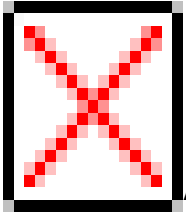


Mega Science Projects: The Economic & Diplomatic gains for India!

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AMONG

massive scale collaborative research efforts in varied frontiers of science cutting across geographic and cultural boundaries and across political dispensation of every kind, 'mega science' as it is commonly known, on account of scale, magnitude and complexity of these ventures, specialized nature of their planning, funding and management, and the sheer audacity of their science ambitions, stand out as special. What else could have propelled projects to determine the properties of the universe or finding its fundamental building blocks, or projects to detect gravitational waves in the universe, or build a telescope to see deeper into space and observe cosmic objects with impeccable precision. Take for example the Large Hadron Collider (LHC), CERN being built around 23 member states and 10 associates at a cost of USD 4.7 billion or the international accelerator facility named Facility for Anti Proton and Ion Research (FAIR) with 11 international partners and associates at a cost of USD 2.11 billion or the Thirty Meter Telescope (TMT) with 5 member states at a cost of USD 2.4 billion. Often touted as largest possible global experiments involving scientists across nations and national institutes for undertaking fundamental breakthrough research in science, mega science apart from enhancing scientific knowledge and capabilities of home grown scientists and researches and capacity of national laboratories, has lent fillip to newer industrial ventures in cutting edge technology areas and spawned specialized project management structures and techniques to cater to the evolving project demands.

While remaining highly complex research ecosystems involving institutions, research scientists, labs and unprecedented levels of funding support, it is often said that mega science experiments act as supranational organizations and bring nations together in times when severe political winds blow in the world. It is this collaborative internationalism that triggered India's participation in a slew of mega science projects- from Large Hadron Collider (LHC), CERN, Switzerland; Facility for Anti Proton and Ion Research (FAIR), Germany; Thirty Meter Telescope (TMT), USA; Pottipuram Research Centre (India based Neutrino Observatory-INO), India; Large Interferometer Gravitational Wave Observatory, India (LIGO-India); Square Kilometer Array (SKA), Australia and S. Africa; ASTROSAT, India's astronomy satellite; Major Atmospheric Cherenkov Experiment (MACE), India; International Thermonuclear Experimental Reactor (ITER), France; High Intensity Superconducting Proton Accelerator (HISPA), USA and India. All of India's mega science projects under the extant rules have undergone strictest administrative and science -based scrutiny and many have been accorded cabinet approval before their launch off. India's participation in TMT for example, the project to fabricate and install the largest optical infrared telescope in the world was accorded cabinet approval in September, 2014. In February, 2016, cabinet accorded in-principle approval to LIGO-India mega science proposal for research in gravitational waves.

Unlike bilateral or formal multilateral science programs, for example India-USA Vaccine Action Program (VAP) or Indo-USA Clean Energy Program or International Cancer Genome Consortium (ICGC), India-Australia Bio Design, Welcom Trust- DBT India Alliance or collaborative international science programs run by established institutes such as CEFIPRA for France, or IGCSTC for Germany or IUSSTF for USA, mega science programs in India are mostly anchored across 2 or 3 government departments- Department of Atomic Energy, Department of Space, Department of Science and Technology with clear defined actions and funding responsibilities- and several autonomous bodies under the departments' administrative control. LHC CERN for example has TIFR, BARC, VECC and Shah Institute of Fundamental Research as some of the collaborating partners, whereas TMT is steered by Indian Institute of Astrophysics for India centric operational requirements.

More than science gains or societal benefits in co-locating mega science projects in off beat locations, technology and diplomatic gains from mega science projects far outweigh the concerns and uncertainties surrounding these projects. Since substantial portion of India's contribution to these projects are mandated as in-kind contributions- precision magnet positioning system-PMPS jacks, magnets, cryogenic and electronic

components for LHC, power converters and vacuum chambers for FAIR, vacuum systems, cryogenics, control and diagnostics for ITER- assimilating and improving the domestic industrial capacity in niche precision areas of high end technology has been an invaluable fallout of India's participation in mega science projects.

Leaving the issues of time and cost over-runs associated with mega science projects owing to the inherent nature of these projects, uncertainties over long gestation, technological, regulatory and political challenges including geopolitical disturbances (leakage in cryogenic storage system in LHC setting back the project by two years, or new safety regulations in Germany impacting FAIR, or ecological concerns delaying TMT by almost 10 years), it is widely accepted that mega science through active multilateral engagement in large science and engineering ventures brings momentum in enlarging scientific base of a nation and its industrial capacity in commercialization and technology translation areas. Further efforts by Indian scientists in putting together India centric mega science projects such as National Large Solar Telescope (NLST), Radio Active Ion Beam (RIB) Facility, National Large Optical Telescope (NLOT), High Brilliance Synchrotron Radiation Sources (HBSRS), or Spatial Neutron Source (SNS) are a positive consequence of India's past association and experience with multitude of mega science projects and its commitment to collaborative internationalism for public good.