Preface

Year 2018 marks an important milestone as far as CSIR Fourth Paradigm Institute (CSIR-4PI) is concerned. On June 21, 2018, a meeting was held under the chairmanship of Shri Narayana Murthy, Founder Infosys, wherein the roadmap for CSIR-4PI was presented before a committee consisting of experts and thought-leaders around the country. The committee appreciated past achievements of the Institute in the area of Earth Sciences and high performance computing and the role it has thus far played in CSIR. With the advent of data science, the committee was of the opinion that CSIR-4PI has a much larger role to play in the new theme-based CSIR and suggested that all mechanisms be put in place to move forward. Following this, much needed Advisory Committee (AC) was formed with Shri Narayana Murthy as its Chair.

The Advisory Committee met in December 2018 and made many recommendations. A call to tackle urgent issues in Agriculture and Healthcare were given. Much needed approval to initiate hiring of manpower to build data science group was also given. Following this, steps have been taken to formulate multi-institutional precision agriculture project to develop an AI/Drone based system to assist marginal/small farmer.

An important step in establishing a data-driven scientific institution is to establish AI infrastructure. The existing HPC platform, Ananta, is undergoing enhancement of compute power with addition of new Skylake nodes. More importantly, Data Cloud will now be established which help us infuse AI capability in CSIR and also fulfill our mandate as a new Institute focused on the fourth paradigm.

Existing groups working in the area of earth sciences have made significant progress during this year.

Solid earth modeling research work on Indian reference frame published in Scientific Reports, Nature is recognized in the Top 100 earth science papers. Research article published on ionosphere variability specific to Indian subcontinent has attracted much attention. The Institute is running and maintaining 12 broadband seismic stations in Kashmir Himalayas which has provided data over 2628 source-receiver path contributing to surface wave disperison data from 8 to 60 seconds period. This data set along with the data from the international agencies like IRIS, RESIF and GEOFON were used to produce shear wave velocity structure at a regular grid of 0.5° x 0.5° in northwestern Himalaya and at 1°×1° in the surrounding areas.

On the climate modeling front, we continue to perform high resolution long-range dynamical forecasting of Indian monsoon. Use of WRF model for simulation of multi-level soil moisture and other parameters will be used for various applications including proposed cloud seeding activities of Government of Karnataka. Efforts have also been made to develop new rain based index for Indian summer monsoon. Significant efforts have also been made to simulate climate change effects on monsoon rainfall. We have also used temperature dependent model to predict Chikungunya epidemic and studied land use change in mega-cities with a view to understand impact on heavy rainfall.

Carbon cycling and ocean modeling are important areas with unique strength in the Institute. We continue to gather data from the four WMO compliant GHG stations. These efforts have also resulted in continued collaboration with IIA, Bangalore,

Pondicherry University and NIOT in Chennai. Hanle station data provides background GHG concentration which, is essential for modeling purpose. We have also studied effect of Iron on specific growth rate of phytoplankton and influence of physical processes on biological and chemical processes in north Indian Ocean.

Cyber-security is yet another unique capability developed at the Institute. Our efforts have resulted in important projects sponsored by MEITy and industry.

These are significant societal contributions by the Institute and these efforts will continue in the future by the modeling and simulation group.

Among other things, we signed an MoU with IIA Bangalore, VIT Vellore and Berhampur University. These collaborations are expected to enhance our reach and capability.

The past year also saw good scientific publications. There were 11 journal publications, 4 books/proceedings and around 20 presentations in various conferences. One patent was also granted.

Two major projects are presently being sponsored by MoEF&CC. CSIR-4PI is playing nodal role in the Intelligent Systems Mission project that has major industry involvement. One scientist was awarded CSIR Raman Research Fellowship and 8 scientists were promoted during the year gone by.

It is now time for us to take concrete steps towards building capacity in data sciences. Once established, this capability will provide impetus to several domains across CSIR. Already, CCMB, Hyderabad, IGIB, Delhi, NEERI, Nagpur, NEIST, Jorhat and IIP, Dehradun laboratories have come forward to work with CSIR-4PI to set up joint teams at their locations to tackle problems in their domain using Big Data, AI and Machine Learning techniques. Thus, CSIR-4PI is poised to play a central role in the CSIR system and thereby provide much needed leadership in AI which has now come to stay as a major force in science and technology.

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