**	**21,97,62,622**	**2,30,41,871**	**10,66,81,635**	**40,62,93,040**	**1,03,38,18,062**	**2,99,55,810**	**45,31,17,962**	**2,02,98,66,509**	**6,22,34,02,431**	**2,59,08,00,406**
	Grand Total	**10,94,87,14,692**	**6,15,13,00,102**	**26,34,70,886**	**4,91,68,530**	**1,48,60,82,832**	**1,48,71,27,552**	**1,78,19,36,766**	**26,75,19,716**	**1,03,53,29,205**	**6,05,79,96,071**	**9,05,05,82,821**	**2,30,40,75,318**

Amount in ₹

Particulars	2022-23	2021-22

Schedule 4 - Current Liabilities and Provisions

A. Current Liabilities		
1. Trade Payables (For Goods and Others)	1,50,43,30,354	90,39,25,281
2. Advances Received		
a) Advances Received from Parties	2,64,07,61,667	1,96,57,88,593
b) Fees Received in Advance	36,299	12,000
c) AMC Charges Received in Advance	-	27,88,000
d) Other Income Received In Advance	29,21,57,742	18,57,89,039
3. Statutory Liabilities		
a) Members CPF Recovery Payable	1,64,22,711	2,15,41,438
b) Members VPF Payable	11,89,641	27,30,477
c) Members CPF Loan Recovery Payable	-	3,311
d) Members Benevolent Fund Payable	6,45,497	7,24,513
e) Members CGEIS/Group Insurance Payable	65,118	1,11,049
f) Members Other Recoveries Payable	45,56,923	12,48,440
g) C-DAC's Contribution to CPF Payable	3,99,52,685	2,62,77,820
h) Gratuity Payable	8,07,14,419	17,45,23,773
i) Leave Salary and Pension Contribution Payable	43,91,84,331	45,24,60,822
j) Members Income Tax Payable	3,15,68,353	4,40,09,013
k) Tax Deducted at Source Payable	8,48,75,822	4,91,34,765
l) Profession Tax Payable	2,11,104	3,11,212
m) Service Tax Payable	-	-
n) CGST Payable	2,20,06,908	3,00,55,269
o) SGST Payable	1,80,10,836	2,16,21,671
p) IGST Payable	20,21,26,691	20,43,12,767
q) UTGST Payable	-	-
r) Reverse charge GST Payable	85,48,436	(12,297)
4. Other Current Liabilities		
a) Unpaid Salaries	2,35,83,393	2,42,63,353
b) Library Deposits Payable	82,700	95,850
c) Other Security Deposits Payable	5,40,47,686	4,60,77,845
d) Earnest Money Deposit Contractors Payable	1,20,76,244	98,56,601
e) Retention Deposit Contractors	68,01,229	1,01,20,329
f) Refund of Course Fees Due	20,15,681	16,42,015
g) ATC's & Others Share in Fees Payable	87,934	94,726
h) Other Current Liabilities	44,88,39,523	8,32,67,606
Total (A)	5,93,48,99,927	4,26,27,75,281
B. Provisions		
1. Others (Specify)		
a) Provisions / Accrued Liabilities for Expenses	50,29,03,853	31,95,04,740
Total (B)	50,29,03,853	31,95,04,740
Total (A)+(B)	**6,43,78,03,780**	**4,58,22,80,021**

Schedule-5 FIXED ASSETS Acquired out of own funds
(Attached to and forming an integral part of Balance Sheet)

Amount in ₹

Sr. No.	Particulars	Gross Block						Depreciation					Net Block	
		Cost/Valuation as on beginning of the year	Additions During the Year: On or Before 30th September	Additions During the Year: After 30th September	Additions During the Year: Total Additions during the year	Deletion/Adjustments During the Year	Cost/Valuation as on end of the year	Depreciation as at beginning of the year	Depreciation Written Back	Depreciation on Rate	Depreciation for Current Year	Total Depreciation up to the year end	WDV (Closing)	WDV (Opening)
A	B		D	E	F	G	H	I	J	K	L	M	N	O
1	Land													
	a) Freehold	3,21,67,475	-	-	-	-	3,21,67,475	-	-	0%	-	-	3,21,67,475	3,21,67,475
	b) Leasehold	17,21,96,623	-	-	-	-	17,21,96,623	2,23,14,675	-	0%	6,97,292	2,30,11,967	14,91,84,656	14,98,81,948
2	Building													
	a) On Freehold Land	91,18,277	-	-	-	-	91,18,277	63,98,496	-	10%	2,71,978	66,70,474	24,47,803	27,19,781
	b) On Leasehold Land	10,89,53,874	-	-	-	-	10,89,53,874	9,20,29,847	-	10%	16,92,402	9,37,22,249	1,52,31,625	1,69,24,027
	c) Ownership Flats/Premises	3,97,26,295	-	-	-	-	3,97,26,295	3,44,53,479	-	10%	5,27,282	3,49,80,761	47,45,534	52,72,816
	d) Superstructures on Land not belonging to the entity	1,34,26,841	-	-	-	-	1,34,26,841	1,24,87,938	-	10%	93,890	1,25,81,828	8,45,013	9,38,903
3	Plant, Machinery and Equipments	6,76,31,914	15,22,392	2,89,57,627	3,04,80,019	48,84,487	9,32,27,446	5,52,17,354	40,67,099	15%	63,11,578	5,74,61,833	3,57,65,613	1,24,14,560
4	Vehicles	2,34,77,246	-	23,55,000	23,55,000	17,41,632	2,40,90,614	1,43,03,429	14,50,182	15%	16,85,606	1,45,38,853	95,51,761	91,73,817
5	Furniture & Fixtures	10,29,63,781	25,55,987	1,89,27,222	2,14,83,209	32,15,300	12,12,31,690	7,83,47,780	29,33,873	10%	45,81,779	7,99,95,686	4,12,36,003	2,46,16,001
6	Office Equipments	5,04,25,316	7,41,016	38,56,591	45,97,607	39,442	5,49,83,481	3,51,05,571	32,841	15%	29,86,614	3,80,59,344	1,69,24,137	1,53,19,745
7	Air Conditioning Equipments	3,93,49,582	7,90,777	4,70,469	12,61,246	2,96,769	4,03,14,059	2,84,63,220	2,71,494	15%	18,18,350	3,00,10,076	1,03,03,982	1,08,86,361
8	Computer Peripherals	45,36,49,101	2,52,63,503	6,96,78,049	9,49,41,552	(3,11,68,156)	57,97,58,809	39,05,46,706	(3,12,19,147)	40%	6,31,97,180	48,49,63,033	9,47,95,776	6,31,02,395
9	Electrical Installations	7,76,16,954	63,150	2,86,407	3,49,557	-	7,79,66,511	5,23,53,755	-	10%	25,61,277	5,49,15,032	2,30,51,478	2,52,63,197
10	Electronic Tools & Lab Equipments	1,67,71,279	3,48,701	3,91,867	7,40,568	-	1,75,11,847	93,05,556	-	15%	12,30,943	1,05,36,499	69,75,348	74,65,723
11	Library Books	1,57,82,145	57,183	4,95,763	5,52,946	24,902	1,63,10,189	1,55,38,389	18,336	40%	3,16,053	1,58,36,106	4,74,083	2,43,756
12	Copyright Know-how	66,950	-	-	-	-	66,950	66,286	-	25%	166	- 66,452	498	664
13	Other Fixed Assets	84,20,919	4,97,518	31,09,277	36,06,795	-	1,20,27,714	53,69,891	-	15%	9,98,674	63,68,565	56,59,149	30,51,028
	Total	**1,23,17,44,572**	**3,18,40,227**	**12,85,28,272**	**16,03,68,499**	**(2,09,65,624)**	**1,41,30,78,695**	**85,23,02,374**	**(2,24,45,322)**		**8,89,71,064**	**96,37,18,758**	**44,93,59,934**	**37,94,42,197**
	Capital Work-in-progress	**1,54,94,131**	**2,97,417**	**1,89,87,401**	**1,92,84,818**	**-**	**3,47,78,949**	**-**	**-**		**-**	**-**	**3,47,78,949**	**1,54,94,131**
	Grand Total	**1,24,72,38,703**	**3,21,37,644**	**14,75,15,673**	**17,96,53,317**	**(2,09,65,624)**	**1,44,78,57,644**	**85,23,02,374**	**(2,24,45,322)**		**8,89,71,064**	**96,37,18,758**	**48,41,38,879**	**39,49,36,323**
	Previous Year	**1,16,03,83,435**	**4,38,36,012**	**4,85,22,812**	**9,23,58,824**	**55,03,556**	**1,24,72,38,703**	**79,56,86,073**	**50,17,172**		**6,16,33,473**	**85,23,02,374**	**39,49,36,323**	**36,46,97,358**

Schedule-6 FIXED ASSETS Acquired out of Grant-In-Aid
(Attached to and forming an integral part of Balance Sheet)

Amount in ₹

Sr. No.	Particulars	Gross Block						Depreciation					Net Block	
		Cost/Valuation as on beginning of the year	Additions During the Year			Deletion/Adjustments During the Year	Cost/Valuation as on end of the year	Depreciation as at beginning of the year	Depreciation Written Back	Depreciation Rate	Depreciation for Current Year	Total Depreciation up to the year end	WDV (Closing)	WDV (Opening)
			On or Before 30th September	After 30th September	Total Additions during the year									
A	B		D	E	F	G	H	I	J	K	L	M	N	O
1	Land													
	a) Freehold	49,04,850	-	-	-	-	49,04,850	-	-	0%	-	-	49,04,850	49,04,850
	b) Leasehold	1,67,45,711	-	-	-	-	1,67,45,711	32,10,042	-	0%	1,71,770	33,81,812	1,33,63,899	1,35,35,669
2	Building													
	a) On Freehold Land	21,87,89,031	-	-	-	-	21,87,89,031	14,00,03,175	-	10%	78,78,586	14,78,81,761	7,09,07,270	7,87,85,856
	b) On Leasehold Land	67,39,51,747	-	-	-	-	67,39,51,747	16,59,05,691	-	10%	5,08,04,605	21,67,10,296	45,72,41,451	50,80,46,056
	c) Ownership Flats/Premises	33,41,269	-	-	-	22,91,254	10,50,015	30,73,131	21,58,615	10%	13,550	9,28,066	1,21,949	2,68,138
	d) Superstructures on Land not belonging to the entity	53,89,260	-	-	-	-	53,89,260	10,23,959	-	10%	4,36,530	14,60,489	39,28,771	43,65,301
3	Plant, Machinery and Equipments	9,10,19,283	-	-	-	20,28,464	8,89,90,819	8,24,08,108	16,89,014	15%	12,40,758	8,19,59,852	70,30,967	86,11,175
4	Vehicles	81,28,717	-	-	-	16,23,438	65,05,279	76,06,870	14,72,328	15%	55,610	61,90,152	3,15,127	5,21,847
5	Furniture & Fixtures	14,91,34,778	4,12,590	19,39,309	23,51,899	-	15,14,86,677	10,26,57,354	-	10%	48,82,934	10,75,40,288	4,39,46,389	4,64,77,424
6	Office Equipments	5,56,63,691	58,135	3,77,918	4,36,053	26,500	5,60,73,244	4,71,50,194	3,978	15%	13,39,055	4,84,85,271	75,87,973	85,13,497
7	Air Conditioning Equipments	5,86,17,321	1,03,749	-	1,03,749	77,41,878	5,09,79,192	4,76,29,175	74,84,894	15%	16,25,236	4,17,69,517	92,09,675	1,09,88,146
8	Computer Peripherals	1,17,06,52,305	69,88,459	1,29,69,606	1,99,58,065	71,07,156	1,18,35,03,214	1,11,98,58,101	-	40%	2,54,58,047	1,14,53,16,148	3,81,87,066	5,07,94,204
9	Electrical Installations	7,82,90,941	-	-	-	-	7,82,90,941	5,48,23,618	-	10%	23,46,733	5,71,70,351	2,11,20,590	2,34,67,323
10	Electronic Tools & Lab Equipments	10,16,70,235	-	-	-	-	10,16,70,235	9,24,89,663	-	15%	13,77,084	9,38,66,747	78,03,488	91,80,572
11	Library Books	3,99,91,587	3,621	2,515	6,136	9,791	3,99,87,932	3,99,56,554	9,789	40%	16,468	3,99,63,233	24,699	35,033
12	Copyright Know-how	4,40,660	-	-	-	-	4,40,660	4,40,653	-	25%	2	4,40,655	5	7
13	Other Fixed Assets	73,48,553	1,100	-	1,100	-	73,49,653	65,77,789	-	15%	1,15,781	66,93,570	6,56,083	7,70,764
	Total	**2,68,40,79,939**	**75,67,654**	**1,52,89,348**	**2,28,57,002**	**2,08,28,481**	**2,68,61,08,460**	**1,91,48,14,077**	**1,28,18,618**		**9,77,62,749**	**1,99,97,58,208**	**68,63,50,252**	**76,92,65,862**
	Capital Work-in-progress	1,14,78,93,899	70,000	1,25,80,656	1,26,50,656	-	**1,16,05,44,555**	-	-		-	-	1,16,05,44,555	1,14,78,93,899
	Grand Total	**3,83,19,73,838**	**76,37,654**	**2,78,70,004**	**3,55,07,658**	**2,08,28,481**	**3,84,66,53,015**	**1,91,48,14,077**	**1,28,18,618**		**9,77,62,749**	**1,99,97,58,208**	**1,84,68,94,807**	**1,91,71,59,761**
	Previous Year	3,70,07,20,467	4,94,54,796	62,54,77,146	67,49,31,942	54,36,78,571	3,83,19,73,838	1,80,27,18,359	22,61,518		11,43,57,236	1,91,48,14,077	1,91,71,59,761	1,89,80,02,108

Schedule-7 FIXED ASSETS Acquired out of Project Grants
(Attached to and forming an integral part of Balance Sheet)

Amount in ₹

Sr. No.	Particulars	Gross Block						Depreciation					Net Block	
		Cost/Valuation as on beginning of the year	Additions During the Year			Deletion/Adjustments During the Year	Cost/Valuation as on end of the year	Depreciation as at beginning of the year	Depreciation Written Back	Depreciation Rate	Depreciation for Current Year	Total Depreciation up to the year end	WDV (Closing)	WDV (Opening)
			On or Before 30th September	After 30th September	Total Additions during the year									
A	B		D	E	F	G	H	I	J	K	L	M	N	O
1	Bangalore Centre Project Assets	37,58,10,949	27,35,791	38,58,059	65,93,850	-	38,24,04,799	34,33,39,820	-		1,17,93,685	35,51,33,505	2,72,71,295	3,24,71,129
2	Chennai Centre Project Assets	9,85,57,018	-	-	-	-	9,85,57,018	9,02,54,668	-		19,21,882	9,21,76,550	63,80,468	83,02,350
3	Corporate Project Assets	-	-	-	-	-	-	-	-		-	-	-	-
4	Delhi Centre Project Assets	15,72,623	-	-	-	-	15,72,623	15,68,471	-		643	15,69,114	3,509	4,152
5	Hyderabad Centre Project Assets	42,82,86,798	3,98,83,975	1,83,998	4,00,67,973	-	46,83,54,771	33,96,20,759	-		5,05,20,572	39,01,41,331	7,82,13,440	8,86,66,039
6	Kolkata Centre Project Assets	3,99,63,593	23,32,897	2,11,42,556	2,34,75,453	-	6,34,39,046	3,27,29,604	-		1,22,83,782	4,50,13,386	1,84,25,660	72,33,989
7	Mohali Centre Project Assets	14,11,06,511	3,24,00,908	78,42,151	4,02,43,059	-	18,13,49,570	11,48,33,140	-		2,30,64,974	13,78,98,114	4,34,51,456	2,62,73,371
8	Mumbai Centre Project Assets	36,09,44,050	30,27,116	1,50,67,603	1,80,94,719	-	37,90,38,769	32,28,03,081	-		1,94,15,965	34,22,19,046	3,68,19,723	3,81,40,969
9	Noida Centre Project Assets	13,56,18,479	-	8,24,71,516	8,24,71,516	443	21,80,89,552	10,83,17,775	283		2,18,37,226	13,01,54,718	8,79,34,834	2,73,00,703
10	Patna Centre Project Assets	-	-	-	-	-	-	-	-		-	-	-	-
11	Pune Centre Project Assets	2,67,55,64,675	12,10,29,422	1,03,26,33,431	1,15,36,62,853	-	3,82,92,27,528	1,68,61,14,050	-		85,71,80,789	2,54,32,94,839	1,28,59,32,689	98,94,50,626
12	Silchar Centre Project Assets	-	-	-	-	-	-	-	-		-	-	-	-
13	Thiruvananthapuram Centre Project Assets	1,39,17,47,704	8,75,58,023	3,39,15,386	12,14,73,409	-	1,51,32,21,113	72,65,64,477	-		19,23,60,948	91,89,25,425	59,42,95,688	66,51,83,227
	Total	**5,64,91,72,400**	**28,89,68,132**	**1,19,71,14,700**	**1,48,60,82,832**	**443**	**7,13,52,54,789**	**3,76,61,45,845**	**283**		**1,19,03,80,466**	**4,95,65,26,028**	**2,17,87,28,762**	**1,88,30,26,555**
	Capital Work-in-progress	-	-	-	-	-	-	-	-		-	-	-	-
	Grand Total	**5,64,91,72,400**	**28,89,68,132**	**1,19,71,14,700**	**1,48,60,82,832**	**443**	**7,13,52,54,789**	**3,76,61,45,845**	**283**		**1,19,03,80,466**	**4,95,65,26,028**	**2,17,87,28,762**	**1,88,30,26,555**
	Previous Year	**4,00,48,98,326**	**74,93,39,068**	**89,53,81,585**	**1,64,47,20,653**	**4,46,577**	**5,64,91,72,400**	**2,77,41,57,536**	**1,62,739**		**99,21,51,050**	**3,76,61,45,845**	**1,88,30,26,555**	**1,23,07,40,790**

Amount in ₹

Particulars	2022-23	2021-22

Schedule 8 - Current Assets, Loans and Advances

A. Current Assets		
1. Inventories :		
a) Stock in trade		
Finished Goods	94,42,011	81,26,221
Work-in-progress	66,75,39,000	14,95,56,884
Raw Material	17,21,324	29,73,995
b) Stock of Course Material	24,43,138	18,59,044
2. Sundry Debtors		
Trade Receivables	1,79,28,41,841	1,51,30,21,637
Less: Provision for Bad and Doubtful Debts	33,86,94,529	32,33,70,964
	1,45,41,47,312	1,18,96,50,673
3. Cash balances in hand (including cheques/drafts and imprest)	222	8,921
4. Bank Balances		
a) With Scheduled Banks		
On Deposit Accounts (includes margin money)	7,20,24,64,233	12,95,63,97,052
On Savings/Current Account	4,78,20,97,587	5,03,36,62,034
b) Funds/Goods in Transit	2,78,48,950	61,79,870
5. Post Office-Savings Accounts	5,828	8,132
Total (A)	14,14,77,09,605	19,34,84,22,826
B. Loans, Advances and Other Assets		
1. Loans		
a) Staff	51,62,000	49,73,243
b) Other (Specify)	9,40,004	9,25,837
2. Advances and other amounts recoverable in cash or in kind or for value to be received		
a) On Capital Account	50,89,256	50,89,256
b) Prepayments (Advances to Suppliers)	1,14,24,21,755	31,84,82,731
c) To Employees	1,03,76,176	74,94,088
d) To Others	3,20,64,936	62,30,41,899
3. Income Accrued		
a) On Investments from Earmarked/Endowment Funds	-	-
b) On Bank Deposits	19,91,18,399	19,90,89,098
c) Others		
I) Course Fee Receivable	27,44,840	21,25,513
ii) Receivable from Guest House Receipts	-	-
iii) Other Grants Receivables	-	-
4. Claims Receivable		
a) Insurance Claims Lodged but not received	-	-
b) Cliams due but not received	-	6,25,354
c) Income Tax Deducted at Source	26,63,16,694	17,18,60,362
d) Sales Tax / VAT Refund Due	-	-
e) CGST Receivable	80,91,681	63,12,248
f) SGST Receivable	80,91,681	62,18,678
g) IGST Receivable	6,71,56,949	1,17,94,385
h) UTGST Receivable	-	-
i) Reverse Charge GST Receivable	-	-
j) Input Tax Credit GST Receivable	1,84,58,546	1,65,61,908
k) GST Paid on Advance Receipt	7,30,66,233	4,38,70,794
l) Receivable from PF Trust	-	-
m) Other Receivables	19,61,808	96,70,890
5. Prepaid Expenses		
a) Insurance	12,25,235	16,76,188
b) Other Expenses	3,05,50,813	4,16,86,446
6. Deposits (Assets)		
a) Telephone Deposit	12,65,715	12,61,715
b) Lease Rent Deposit	4,01,40,217	4,00,98,792
c) Other Deposits	6,94,76,423	2,62,74,639
d) Security Deposit	1,14,67,581	1,39,96,104
e) EMD / Tender Deposit	4,24,47,525	2,05,08,466
7. Differed Expenses		
a) Unutilised Modvat / Cenvat	-	-
Total (B)	2,03,76,34,467	1,57,36,38,634
Total (A+B)	**16,18,53,44,072**	**20,92,20,61,460**

Amount in ₹

Particulars	2022-23	2021-22
Schedule 9 - Income from Sales/Services		
1. Income from Sales		
a) Sale of Finished Goods	37,40,98,611	81,91,76,874
b) Sale of Raw Material	-	-
c) Sale of Scraps	24,28,805	5,94,545
2. Income from Services		
a) Software Development Charges	98,98,45,348	77,76,27,784
b) Others (Specify)	-	-
AMC Charges Received	8,64,01,467	13,07,61,031
Consultancy Charges / Service Charges	3,34,79,84,196	2,73,50,48,427
TOT Fees Received	87,02,372	1,89,68,644
Royalty Received	1,35,55,382	77,95,260
Data Charges	21,66,58,167	12,11,88,759
3. Inter Unit / Inter Branch Sales / (Purchases)	4,75,000	(77,17,019)
Total	**5,04,01,49,348**	**4,60,34,44,305**
Schedule 10 - Grants/Subsdies *(Irrevocable Grants & Subsdies Received)*		
1. Central Government	2,50,00,00,000	2,17,00,00,000
2. Others (Specify)		
a) C-DAC's own Contribution and Other Adjustments	3,23,93,108	7,51,58,855
3. Less : Amount utilised for Capital Expenditure in the current year transferred to Capital Reserve	1,90,19,622	10,25,90,624
Total	**2,51,33,73,486**	**2,14,25,68,231**
Schedule 11 - Fees/Subscriptions *(Accounting Policies towards each item are to be disclosed)*		
1. Entrance Fees	-	-
2. Course Fees	1,04,39,13,236	88,21,10,286
3. Corporate Training Fees	88,17,735	54,28,579
4. Annual Fees/Subscriptions	60,19,155	27,31,581
5. Authorization Fees	12,00,537	7,79,700
6. Others (Specify)	-	-
a) Virtual Centre Processing Fees	-	-
b) Admission Cancellation Fees	27,73,641	27,85,575
c) Examination Fees	3,70,67,665	3,62,28,381
d) Late Fee	14,250	8,906
e) Registration Fees / Project Fee	1,06,000	1,68,610
f) Students Hostel Fees	1,37,80,000	(2,71,451)
TOTAL	**1,11,36,92,219**	**92,99,70,167**
Schedule 12 - Interest Received		
1. On Term Deposits		
a) With Scheduled Banks	33,78,15,588	25,74,31,447
2. On Savings Accounts		
a) With Scheduled Banks	5,88,64,903	2,38,41,893
3. On Loans		
a) Employees/Staff	7,11,022	1,61,864
Total	**39,73,91,513**	**28,14,35,204**
Schedule 13 - Other Income		
1. Profit on Sale/Disposal of Assets		
a) Owned Assets	(3,95,107)	2,93,957
b) Assets acquired out of grants, or received free of cost	(1,48,065)	1,17,290
2. Exports Incentives Realized	-	-
3. Fees for Miscellaneous Services	41,62,606	8,83,127
4. Miscellaneous Income	6,15,78,706	1,21,72,730
Total	**6,51,98,140**	**1,34,67,104**

Amount in ₹

Particulars	2022-23	2021-22
Schedule 14 - Increase/(Decrease) In Stock of Finished Goods & Work-In-Progress		
a) Closing Stock		
Finished Goods	94,42,011	81,26,221
Work-in-progress	66,75,39,000	14,95,56,884
Raw Material	17,21,323	29,73,995
Loose Tools	-	-
Course Material Stock	24,43,138	18,59,044
b) Less : Opening Stock		
Finished Goods	81,26,221	58,07,05,260
Work-in-progress	14,95,56,884	72,834
Raw Material	29,73,995	5,58,802
Loose Tools	-	-
Course Material Stock	18,59,044	16,53,863
Total (a-b)	**51,86,29,328**	**(42,04,74,615)**
Schedule 15 - Establishment Expenses		
a) Salaries & Wages	3,13,90,27,097	2,46,97,39,937
b) Allowances & Bonus		
Awards & Prizes	3,61,419	1,10,400
Bonus	-	(2,15,879)
Canteen Facility	2,81,64,975	2,03,43,063
Hire Charges - Contractual Services	27,99,78,606	18,30,18,278
Lease Rent for Employees Quarters	-	-
Leave Travel Concession	2,60,70,446	59,79,470
Medical Reimbursement	14,35,04,886	11,28,18,250
Members Medical & Accident Insurance Expenses	9,30,788	9,52,168
Misc. Allowances and Other Reimbursements	2,57,32,529	2,38,23,622
Staff Recruitment Expenses	83,63,351	30,56,766
Staff Training Expenses	48,09,312	16,27,889
Transfer & Relocation Expenses	10,85,832	4,22,047
c) Contribution to Provident Fund	24,75,79,222	21,11,95,851
d) Staff Welfare Expenses	75,74,269	67,35,321
e) Expenses on Employees Retirement and Terminal Benefits	-	-
Gratuity	13,03,72,446	21,85,60,404
Leave Encashment	7,90,39,600	22,02,54,822
Leave Salary & Pension Contribution	11,73,50,958	10,08,42,748
f) Others	-	-
Total	**4,23,99,45,736**	**3,57,92,65,157**
Schedule 16 - Purchases		
Purchases	-	52,92,19,550
Hardware Components	88,35,46,127	6,33,16,841
Software Components	7,65,60,438	2,37,06,795
Fabrication & In-Fleet Components	61,73,512	-
Consumables	82,63,956	-
Others	57,02,033	-
	-	-
Total	**98,02,46,066**	**61,62,43,186**

Amount in ₹

Particulars	2022-23	2021-22
Schedule 17 - Direct Expenses		
Consumables	4,09,71,639	3,69,33,893
Design and Development Charges	-	5,740
Excise/Custom Duty/Service Tax Paid	9,74,204	16,49,464
Freight and Handling Expenses	7,23,684	11,42,111
Labour Charges	9,050	2,950
Liquidated Damages	-	(12,71,200)
Material Insurance Expenses	-	-
Other Packing Charges	-	-
Royalty and Support Fees	-	-
Software Development Consultancy Charges	1,30,18,118	97,16,530
Technical Service Charges	1,07,99,59,867	60,64,51,283
Warehouse Charges	-	-
Total	**1,13,56,56,562**	**65,46,30,771**
Schedule 18 - Expenses on Courses		
Advertisement Expenses	1,18,42,533	1,37,11,850
ATC's Share in Fees	30,22,25,401	33,21,66,674
Awards & Prizes	14,160	17,250
Campus Interview Expenses	8,80,925	2,33,500
Course Material Production Expenses	2,28,67,610	23,54,462
Data Entry & Scanning Expenses	-	-
Examination Expenses	1,48,05,646	47,19,780
Faculty Members Expenses	4,95,62,709	3,12,46,011
Other Course Related Expenses	4,33,30,845	60,88,133
Printing of Forms & Prospectus	392	66,540
Students Hostel Expenses	1,05,718	4,100
Total	**44,56,35,939**	**39,06,08,300**
Schedule 19 - Other Administrative Expenses		
a) Administrative Expenses		
Administrative Charges on Provident Fund	1,45,38,481	81,15,289
Asset Hire Charges	66,19,226	68,91,178
Auditors Remuneration	17,38,909	12,95,158
Bank Charges and Commission	2,84,148	22,45,080
C-DAC's Contribution to Funded Projects	8,05,61,767	13,24,77,724
Cultural Program Expenses	68,58,973	13,66,682
Development Contracts and Spon. Project Expenses	-	-
Electricity, Power and Water Charges	8,40,83,640	5,95,91,060
Entertainment/Hospitality Expenses	39,08,579	20,14,415
Foreign Exchange Fluctuation	(22,915)	(60,471)
Gifts and Presentation	10,58,857	4,95,484
Insurance	29,23,344	16,90,734
Interest Paid	15,49,504	5,28,469
Irrecoverable Balances Written-off/(Written-back)	26,33,049	18,07,348
Legal & Professional Charges	2,18,49,840	2,78,15,287
Miscellaneous Expenses	34,76,885	19,07,871
Office Expenses	1,92,34,323	79,41,197
Postage, Telephone & Communication Charges	1,79,70,566	1,97,06,431
Printing and Stationery	76,92,138	43,85,240
Provision for Bad and Doubtful Debts/Advances	1,96,03,609	3,83,63,847
Rent, Rates and Taxes	2,97,18,592	5,14,32,665
CGST Paid	-	-
SGST Paid	1,30,413	-
IGST Paid	20,655	-
UTGST Paid	-	-
Reverse Charge GST Paid	-	-
Service Hire Charges	11,88,72,070	11,35,86,749
Subscription of Periodicals & Newspapers	25,12,973	19,80,204
Tender Expenses	31,291	20,098
Training Expenses	12,55,073	1,86,928
Transit Quarter & Guest House Expenses	19,10,671	26,87,864
Transportation Charges	1,56,550	96,057
Vehicles Hire, Running and Maintenance	1,43,79,007	77,38,678

Amount in ₹

Particulars	2022-23	2021-22
b) Repairs and Maintenance		
Air Conditioning Equipments	68,35,910	18,89,858
Building	1,45,31,480	87,26,635
Computers	1,48,24,105	64,13,344
Electrical Fittings	2,67,77,051	1,83,83,085
Furniture and Fixtures	28,88,695	18,72,679
Garden Maintenance	13,61,478	13,51,850
Lab Equipments	7,51,538	1,43,703
Office Equipments	18,33,571	33,63,739
Other Assets	53,35,363	41,24,769
c) Travelling and Conveyance Expenses	-	-
Inland Travel Expenses	-	-
Director	66,39,276	6,06,322
Members	12,16,57,065	6,57,54,952
Others	32,99,901	21,56,539
Foreign Travel Expenses	-	-
Director	4,55,330	-
Members	14,14,471	-
Others	25,146	8,719
Conveyance Expenses	4,58,876	10,926
d) Selling Distribution and Business Promotion Expenses	-	-
Advertisement Expenses	7,89,600	19,76,819
Expenses on Exhibition, Seminars/Workshops	1,34,27,258	45,21,416
Distribution Expenses	26,101	56,368
Product Literature & Brochures Expenses	-	-
Other Sales Promotion Expenses	73,296	13,28,769
e) Other Expenses	-	-
Total Other Administrative Expenses	**68,89,55,729**	**61,89,97,758**

Schedule 20: Significant Accounting Policies:

1. Accounting Convention

The financial statements are prepared under the historical cost convention C-DAC follows Mercantile System of Accounting and recognizes Income and Expenditure on Accrual basis except otherwise stated, and the following items, due to their peculiar nature are recognized otherwise:

1.1. The course fees of Diploma in Advanced Computing and other Courses commencing before the end of financial year and the duration of which falls beyond the financial year are recognized entirely in the year under audit. In respect of these courses, entire expenditure of course material and agreed proportionate share of the Authorized Training Centers (ATCs) is also accounted for in the year under audit.

1.2. Bonus is accounted for on Cash Basis.

1.3. Expenditure incurred on incomplete Software Development Projects is expensed out in the year of incurrence.

2. Revenue Recognition

2.1. Sales are recognized as net of Trade Discount, Sales Returns and Excise Duty, but including Goods and Services Tax.

2.2. Software Development Charges are recognized on the basis of Terms of Individual Contract and / or as per Phases of completion.

2.3. The income in respect of Annual Maintenance Contract is recognized on accrual basis and as per the terms of individual contracts entered into with parties.

2.4. Income in respect of consultancy charges/service charges is recognized on accrual basis and on the basis of terms of individual contracts entered into with the parties.

2.5. Grants in aid received from the government are treated as income to the extent of net of capital expenditure incurred during the year.

2.6. Interest and other miscellaneous incomes are accounted for on accrual basis.

3. Fixed Assets

3.1 Actual cost of fixed assets acquired is accounted for as per the terms of purchase order; any recovery is netted off to the cost of the asset and all expenses directly attributable to the acquisition and installation of the fixed assets are capitalized.

3.2 Fixed Assets are stated at Cost less Accumulated Depreciation.

3.3 Direct Material Cost with respect to major Fixed Assets developed in-house is capitalized along with manpower and Overhead costs. The Manpower and Overhead costs are charged on basis of man-days spent on the development of Assets as ascertained by the Management. Cost of prototype incurred in the process is charged to Revenue.

3.4 Costs incurred on Assets, which are in process of acquisition, or installation or development is treated as Capital WIP.

3.5 Fixed Assets created out of Sponsored Project Grants and lying at project site are not capitalized and shown as consumables under revenue expenditure.

4. Depreciation

4.1. The ownership of assets acquired out of Mission Grants & Sponsored Projects Grants rests with the respective funding agencies. However, depreciation is charged on the WDV basis on all assets including on those acquired out of Mission and Sponsored Project Grants. The Written-Down Value of the said assets is represented by an equivalent amount of Capital Reserve.

4.2. All additions to Fixed Assets are depreciated at full rates irrespective of the date of acquisition. Depreciation is charged at the rates prescribed by the Income Tax Act 1961.

5. Inventory Valuation

The inventories are valued and certified by the Management as under –

5.1. Components, Raw Materials and Loose Tools in stock are valued at cost or net realizable value whichever is lower.

5.2. Work in Progress and Finished Goods are valued at cost.

5.3. Course Material stock is valued at landed cost. The course material, which is outdated due to change in the syllabus, is shown at nil value.

6. Deferred Expenditure on Projects

The expenditure incurred on incomplete business projects for which income is to be recognized in the ensuing period is deferred.

7. Foreign Currency Transaction

7.1. Transactions denominated in foreign currency are accounted at the exchange rate prevailing on the date of transaction and difference between the date of transaction and payment/receipt are accounted for as income or expenditure as the case may be.

7.2. Current assets and current liabilities denominated in foreign currency are converted at the exchange rate prevailing as at the year-end and the resultant gain/loss is adjusted to revenue account. Contingent liabilities denominated in foreign currency are converted at the exchange rate prevailing as at the year-end.

8. Retirement Benefits

Retirement benefits in respect of Provident Fund, Pension Fund, Gratuity and Leave Encashment has been provided for on accrual basis.

9. Other Policies

All other Accounting Policies are generally consistent with normally accepted accounting practices.

Indira Pasupathy	**Sunil Misar**	**Magesh Ethirajan**
Director Finance	Registrar (I/C)	Director General

For M/s. Gogate & Co.(FRN:124144W)
Chartered Accountants

CA Umesh Gogate
Partner (M.No. 109574)
UDIN : 23109574BGWYJP4846

Date : 10th August, 2023
Place : Pune

Schedule 21: Notes to Accounts

1. Merger of Societies with C-DAC

The Assets, Liabilities and Other obligations at the book value as on 15th December, 2002 are merged in C-DAC in respect of the societies viz. Electronics Research And Development Centre at Kolkata, Noida, Thiruvananthapuram, National Centre for Software Technology Mumbai, and Centre For Electronics Design And Technology of India, Mohali, due to merger of these Societies in C-DAC as per the Government of India orders.

The process for transfer of title deeds of Immovable properties in the name of C-DAC of the above centres is under process. No liability towards expenses such as stamp duty, taxes and other expenses (if any) is provided for. The same will be accounted for in the year of payment if any.

2. Capital Commitment

Capital Commitments not provided for ₹11,757.47 Lakhs (Previous Year ₹1,074.70 Lakhs).

3. Sponsored Projects

Balance of Core Grant Projects as per Annexure 1 of Schedule 3 to the Balance Sheet includes unutilized grants amounting to ₹0.00 Lakhs (Previous Year ₹0.00 Lakhs) and ₹1,124.75 Lakhs (Previous Year ₹1,442.65 Lakhs) grants receivable on account of expenditure incurred in anticipation of release of grants on projects.

Balance of unutilized Funded Projects grants as per Annexure 2 of Schedule 3 to the Balance Sheet includes unutilized grants amounting to ₹29,494.51 Lakhs (Previous Year ₹1,10,586.75 Lakhs) and ₹6,453.76 Lakhs (Previous Year ₹1,099.61 Lakhs) grants receivable on account of expenditure incurred in anticipation of release of grants on projects.

4. Contingent Liabilities

4.1. Against Bank Guarantees: ₹774.71Lakhs. (Previous Year ₹1,115.83 Lakhs)
4.2. Against Letter of Credit is Nil (Previous Year is Nil)
4.3. Against Liquidated Damages is Nil (Previous Year is Nil)
4.4. Against Sales Tax: ₹0.00 Lakhs (Previous Year ₹6.84 Lakhs)
4.5. Against GST: ₹82.84 Lakhs (Previous Year ₹0.00 Lakhs)
4.6. Against Service Tax: ₹11,500.38 Lakhs (Previous Year ₹11,474.72 Lakhs)
4.7. Cases related to staff at various centres are pending at various levels for which liability cannot be assessed.
4.8. Goods and Services Tax Assessments are pending for assessment and therefore liability cannot be assessed. GST is under reconciliation for the FY2022-23.

5. Statutory Liabilities

The entire income of C-DAC is exempt u/s 10(21) being a scientific research association notified under section 35(1)(ii) of the Income Tax Act, 1961. Hence no provision for income tax has been made.

6. Foreign Currency Transactions

6.1 **Imports:** Total Rupee value of imports (CIF) during the year is as follows:

(₹ in Lakhs)

Centre	Raw Material / Components	Capital Goods	Total
Current Year	32.33	32.03	64.36
Previous Year	225.01	177.78	402.79

6.2 **Expenditure in foreign currency for Travel:** ₹73.36 Lakhs. (Previous Year is Nil)
6.3 **Other Expenditure in foreign currency**: ₹151.18 Lakhs (Previous Year ₹4,081.69 Lakhs.)
6.4 **Earnings in Foreign Exchange:** Total Earnings in Foreign Exchange during the year are as follows :

Currency	Current Year	Previous Year
US Dollars	693.22	0.00
Euro	0.00	0.00
Total Value in ₹ (In Lakhs)	0.56	0.00

7. Remuneration to Statutory Auditors (Including Branch Auditors)

(₹ in Lakhs)

Particulars	Current Year	Previous Year
Audit Fees (Exclusive of GST)	4.15	3.26

8. Interest received on grants is treated as liability. Expenses on the core/sponsored projects are charged to respective project and not routed through Income & Expenditure Account.

9. Fixed Assets: The depreciation on the assets purchased out of grants is debited to Capital Reserve.

10. Current Assets and Current Liabilities

10.1 Balances of Debtors, Creditors, Receivables and Payables are subject to adjustments, writing off and confirmation and reconciliation from parties.

10.2 An amount of ₹3,386.95 Lakhs (Previous Year ₹3,746.69 Lakhs) up to 31st March, 2023, debtors outstanding for more than three years has been provided for as Bad and Doubtful debts except the amount realized till date & the amount realizable from the existing customers. In the opinion of Management the said provision is adequate.

10.3 Age wise Analysis of Sundry Debtors as on 31st March, 2023 is as follows:

(₹ in Lakhs)

Centre Name	Less than 6 Months	More Than 6 Months	More Than 1 Year	More Than 2 Years	More Than 3 Years	Total
Bengaluru	81.64	13.31	59.05	1.17	69.30	224.47
Chennai	480.46	26.92	13.98	5.12	2.01	528.49
Delhi	159.67	27.65	0.03	110.61	134.50	432.46
Hyderabad	131.28	39.27	2.85	46.32	4.81	224.53
Kolkata	115.66	0.81	0.13	0.00	11.78	128.38
Mohali	316.83	37.53	150.85	16.40	93.05	614.66
Mumbai	389.95	61.29	0.27	25.75	688.82	1166.08
Noida	3228.80	497.87	762.50	217.19	1008.97	5715.33
Patna	7.48	0.00	0.00	0.00	0.00	7.48
Pune	2217.36	818.41	187.47	19.01	1151.52	4393.77
Silchar	355.64	133.53	57.29	0.00	25.09	571.55
Thiruvananthapuram	2571.43	171.44	882.85	98.40	197.10	3921.22
Total	**10056.20**	**1828.03**	**2117.27**	**539.97**	**3386.95**	**17928.42**
Previous Year	**8747.22**	**963.06**	**1017.79**	**655.48**	**3746.69**	**15130.24**

11. Accounting of grants is made on accrual basis. The Core Grants & expenditure related to Core Grants (Net off Capital Expenditure) is routed through Income & Expenditure account as per Accounting Standard 12 Accounting for Government Grants.

12. **Physical Verification**

Reconciliation of physical verification & related reports for FY 2022-23 is in progress and the same will be completed in FY 2023-24.

13. **Internal Audit / Internal Control Systems**

C-DAC has an internal control system, which is commensurate with the size and financial transactions. Internal audit is being conducted by external auditors during the year.

14. **Prior Period Items and Changes in Accounting Policies-AS5**

Prior Period Items of Income and Expenses are disclosed in Income and Expenditure account separately
There is no Change in Accounting Policies during the year 2022-23 as per Accounting Standard 5.

15. **Employee Benefits**

Employees benefits with respect to Gratuity and Leave encashment has been paid/provided as per provisions of Accounting Standard 15 Employee Benefits based on the actuarial valuation /demand as per policy except as given in notes to accounts of centres.

16. **Lease Obligations**

Lease rent of ₹158.78 Lakhs (Previous Year ₹213.82 Lakhs) for various premises are debited under the various heads of Income and Expenditure Account for the period under audit as per the Accounting Standard 19 Leases.

17. **Intangible Assets**

Reconciliation of the carrying amount at the beginning and end of the periods are reviewed for intangible Assets such as Technical know-how, copy rights and licenses as per Accounting Standard 26 Intangible Assets.

18. **Impairment of Assets**

As per Accounting Standard 28 Impairment of Assets, fixed assets are reviewed for impairment and there is no impairment of assets during the year, as the carrying amount of the assets are less than the realizable value.

19. **Other Discloser Requirements**

The Management of C-DAC is of the opinion that C-DAC being a scientific society and not a listed company and therefore the reporting requirements as per Accounting Standard 14 Accounting for Amalgamations, Accounting Standard 16 on Borrowing Cost, Accounting Standard 18 on Related Party Disclosures, Accounting Standard 22 in respect of Accounting for Taxes on Income and Accounting Standard 27 Financial Reporting of Interests in Joint Ventures are not applicable.

20. Advances paid to employees include ₹0.90 Lakhs as advances paid to Director General (Previous Year ₹0.12 Lakhs).

21. Centre Specific Notes

21.1. Delhi Centre

21.1.1. No liability has been provided for in respect of civil suit of recovery for ₹322.98 Lakhs filed by M/s IBILT Technology Ltd in DIPP's IPO Project with an outlay of ₹2,340/- Lakhs, since the case is under examination with Hon'ble High Court, Delhi.

21.2. Mumbai Centre

21.2.1. Total outstanding liability in respect of Pension Fund amounting to ₹4,784/- Lakhs (Previous Year ₹3,982/- Lakhs), has been provided in the books of accounts as per the actuarial valuation, (Fund Value ₹1193/- Lakhs plus cumulative Provision ₹3,591/- Lakhs) as on 31st March 2023. There is no shortfall in provision for this year (Previous Year ₹503 Lakhs).

21.2.2. Conveyance Deed for the office and residential buildings in Mumbai has not been executed by the Bombay Housing & Area Development Board (BH&ADB), though the Centre has made the payment towards the acquisition of the said assets. The possession for the office building and the residential buildings has been obtained from BH&ADB from 1st April, 1986 and 1st June, 1986, respectively.

21.2.3. The Centre has undertaken Software Development Project of ECGC ERP Revamp (2nd Phase) from ECGC Limited at a total project cost of ₹11,000/- Lakhs (Excluding GST) for a period of 3 years w.e.f. March-2019. The Centre has raised 2nd Invoice for an amount of ₹1,650/- Lakhs (15% of project cost) on "SRS & Design document for Phase 1 Modules" and we have received the money on 3/6/2022. We have accounted ₹1,650/- Lakhs as Business Income for FY 2021-22. The total Invoices raised on ECGC Ltd. for the above project is ₹3,300/- Lakhs. No Invoice has been raised during the current financial year.

21.2.4. The Centre has Bulk SMS activity under MEGD Project. Under this activity, the centre purchases a certain number of Bulk SMS from service providers (Airtel, Vodafone, etc.) and credits the same to various Govt. & Non Govt. parties as per their demands and raises invoices to the parties. Furthermore, the service providers raises the bills on the centre as per the actual SMS consumed by the parties. All the utilized SMS till 31st March, 2023 have been billed by the centre. The amount equivalent to ₹1,354.54 Lakhs is available with the Centre as on 31st March, 2023 towards unutilized SMS by the parties. The said amount is transferred to "Advance Received from Party".

21.2.5. The amount received /credited in the Centre's bank account since April 2018 accumulating to ₹568.55 Lakhs. The said amount is shown under "Funds Received (Untraceable) MEGD A/c" under Current Liabilities.

21.2.6. The Centre has been awarded a project named "Child Sex Abuse Material (CSAM) NCRB" from Home Ministry, Govt. of India, and an advance amount has been received as first installment for ₹415.67 Lakhs (Software Delivery ₹87.03 Lakhs & Hardware ₹328.64 Lakhs). The procurement of Hardware is under process as on 31st March, 2023. The unutilized amount of ₹53.79 Lakhs from the first installment received is shown as "Advance Received from Party".

21.3. **Noida Centre**

21.3.1. In one of the funded project, namely NAVIC GPS project, an advance of ₹100/- Lakhs is given to M/s. Signal chip Innovations Private Ltd, Bangalore which is shown as advance to others and accordingly not shown as expenditure in the project.

21.3.2. In respect of Business Development Division, Chandigarh –VAT Assessment has been completed up to AY 2010-11. (An amount of ₹3.26 Lakhs has been deposited under protest on dated 26th February, 2020 against demand of ₹13.07 Lakhs for non-consideration input credit and an appeal is in process.)

21.4. **Pune Centre**

21.4.1. Under National Supercomputing Mission (NSM) Project as per the MOU between C-DAC and the respective institutes, C-DAC will Supply/ install, commission and operate HPC Facility along with data centre at host Institution from NSM Project funds. Host institution will be the sole custodian of HPC systems during and after installation and commissioning. The ownership of the assets vest with MeitY, (Govt. of India). The payment released during the year for supply/installation and commissioning of the HPC system at various institutes is accordingly booked under components and consumables (expenditure) in the NSM project.

21.4.2. "Memorandum of Understanding" (MOU) or "Leave and License Agreement", as the case may be, entered into with University of Pune and Small Industries Development Institute (SIDI) regarding transfer of rights to use and develop immovable properties viz. Main Building, NPSF Building and assets therein respectively are not registered.

21.4.3. No provision is made for the Advances to employees against various claims amounting to ₹35.16 Lakhs (Previous Year ₹29.41 Lakhs), which will be booked in the FY 2023-24. As most of the claims will directly be debited to the Projects / Grants.

21.4.4. C-DAC, Pune sold an old commercial property of flat/premises (MHADA scheme Warehouse Go-down) at Gokhale Nagar, Pune, through e-auction as per the approval of MeitY. Net Sale proceeds of ₹209.00 Lakhs will be used for construction of compound wall/property at 10 Acre PCNTDA Land.

21.4.5. C-DAC, Pune purchased servers under the head of Computer and Hardware and transferred to other C-DAC Centers during the FY 2022-23. The gross value of ₹71.07 Lakhs and accumulated depreciation were ₹ 71.03 Lakhs. Net block /WDV of ₹ 0.04 Lakhs have been adjusted against the Corpus, during the FY2022-23.

21.4.6. During the FY 2022-23, C-DAC, Pune adjusted ₹ 547.34 Lakhs from Corpus amount. This amount was very old amount receivable from C-DAC, Bangalore.

21.5. **Thiruvananthapuram Centre**

21.5.1. Advances includes the amount paid to M/s. Eworkz, Los Angeles, USA, ₹25.41 Lakhs for the supply and installation of a LCD based video wall system at police control room Kochi and the customs duty paid to clear the consignment. Since the Indian agent of the party has not come forward for the installation of the system, Centre has taken action to recover the advance through legal recourse.

21.5.2. Trade payables (For Goods & Others) amounting to ₹4390.38 Lakhs were outstanding. However, no aging was provided and as informed by the Management, no necessary steps had been initiated to prepare the aging report.

22. Inter unit /Inter Centre Sales(Purchases)
Inter unit/ Inter Centre Sales and Purchases is showing an amount of ₹4.75 Lakhs (Previous Year ₹77.17 Lakhs) (Net of Sales and Purchases between the C-DAC Centres).

23. The Consolidated Balance Sheet and Consolidated Income & Expenditure Account are prepared based on the Audited Annual Accounts received from the centres.

24. Centre wise Financial Performance is attached as Schedule 21-A and Centre wise details of Assets and Liabilities, Income & Expenditure is attached as Schedule 21-B.

25. Current Year figures from the audited financial statements of Centre's are regrouped wherever necessary in preparation of consolidated financial statements. Previous Year's figures are regrouped, rearranged and reclassified wherever necessary.

26. Figures in the Financial Statements are rounded off to nearest Indian Rupees.

Indira Pasupathy	**Sunil Misar**	**Magesh Ethirajan**
Director Finance	Registrar (I/C)	Director General

For M/s. Gogate & Co.(FRN:124144W)
Chartered Accountants

CA Umesh Gogate
Partner (M.No. 109574)
UDIN : 23109574BGWYJP4846

Date : 10th August, 2023
Place : Pune

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CDAC

Schedule 21-A:

(Attached to and forming an integral part of Balance Sheet)

FINANCIAL PERFORMANCE OF C-DAC FOR THE FINANCIAL YEAR 2022-23 as per AS17:SEGMENT REPORTING

Amount in Lakhs

S.No	Particulars	Total	Bangalore	Chennai	Corporate	Delhi	Hyderabad	Kolkata	Mohali	Mumbai	Noida	Patna	Pune	Silchar	TVM
A	**OPENING BALANCE**														
(i)	**Grant -in- Aid: Core Grant Projects**	**(792.54)**													
	GIA General	650.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	650.11	0.00	0.00	0.00
	Core Grant Projects	(1442.65)	0.00	0.00	0.00	(1109.95)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(332.70)
(ii)	**Grant for Sponsored Projects**	**109487.15**													
	MeitY	36487.97	303.66	(16.45)	0.00	(10.27)	1650.68	12.91	799.17	22.72	5304.08	0.00	20202.24	0.00	8219.23
	Other Agencies	72999.18	145.96	0.00	0.00	1278.26	655.79	258.78	6161.46	0.01	335.36	0.00	64027.33	0.00	136.23
B	**RECEIPTS & INCOME**														
(i)	**Grant -in- Aid**	**25000.00**													
	GIA General	25000.00	2991.30	984.35	1065.49	412.55	694.10	912.35	1174.75	1945.40	2048.60	0.00	8362.70	164.18	4244.23
	Core Grant Projects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(ii)	**Grant for Sponsored Projects**	**61513.00**													
	MeitY	28499.54	1040.30	0.00	0.00	358.25	683.38	1352.34	1819.63	1422.78	1617.56	60.80	15941.50	0.00	4202.99
	Other Agencies	33013.46	90.81	0.00	0.00	436.17	371.49	142.98	39.48	257.26	840.23	0.00	30191.56	0.00	643.48
(iii)	**Revenue Earnings**	**61540.17**													
	Training	23263.95	760.62	167.34	0.00	157.06	414.58	157.72	611.48	602.30	1346.37	199.80	18186.90	55.41	604.37
	Commercial	38276.22	593.65	2295.68	0.00	189.84	976.00	987.68	1073.00	3607.94	9415.32	151.04	9143.84	847.27	8994.96
(iv)															
	Interest, Other Income & C-DAC Contribution	**733.83**													
	GIA General	323.92	0.00	0.00	0.00	0.00	(1.60)	0.00	0.00	0.00	0.01	325.51	(0.03)	0.00	0.00
	Core Grant Projects	409.91	0.00	0.00	0.00	92.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	317.90
		3126.39													
	MeitY Spon Projects	698.35	49.38	0.00	0.00	0.00	35.39	11.00	23.16	0.29	88.86	0.00	288.81	0.00	201.46
	Spon. By Other Agencies	2428.04	0.22	0.00	0.00	0.00	0.00	0.12	188.63	3.03	3.26	0.00	2228.02	0.00	4.76
		9965.05													
	Training	1533.90	39.45	17.39	58.24	1.83	146.70	1.13	324.61	9.95	550.20	0.00	362.09	0.00	22.31
	Commercial	8431.15	47.70	0.50	120.07	84.91	176.87	84.14	9.69	112.76	631.63	20.23	746.28	0.35	6396.02
	TOTAL (A+B)	**270573.05**	**6063.05**	**3448.81**	**1243.80**	**1890.66**	**5803.38**	**3921.15**	**12225.06**	**7984.44**	**22181.48**	**1407.49**	**169681.24**	**1067.21**	**33655.24**
C	**REVENUE Expenditure**														
(i)	**Expenditure from Grant-In-Aid**	**25489.45**													
	GIA General	**25489.45**													
	Establishment Expenses	22976.69	2714.00	899.00	801.07	377.60	596.80	854.25	1069.75	1758.40	1916.60	476.69	7526.35	121.25	3864.93
	Other Administrative Expenses	2512.76	277.30	85.35	243.00	34.95	97.30	58.10	105.00	137.00	132.00	112.76	836.35	14.35	379.30
	Core Grant Projects	**0.00**													
	Establishment Expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Administrative Expenses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(ii)	**Expenditure on Sponsored Projects**	**45719.14**													
	MeitY Total Expenses	**26487.29**													
	Establishment Expenses	10808.34	476.14	76.53	0.00	230.79	961.01	440.99	286.05	731.53	1040.24	13.20	3956.51	0.00	2595.35
	Other Administrative Expenses	15678.95	1052.23	0.00	0.00	157.79	558.46	660.85	1313.91	452.54	2125.86	1.16	6079.79	0.00	3276.36
	Other Agencies Total Expenses	**19231.85**													
	Establishment Expenses	4062.93	74.71	0.00	0.00	162.64	549.49	167.34	1456.96	87.70	625.96	0.00	812.73	0.00	125.40
	Other Administrative Expenses	15168.92	127.42	0.00	0.00	437.29	275.45	59.30	1639.24	28.68	94.54	0.00	12436.37	0.00	70.63
(iii)	**Other Revenue Expenditure**	**50434.39**													
	Training Total Expenses	**15039.63**													
	Establishment Expenses	2751.37	66.82	12.00	0.00	93.22	177.14	85.19	136.27	120.48	772.47	20.09	976.96	0.75	289.98
	Other Administrative Expenses	12288.26	115.15	25.88	0.00	53.35	110.44	7.74	301.12	91.67	446.68	60.61	10967.21	15.56	92.85
	Commercial Total Expenses	**35394.76**													
	Establishment Expenses	16671.41	0.00	498.06	77.13	167.67	376.10	955.93	633.74	3118.65	4543.54	30.19	3923.91	220.38	2126.11
	Other Administrative Expenses	18723.35	69.43	562.88	85.27	158.42	160.67	230.94	82.80	2313.25	1483.56	30.72	3401.02	68.36	10076.03
	TOTAL C	**121642.98**	**4973.20**	**2159.70**	**1206.47**	**1873.72**	**3862.86**	**3520.63**	**7024.84**	**8839.90**	**13181.45**	**745.42**	**50917.20**	**440.65**	**22896.94**

Schedule 21-A:
(Attached to and forming an integral part of Balance Sheet)

FINANCIAL PERFORMANCE OF C-DAC FOR THE FINANCIAL YEAR 2022-23 as per AS17:SEGMENT REPORTING

Amount in Lakhs

S.No	Particulars	Total	Bangalore	Chennai	Corporate	Delhi	Hyderabad	Kolkata	Mohali	Mumbai	Noida	Patna	Pune	Silchar	TVM
D	**CAPITAL Expenditure**														
(i)	**Expenditure from GIA for Core R&D**	**276.33**													
	GIA General	184.32	0.01	0.00	21.42	0.00	(1.61)	0.01	0.00	50.00	(5.86)	91.79	(0.03)	28.59	0.00
	Core Grant Projects	92.01	0.00	0.00	0.00	92.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(ii)	**Expenditure from GIA for Sponsored Proj.**	**14860.83**													
	MeitY	13794.01	60.14	0.00	0.00	0.00	303.05	225.20	51.49	173.42	818.33	0.00	11006.13	0.00	1156.25
	Other Agencies	1066.82	5.80	0.00	0.00	0.00	97.63	9.55	350.94	7.53	6.39	0.00	530.50	0.00	58.49
(iii)	**Expenditure from Own Funds**	**1796.54**													
	Training	457.71	12.13	0.00	0.00	50.52	62.32	0.00	57.77	10.51	7.75	0.00	256.36	0.00	0.35
	Commercial	1338.83	11.95	0.62	0.00	11.45	0.00	9.24	5.32	186.35	680.13	0.00	233.31	11.96	188.51
	TOTAL D	**16933.70**	**90.03**	**0.62**	**21.42**	**153.98**	**461.39**	**244.00**	**465.52**	**427.81**	**1506.74**	**91.79**	**12026.27**	**40.55**	**1403.60**
E	**REFUND / TRANSFER OTHER ADJUSTMENTS**														
(i)	**From GIA for Core R&D**	**0.00**													
	GIA General	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Core Grant Projects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(ii)	**From Sponsored Projects**	**90505.83**													
	MeitY	28271.81	124.59	0.00	0.00	0.09	(54.48)	49.22	1052.21	255.31	2871.42	46.44	19319.49	0.00	4607.52
	Other Agencies	62234.02	13.62	0.00	0.00	0.00	17.31	15.77	7.78	23.62	162.84	0.00	61984.65	0.00	8.43
	TOTAL (E)	**90505.83**	**138.21**	**0.00**	**0.00**	**0.09**	**(37.17)**	**64.99**	**1059.99**	**278.93**	**3034.26**	**46.44**	**81304.14**	**0.00**	**4615.95**
F	**TOTAL Expenditure (C+D+E)**	**229082.51**	**5201.44**	**2160.32**	**1227.89**	**2027.79**	**4287.08**	**3829.62**	**8550.35**	**9546.64**	**17722.45**	**883.65**	**144247.61**	**481.20**	**28916.49**
G	**Unspent Balance / Surplus / Deficit (A+B-F)**														
(i)	**Grant -in- Aid**	**(824.51)**													
	GIA General	300.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.87	294.36	(0.00)	0.00	(0.00)
	Core Grant Projects	(1124.77)	0.00	0.00	0.00	(1109.96)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(14.81)
(ii)	**Sponsored Projects**	**23040.75**													
	MeitY	(2867.25)	(319.75)	(92.99)	0.00	(40.68)	601.40	(0.00)	(61.71)	(167.01)	154.65	0.00	(3929.37)	0.00	988.21
	Other Agencies	25908.00	15.44	0.00	0.00	1114.50	87.40	149.92	2934.65	112.77	289.12	0.00	20682.66	0.00	521.52
(iii)	**Other**	**21070.86**													
	Training	9758.27	618.10	146.85	58.24	12.33	273.70	65.92	498.71	400.10	677.43	119.10	6604.82	39.10	243.85
	Commercial	11312.59	571.91	1235.24	(42.33)	(51.34)	616.10	(115.05)	366.15	(1711.20)	4019.85	110.35	2565.20	558.87	3188.84

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CDAC

Centre for Development of Advanced Computing, Pune
CONSOLIDATED ANNUAL ACCOUNTS 2022-23

Schedule 21-B:

CENTRE WISE BALANCE SHEET AS AT 31st March 2023

(Attached to and forming an integral part of Balance Sheet)

Amount in Lakhs

Particulars	Total	Bangalore	Chennai	Corporate	Delhi	Hyderabad	Kolkata	Mohali	Mumbai	Noida	Patna	Pune	Silchar	TVM
CORPUS/CAPITAL FUND AND LIABILITIES														
Corpus/Capital Fund	80,033.37	4,813.82	1,666.65	3,164.04	2,137.77	5,275.86	1,349.05	6,811.19	(2,399.68)	24,890.39	297.16	25,336.15	1,123.12	5,567.85
Reserves and Surplus	40,256.23	422.70	90.52	27.95	3,228.02	1,547.48	356.61	521.80	478.95	1,171.08	313.03	21,521.78	25.05	10,551.26
Earmarked and Endowment Funds	22,287.72	(302.28)	(91.98)	-	(35.53)	688.82	149.93	2,872.94	(52.84)	449.64	294.37	16,819.73	-	1,494.92
Secured / Unsecured Loan from Bank	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Current Liabilities and Provisions	64,378.07	1,183.29	182.41	3,415.11	294.83	277.71	331.23	774.05	6,501.20	5,321.98	53.89	21,500.35	137.03	24,404.99
Branch & Divisions	-	114.16	35.86	(337.06)	134.49	150.21	616.44	(1,382.21)	(125.26)	(463.58)	(10.82)	444.67	(662.13)	1,485.23
Total	**2,06,955.39**	**6,231.69**	**1,883.46**	**6,270.04**	**5,759.58**	**7,940.08**	**2,803.26**	**9,597.77**	**4,402.37**	**31,369.51**	**947.63**	**85,622.68**	**623.07**	**43,504.25**
ASSETS														
Fixed Assets														
Acquired out of Own Funds	4,841.40	463.96	7.05	-	304.74	89.84	73.50	127.47	208.64	1,577.78	-	1,598.57	14.36	375.49
Acquired out of Grant in Aid	18,468.93	149.98	26.72	27.95	3,227.98	765.35	172.36	87.28	110.75	291.73	313.03	8,662.45	25.05	4,608.30
Acquired out of Project Grants	21,787.29	272.71	63.80	-	0.04	782.13	184.26	434.51	368.20	879.35	-	12,859.33	-	5,942.96
Investments-from Earmarked/Endowment Funds	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Investments-Others	4.33	-	-	-	-	-	-	-	-	4.33	-	-	-	-
Current Assets, Loans, Advances etc.	1,61,853.44	5,345.04	1,785.89	6,242.09	2,226.82	6,302.76	2,373.14	8,948.51	3,714.78	28,616.32	634.60	62,502.33	583.66	32,577.50
Miscellaneous Expenditure	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**2,06,955.39**	**6,231.69**	**1,883.46**	**6,270.04**	**5,759.58**	**7,940.08**	**2,803.26**	**9,597.77**	**4,402.37**	**31,369.51**	**947.63**	**85,622.68**	**623.07**	**43,504.25**
	-	-	-	-	-	-	-	-	-	-	-	-	-	-

CENTRE WISE INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st March 2023

Amount in Lakhs

Particulars	Total	Bangalore	Chennai	Corporate	Delhi	Hyderabad	Kolkata	Mohali	Mumbai	Noida	Patna	Pune	Silchar	TVM
INCOME														
Income from Sales/Services	50,401.48	581.98	2,295.68	-	190.43	976.00	987.68	1,484.35	3,607.94	9,774.76	157.43	20,478.10	847.27	9,019.86
Grants/Subsdies	25,133.74	2,991.30	984.35	1,044.09	412.55	694.10	912.35	1,174.75	1,895.40	2,048.60	233.72	8,362.70	135.60	4,244.23
Fees/Subscription	11,136.92	772.29	167.34	-	156.47	414.58	157.72	200.13	602.30	985.17	193.40	6,852.64	55.41	579.47
Interest Earned	3,973.91	92.83	17.19	144.23	82.48	287.08	71.32	302.88	70.63	1,011.19	20.01	1,090.66	0.21	783.20
Other Income	652.00	0.14	0.20	34.06	1.15	35.45	9.44	14.17	39.85	150.77	0.22	4.50	-	362.05
Prior Period Income	154.60	2.19	0.50	-	3.12	1.04	4.51	17.25	12.23	21.64	-	-	0.14	91.98
Goods and Work-in-progress	5,186.30	(8.01)	-	-	-	-	-	-	-	-	-	13.21	-	5,181.10
Total	**96,638.95**	**4,432.72**	**3,465.26**	**1,222.38**	**846.20**	**2,408.25**	**2,143.02**	**3,193.53**	**6,228.35**	**13,992.13**	**604.78**	**36,801.81**	**1,038.63**	**20,261.89**
EXPENDITURE														
Establishment Expenses	42,399.46	2,780.82	1,409.05	878.20	638.49	1,150.04	1,895.36	1,839.75	4,997.54	7,232.61	526.98	12,427.22	342.38	6,281.02
Purchases	9,802.46	36.40	-	-	0.15	13.17	-	61.49	35.76	-	-	1,772.73	-	7,882.76
Direct Expenses	11,356.55	57.20	350.86	67.98	0.62	2.92	21.46	236.00	1,789.73	535.27	4.52	7,250.54	6.65	1,032.80
Expenses on Courses	4,456.37	25.70	3.40	-	26.30	19.59	5.45	17.31	32.98	339.80	60.30	3,861.29	13.11	51.14
Other Administrative Expenses	6,889.55	299.34	318.55	259.64	162.23	299.84	252.14	140.96	553.19	919.79	139.27	2,051.07	71.02	1,422.51
Prior Period Expenses	129.72	14.04	-	0.65	24.74	2.12	-	0.10	31.13	-	-	53.33	-	3.61
Depreciation (corresponding to Schedule 5)	889.72	29.21	1.30	-	32.68	30.77	17.74	33.06	99.12	267.38	-	215.61	7.49	155.36
Total	75,923.83	3,242.71	2,083.16	1,206.47	885.21	1,518.45	2,192.15	2,328.67	7,539.45	9,294.85	731.07	27,631.79	440.65	16,829.20
Transferred to / (from) Balance of Core Grants	(355.74)	-	-	-	-	-	-	-	-	-	(355.74)	-	-	-
SURPLUS / (DEFICIT)	**21,070.86**	**1,190.01**	**1,382.10**	**15.91**	**(39.01)**	**889.80**	**(49.13)**	**864.86**	**(1,311.10)**	**4,697.28**	**229.45**	**9,170.02**	**597.98**	**3,432.69**

CONSOLIDATED RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 31st March 2023

Amount in ₹ *Amount in ₹*

Receipts	2022-23	2021-22	Payments	2022-23	2021-22
I. Opening Balance			**I. Expenses**		
a) Cash on hand	8,921	2,577	a) Establishment Expenses	1,37,13,36,951	1,33,41,51,411
b) Bank Balances			b) Administrative Expenses	1,15,83,39,697	1,16,25,25,796
i) In Savings/Current Accounts	5,03,36,62,034	2,08,74,49,506	c) Payment made to Creditors for Goods and Others	4,61,85,79,526	4,89,16,38,514
II. Grants Received			**II. Payments made against funds for various projects** (Name of the Fund or Project along with the particulars of payment made for each project shown in separate schedule)	8,63,93,71,791	59,44,06,335
a) From Government of India	2,07,56,77,090	1,70,98,16,607			
b) Grant and Other Income Received for Projects	5,95,20,14,044	6,84,24,61,979	**III. Investments and Deposits made Progress**	12,72,10,64,421	9,38,59,28,028
III. Income from Encashment of FDRs	18,41,28,13,219	9,71,60,91,956			
IV. Interest Received			a) Purchase of Fixed Assets	19,35,35,873	11,64,80,085
a) On Bank Deposits	46,55,17,771	42,09,20,967	b) Expenditure on Capital Work in Progress	92,01,466	-
b) Loans and Advances	(1,49,70,762)	15,29,359	**V. Refund of Surplus money/loans**	-	-
V. Other Income (Specify)			**VI. Finance Charges (Interest)**	-	-
a) Previous years Income recovered	22,39,490	30,25,843	**VII. Other Payments (Specify)**	-	-
b) Advances Received from Customers	29,57,42,297	10,37,78,946	a) Deposit (Assets)	31,40,26,312	23,37,68,008
d) Fees/Subscription & Direct Income	1,68,61,19,005	1,39,26,69,457	b) Loans and Advances	73,05,62,091	76,36,79,978
e) Other Income	1,04,81,60,388	63,45,13,414	c) Previous years outstanding payments	4,91,75,42,446	2,54,63,57,716
f) Amount Received from Debtors	3,30,59,22,636	3,07,64,86,670	d) Prepaid Expenses	1,84,59,580	1,89,11,283
g) Loans and Advances Recovered	1,16,63,72,414	16,38,34,503	e) Branch and Divisions	4,07,15,24,011	2,61,45,27,927
VI. Amount Borrowed			f) Deposits (Liabilities) Refunded	10,83,94,592	8,89,66,874
Branch and Divisions	3,85,40,75,090	2,42,16,62,154	**VIII. Closing Balance**		
Bank Loan	2,60,527	-			
VII. Any Other Receipt (Give Details)			a) Cash on hand	222	8,921
a) Deposits (Liabilities)	41,28,72,402	10,04,65,861	b) Bank Balances		
b) Addition to Reserve Fund	-	3,53,03,111	i) In Savings Accounts	4,85,70,97,587	5,03,36,62,034
Total	**43,72,90,36,566**	**28,78,50,12,910**	**Total**	**43,72,90,36,566**	**28,78,50,12,910**
	-	-			

AS PER OUR REPORT OF EVEN DATE
FOR AND ON BEHALF OF
M/S. Gogate & Co. (FRN: 124144W)
Chartered Accountants

Indira Pasupathy
Director Finance

Sunil Misar
Registrar (I/C)

Magesh Ethirajan
Director General

CA Umesh Gogate
Partner (Membership No.109574)
ICAI-UDIN:23109574BGWYJP4846
Place : Pune , Date : 10th August, 2023

C-DAC/Corporate Office/Annual Report 2023

● Bengaluru ● Chennai ● Hyderabad ● Kolkata ● Mohali ● Mumbai ● New Delhi ● Noida ● North East (Silchar) ● Patna ● Pune ● Thiruvananthapuram