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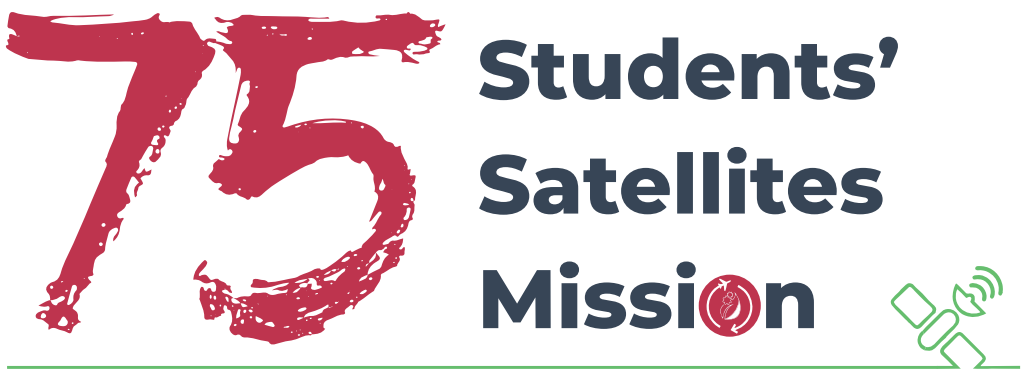
Engineering for NewSpace:

Era of Small Satellites

75 Students' Satellites Mission 2022


75
Students'
Satellites
Mission
ITCA's Engineering Prowess and Ingenuity

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Engineering for NewSpace: Era of Small Satellites

75 Students' Satellites Mission 2022

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Mission

Encourage interdisciplinary thinking by disseminating curated scientific and engineering knowledge to stimulate and inspire Indian Engineering and technology ecosystem

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Cover Page

The image depicts exploded view of components in a typical 1 U satellite

This publication is a collaborative effort between ITCA and the 75 Students' Satellites Mission.

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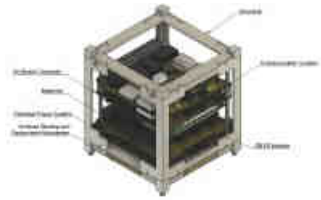


Editor-In-Chief

L V Muralikrishna Reddy, PhD
President
Indian Technology Congress Association

The Engineering of SmallSats

New Year's Greetings. Let us aspire for more spectacular space missions this year.

The space sector has grown dramatically in recent years and is now seen as an important growth engine for the global economy. Tourism, mass and mega launches, moon, mars, asteroid missions, and deployment of the Webb observatory were highlightes in 2021. The year 2022 promises to be yet another fantastic sign of the private sector expanding its hold over modern space and enabling Space Industrialization to progress.

The year-on-year global payload deployments increased by 29%, fourteen civilians experienced space tourism, ushering in a new age of space exploration, and international launch attempts reached a record high of 145, mainly owing to SpaceX's Starlink and OneWeb missions. This is unprecedented, and there has never been a more exciting or better time to be part of the global space ecosystem. Influential commercial factors, evolving technologies, and human imagination are driving the new space sector to completely unexplored heights. Furthermore, the explosive growth of the space industry has resulted in large-scale entrepreneurship and exceptional start-up culture.

The first space race, which began sixty years ago, resulted in several breakthrough innovations that have contributed to the advancement of society on Earth, such as enhanced computing processing power, wireless communications, and intelligent materials, to name a few. The current and ongoing Space Race 2 will offer greater and mind-boggling technological innovations that will culminate in whole novel applications for humanity's and the planet's needs. Furthermore, with the advancement of miniaturization and digitalization in the current race, small satellites like NanoSats and CubeSats are transforming the space sector and attracting a large number of investors.

Because of the availability of niche technologies that are revolutionizing advancements in Small Satellite capabilities, heralding a golden age in space engineering with never-before-seen applications, hence more and more organizations from both the corporate and public sectors are joining the bandwagon on a global scale. The next stage of development may see more countries enter this domain, transforming "spacefaring nations" into "nations of spacecrafts," allowing for better access to the sector at a lower cost and a faster pace, and thereby building a better perception of space and its potential resources.

Following a two-year pause due to the pandemic, the Department of Space (DOS) and its organizations, ISRO, NSIL, and IN-SPACe, have regained momentum and announced a slew of new missions for 2022, including Gaganyaan, India's first human spacecraft mission, and Chandrayaan-3, a moon exploration programme. In addition, the government began the year by appointing Shri S Somanath, a distinguished scientist and Director of the Vikram Sarabhai Space Centre, as Secretary of the DOS and Chairman of ISRO. It is a wonderful start for Indian space in 2022; congratulations to the new commander of Indian Space research, and advance best wishes for phenomenal success in the ISRO's current and forthcoming missions as well as for their efforts to transform India into a space hub.

Shri S Somanath emphasizes the importance of opening India's mostly govt-run space sector to private enterprises and budding investors. In an exclusive interview with the media, the Chairman shared his vision for the current term, thoughts on Indian reusable rocket projects, expectations from Indian start-ups and conglomerates, the ambitious Gaganyaan Programme, and related international collaborations. He expressed optimism despite the ongoing pandemic. In that spirit, we look forward to him succeeding in all of his endeavours and propelling the Indian space sector to new heights.

Prime Minister Shri Narendra Modi has voiced his support for start-ups and declared 16 January to be India's Start-up Day. Recognizing India's entrepreneurial prowess, he added that the country now has over 60,000 registered start-ups and more than 80 unicorns, 42 of which entered the club last year. The Prime Minister referred to the current decade as India's "techade" and detailed three essential components of significant changes that the government is implementing to strengthen the innovation, entrepreneurship, and start-up ecosystem. The already burgeoning space economy will be bolstered even more by government backing for start-up business models, and we hope to see many entrepreneurs in this new industry.

The ITCA's audacious 75 Students Satellites initiative, which has been well acknowledged and widely praised by a range of organizations, including government bodies, is steadily progressing towards commemorating India's Azadi ka Amrit Mahotsav. The national space agency ISRO has constituted a Project Monitoring Committee (PMC) to mentor and guide

the mission's determined and passionate personnel. The mentoring will help boost teams' confidence and the zeal of the participating institutions collaborating on this endeavour. The mission's success can also be credited to the Prime Minister's vision, which was announced during the United Nations General Assembly in September 2021.

ITCA is expanding space scholarly expertise & competencies and applying them to mission objectives through its well-structured mandate and well-applauded strategy while bridging knowledge gaps and increasing student competitiveness. These actions are likely to result in ground-breaking accomplishments in the new space revolution and would benefit transactional academia and industry in the days ahead. Small satellites in space are helping to solve some of the world's most pressing challenges. ITCA is placing India's academia on the cutting edge of space technological innovations by designing, developing and launching student-built satellites as part of its mission, which has been nurtured for the past three years. The leading scientists, brilliant institutions, and ever-learning students engaged are all part of its efforts to realise the aim.

The joining of the Government of Karnataka as a strategic partner in the development and deployment of the KG3Sat - the Karnataka Government School Students' Satellite - is yet another gem in the mission's crown. This CubeSat, which may be the first of its sort in India, is distinguished by including government school children in the development cycle. This project applauds the government's ambition for changing school education and assisting students in developing abilities to address future society concerns fearlessly.

The 9th edition of ITCA's Indian Technology Congress (ITC2021), with the theme "Satellites for Everyone and Space for Everyone," was conducted digitally in September 2021. Over 15,000 delegates from throughout the country participated, thanks to the strategic partnership with Chandigarh University. In addition, the World-UNITYSat Programme, which involves 75 nations associating and providing domain knowledge for CubeSat missions, was officially launched at the Congress. The global organizations UNISEC and WCRC, in partnership with ITCA, who are driving these initiatives, will undoubtedly signal the beginning of international knowledge exchange efforts on space programmes and value addition to the ongoing 75 Sat mission.

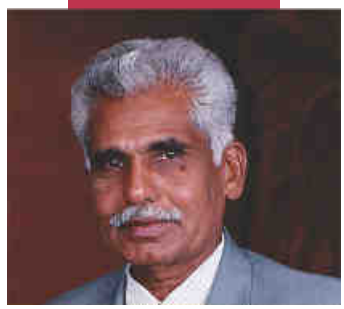
Space captivates the imagination, providing endless boundaries to explore and innumerable technological challenges to overcome. As a result, space has become an inseparable component of our way of life, influencing nearly every facet of human civilization. From commerce and trade to climate forecasts, global networking, scientific research, national security, and other applications, society relies on and expects to utilize space capabilities for human comforts. The year 2022 may determine whether the next great thing in space is achievable and whether or not space will be viable in the years ahead

Imagineering ITCA's 75 Students' Satellites Constellation

Implementing Systems Engineering Framework

Development of 75 Students' Satellites

Advisor
75 Students' Satellites Mission



Prof. R.M. Vasagam
Vice President
Indian Technology Congress Association

The Indian Technology Congress Association (ITCA) promoted the mission of conceiving, building, launching, and operating CubeSat class satellites by Students of Indian Academic Institutions synchronising with the celebration of 75 years of India's Independence in 2022 throws formidable challenges for time-tested Systems Engineering tools and techniques. Such tools and techniques have proven in the successful completion of ambitious space missions as well as missile programmes in the past. Now it is driving time-bound goal-oriented mission mode projects globally. The projects are highly interdisciplinary and comprise hundreds and thousands of interconnected activities and need to be completed from the concept stage onwards with time and resource constraints. The 75 students' satellites programme is applying a systems engineering approach from the initial stage.

The mission begins with work breakdown structure subsystems identification project team formation, make buy options, model philosophy, reliability and quality plan, parts, materials and test plans, mission operations plans and project management and progress monitoring and budget and cash flow. Extensive documentation and intensive reviews keep track of the progress and midcourse corrections and fallback options, waivers for non-conformance, launch vehicle interface, mechanical and electrical interfaces and ground stations compatibility. All activities progress with continuous monitoring and months days and hours count. The teams have to have information systems accessible by all team members and impact of shortfall in performance in any subsystem has to be analysed and rectified by change in hardware and software. Configuration Management and Change control to be documented and waivers granted after reviews without jeopardising the mission success should be criteria for launch readiness.

There are tasks in connection with launch vehicle interface like orbit needed, vehicle performance and margins, payload volume and dynamic envelope, environmental levels, coupled loads analysis, static and dynamic balancing requirements, thermal modeling, Electromagnetic interference and compatibility, separation induced disturbances, sequencing in case of multiple satellites in same launch, integration on the vehicle and prelaunch operations and launch control centre operations, launch abort procedures. These are concurrent tasks to be completed while satellite building tasks are progressing.

Through the application of above methodology the satellite is made ready. One can say that student built satellites have matured from the days of CubeSats developed by California Polytechnic College in 1998 and have evolved as platforms for innovative approaches and has provided opportunities for scientific and application payloads for communication and remote sensing payloads in shorter timeframes. World over more than 2500 missions have take place itself an indication to demonstrate democratisation of space technology and blending Experiential Learning for making students future ready.

Innovative ideas are to emerge from School and college students for mapping the natural resources, disaster mitigation, emergency communication areas. There is urgent need for high efficiency low thrust propulsion systems and most importantly de orbiting systems at the end of mission life. Also plans for formation flying for global connectivity are to be tested and validated.

There are also Cube Sat projects for orbiting the moon and Mars being supported by Space agencies.

System studies for such missions will trigger more and more students to join in such efforts.

The curriculum should have systems engineering to be taught as an interdisciplinary elective with lab integrated course on Cube Sat based developments in academic institutions.

Let the 75 Students' Satellites Mission to fructify in 2022 make India a global hub of innovation and entrepreneurship in this exciting field of space technology and provide talented and competitive human resource for national and international missions

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Engineering for NewSpace:
Era of Small Satellites

Engineering has advanced considerably over the course of sixty years of high-tech space flights and more than fifty years since the first Apollo lunar landing. Engineers and scientists have made significant advances in fields such as rocket propulsion, onboard computers, and space operations, thanks in part to early investments and commitments from national space agencies such as NASA, the Russian Federation Space Agency (RFSA), the European Space Agency (ESA), the Indian Space Research Organization (ISRO), the Japan Aerospace Exploration Agency (JAXA), and others.

Space engineering has evolved from the days of unrelenting efforts sixty years ago into a network of interconnected technological solutions that enable exciting new space missions, such as today's small satellite revolution. Tourists are now being sent into space, which could someday permit planet colonization, land probes on comets, and travel further back in time than ever anticipated, all of which will contribute to the space sector's transformation over the next few decades.

Technology miniaturization has enabled a wide range of spacecraft dimensions with capabilities equivalent to those of traditional larger ones. These spacecraft operate in constellations and are used for Earth studies, communications, and catastrophe monitoring. Small satellites can weigh anywhere from 100 kg to 1 kilogramme. CubeSats are small satellites made out of aluminum modules that measure about 10 cm x 10 cm x 10 cm (just under four inches square, or 1U) and weigh one to two kilograms each. They can be combined to form multiples ranging from two to twenty-four units. Because of their small size and weight, they are easier and less expensive to launch as a payload on a rocket. Because a large number of these SmallSats may be launched as secondary payloads with larger spacecraft, they are commonly used for Earth observation and low-cost science projects. Miniature spacecraft have already had an impact on civilization and have the potential to make an even greater impact in the future. Small satellites, such as CubeSats and NanoSats, are leading the way in this field, addressing a wide range of pressing social issues such as climate change, good governance, education, and healthcare, among others.

Because they cannot use current large components, actuators, or thrusters, these small space vehicles have great advantages but must overcome severe obstacles and limits. Because of the small and limited capacity of the onboard CPU, they cannot perform at the same level as much larger satellites. This interdisciplinary project driven by core engineering addresses the technological challenges inherent in a new era of satellite alignment systems and space manoeuvres with a diverse range of creative applications.

The design of any system or process never ends if allowed to continue. Because such maturity is extremely difficult to gauge, developers are encouraged to keep developing features until an external force compels them to pause or cease. The same may be said of the process of constructing small satellites, as technology breakthroughs continue to offer up new possibilities for ever-expanding global and human applications. SmallSats are undergoing this change, and they will most certainly become more complicated in the coming years as tools for addressing unsolved scientific concerns. Fortunately, at this early stage of the new space era, the continual march toward miniaturization and the growth of digital technology presents huge opportunities.

Space systems are interdisciplinary endeavours involving a varied variety of persons, each with their own set of talents and prior experiences, allowing for information sharing and intelligence exchange throughout the design and development process. Engineering will, without a doubt, be crucial throughout the project's lifecycle, which includes design, production, testing, deployment, and post-launch support. To complete the missions successfully, it is considered necessary to have an interdisciplinary understanding of the spacecraft as well as domain knowledge of the components. Diagrammatic reasoning, prototype modelling, systems engineering, concept mapping, knowledge graphs, interoperability, and hierarchical component architectures are also required, as is an understanding of how these may enhance or facilitate space system design.

CPSs are designed modules that rely on the interaction of computational and physical components. Future space systems must have a stronger correlation between cyber (processing, communication) and physical (sensing, actuation) aspects onboard in order to survive the hazardous extraterrestrial environment and effectively accomplish epic missions. Powerful engineering insights will aid space missions through cyber-physical integration projects.

Because of developments in telemetry, tracking, and command-and-control satellites, next-generation ground systems are a top satellite technology trend. Ground stations use radio-frequency (RF) communication terminals such as electronically-steered and phased-array antennas to track satellites with little human input. On the commercial side, ground stations support software-defined satellites by providing virtualized ground networks. These technologies enable satellites to autonomously reallocate, reconfigure, and manage massive amounts of bandwidth in order to satisfy the needs of an expanding number of end users.

Engineering is broadening its concepts, capabilities, and procedures by utilizing an integrated digital framework, allowing for the prospect of reinventing what is possible in the most complex professions in the modern space sector.

Material characterisation and material modelling, with a focus on dynamic material behavior at high strain rates, are the foundations for satellite structural development, which necessitates strong interdisciplinary technical skills. Designing scientific payloads such as impact detector payloads, data acquisition boards, software for camera payload data handling units, ground stations for data transmission, and so on are examples of technological undertakings. These activities are interdisciplinary in nature and are founded on basic engineering principles. The high expenses of developing satellites and their subsystems for the hostile space environment are decreased by using additive manufacturing technology. Satellite manufacturers are currently 3D manufacturing satellite buses, customised payloads, and rocket engines in satellite launchers. Satellite parts that are customized and complex are digitally twinned and 3D printed. By accelerating prototyping and testing of satellites and their components, this saves manufacturing lead time and costs. Similarly, 3D printing tiny components of enormous space structures on the ground and assembling them in orbit significantly reduces the complexity of space manufacturing.

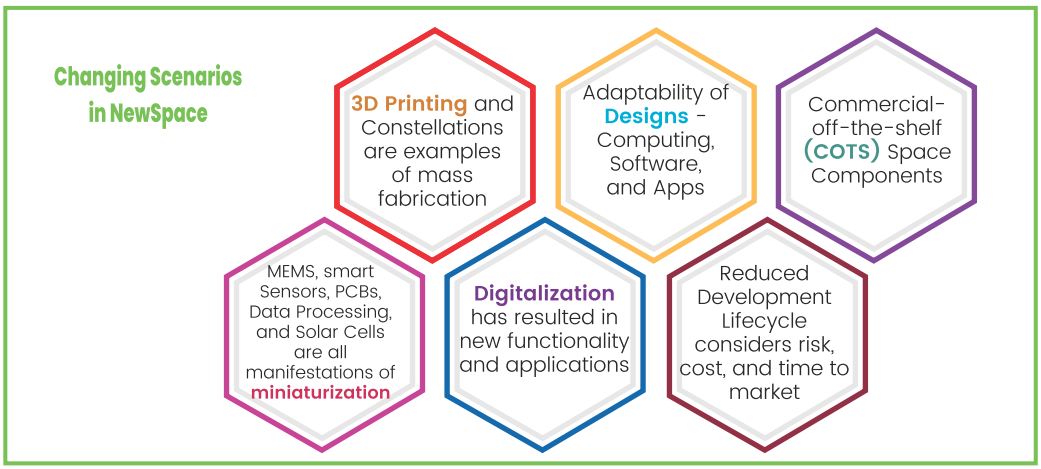
Another notable factor is satellite Internet of Things (IoT), which allows exceptional connectivity across organizations while also enhancing 5G and upcoming 6G capabilities. At the same time, satellite manufacturers and operators are introducing technological advances to both ground stations and orbital services. Satellites can do more complex tasks on their own thanks to digitized payloads, propulsion systems, and technologies such as Artificial Intelligence (AI).

ITCA's current 75-student satellite mission is a national project that brings students from various science and engineering departments from 75 partner institutes and secondary schools together. Students are that extra factor whose participation in projects like ITCA's expands opportunities for contributing and growing in the business.

Aerospace specialists, for example, may work on environmental analyses and control systems, whereas mechanical engineers may work on structures and layout mechanisms, computer scientists may test and develop data communication software, and electrical engineers may design and test the electrical power subsystem (EPS) and other electrical systems. Chemical engineers, on the other hand, will investigate thermal aspects, materials, control theory, and so on. While mechanical and aerospace engineering students learn orbital mechanics, spacecraft dynamics and control, and spacecraft design, there are numerous sensors and electronic equipment that require electrical engineering students' competence. We also need computer scientists and astronomers for research missions. This CubeSat project is the result of a partnership between engineering and science students.

We are entering a new era of engineering with businesses like SpaceX, Blue Origin, and Virgin Galactic.

Technology is always evolving, and new inventions are discovered on a regular basis. Science and engineering push the boundaries of technology to create new applications and small satellites that will last for centuries to come



Advancing Start-ups in NewSpace

Prime Minister Narendra Modi declared January 16 as 'Start-up' day, saying that while small enterprises form the backbone of the Indian economy, Start-ups are game changers. Recalling the current decade as India's "techade," the Prime Minister outlined three key parts of the significant reforms that the government is doing in this decade to boost the innovation, entrepreneurship, and start-up ecosystem. The government has defined six themes: 'Growing from Roots,' 'Nudging the DNA,' 'From Local to Global,' 'Technology of the Future,' 'Building Champions in Manufacturing,' and 'Sustainable Development.'

The Prime Minister also stated that the government's goal is to institutionalise creativity in the country by instilling a

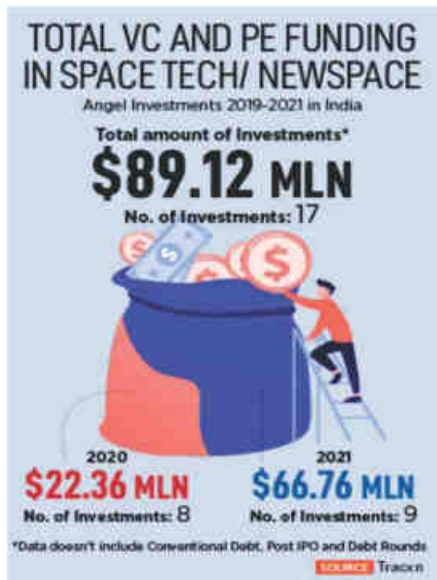
desire for innovation in kids from an early age. "More than 9,000 Atal Tinkering Labs are offering students an opportunity to innovate in schools and work on new ideas," he said, adding that "whether it is new drone rules or new space policy, the government's objective is to provide as many youths as possible with possibilities for invention." Outlining the many government initiatives, PM Modi stated that India had 60,000 registered companies and over 80 unicorns, 42 of which joined the club last year.

In a staged approach, the government and ISRO have taken substantial initiatives to foster and develop start-ups. The government announced the formation of New Space India Limited (NSIL) in the 2019 budget, with the mission of mass-producing and manufacturing small satellite launch vehicles (SSLVs) and polar satellite launch vehicles (PSLVs) in collaboration with the private sector through knowledge transfer. The Union Cabinet approved the establishment of the Indian National Space Promotion and Authorisation Centre (IN-SPACe) in 2020 to serve as a single-window, independent nodal agency between ISRO and private firms in order to maximise India's space resources. The draft of the new "Spacecom Policy" to authorise and promote private participation in the field of space-based encrypted communication was released by the Department of Space in October 2020. Furthermore, ISRO delivered Chandrayaan-2 data in September 2021, after the orbiter has been operational for two years. The goal is to involve academia, students, and other scientific stakeholders in the analysis of data for future advances.

Six decades ago, India's foray into space began with the establishment of the national space agency, the Indian Space Research Organization. After beginning as predominantly a government endeavour, space activity in India is gaining impetus in the private sector. India is making significant strides in the space technology sector, and associated innovation is drawing the attention of investors. To keep the value chain sustainable and on track for continuing healthy growth, start-ups and SMEs must participate, innovate, collaborate, and distribute their products, solutions, and services through the global space industry network. This is essential for both upstream (space technology) and downstream (space data applications) start-ups (downstream).

While the uber-wealthy and space enthusiasts initially funded global spacetech enterprises, recent investments have increasingly been made by venture capitalists, private equity, and now huge corporations. The NewSpace business is defined by the need for patient capital, significant capital expenditure, and the fact that it has yet to totally disengage from government and public sector support.

Global trends are also pointing in the same direction, with the space industry absorbing and leveraging developing technologies such as sophisticated satellite systems, big data, 3D printing, 5G, and quantum technology to scale-up activities in space. Significant work and investments are also being made in the NewSpace business in the fields of smart propulsion, space traffic management, and space robotics to facilitate movement, communications, and activities between Earth and space. In the context of a multifold increase in space traffic, start-ups are focusing on developing and scaling-up small satellites (CubeSats and NanoSats) to reduce the cost of launching vehicles into space, as well as constructing reusable launch vehicles to provide affordable access to space. Start-ups like Space Inventor are assembling subsystems with thermal stability, insulation, and mechanical ruggedness into modules to manufacture small satellites in order to shorten the time frame for building SmallSats. EnduroSat, another start-up, is focusing on establishing robust data handling of up to ten payloads, increasing efficiency, and enabling secure communications for telemetry and telecommands via high-speed X-band and K-band frequencies.



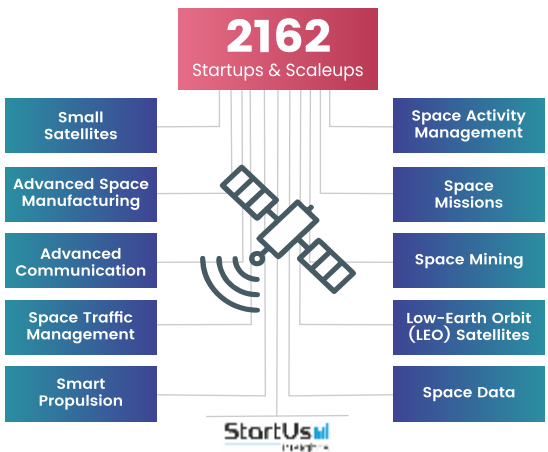
Another US-based start-up Momentus is attempting to make space travel affordable by developing reusable rockets that will de-orbit to another orbit following the final drop-off. The reusable vehicle has robotic arms and is capable of conducting proximity manoeuvres, docking, and refuelling, making it well-suited for a wide range of in-orbit services.

Arctic Space Technologies, a Swedish start-up, adds processing capacity to the software-driven ground station. Instead of transmitting satellite data directly to the cloud and perhaps encountering data bottlenecks, the start-up decentralises processing power near to the station. Their innovative technology provides real-time processing with no latency while decreasing network traffic and storage requirements.

According to a recent New York Times report, "investors are spending more money into space technologies than ever before." According to the space analytics business BryceTech, space start-ups raised more than $7 billion in 2020, more than doubling the amount raised just two years ago. This tendency is expected to continue this year, according to Carissa Christensen, CEO of BryceTech. " These expenditures are being driven by technological developments that have made it feasible for private enterprises, not just national space agencies, to create modern space technology and launch things into space.

According to industry analysts (ref: NSR's Emerging Space Investment Analysis, 3rd Edition study (ESIA3)), a potential equilibrium between investment activity from Venture Capitalists (VC), traditional investors, and governments is taking place. The majority of the recent arrivals in the satellite ecosystem are analytics companies that exploit space-derived data, although they command less money due to their reduced capital requirements. Earth Observation and Communications, on the other hand, are maturing and require bigger sums of financing to support their growth and pay for their infrastructure.

Innovation Map: SpaceTech



Ref: StartUs Insights: Innovation Map depicting the major trends that impact the SpaceTech sector.

SpaceTech Unicorns

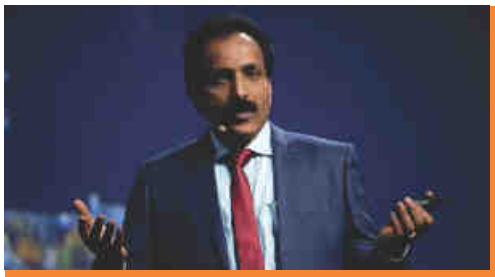
Unicorns are privately held start-up firms with valuations of $1 billion or more. It is exciting to see a number of unicorns in NewSpace. An indicative list is given below for reference;

Relativity Space (Estimated valuation: $4.2B) https://www.relativityspace.com/	Relativity is building the first autonomous rocket factory and launch services for satellites.
Rocket Lab (Estimated valuation: ~$4.1B) https://www.rocketlabusa.com/	Rocket Lab is a space systems company dedicated to small satellite launches.
Planet (Estimated valuation: $2.8B) https://www.planet.com/	Planet is the leading provider of global, daily satellite imagery and insights.
Astra (Estimated valuation: $2.1B) https://astra.com/	Astra is a rocket launch vehicle start-up that provides satellite delivery and launch services.
AST Spacemobile (Estimated valuation: $1.8B) https://ast-science.com/	AST & Science and our global partners are building the first and only space-based cellular broadband network to be accessible by standard smartphones.
Spire Global (Estimated valuation: $1.6B) https://spire.com/	Harnessing space to solve problems on Earth
Astranis (Estimated valuation: $1.4B) https://www.astranis.com/	Astranis improves access to internet connectivity by making smaller and more powerful satellites at a fraction of the cost.
ABL Space Systems (Estimated valuation: $1.3B) https://ablspacesystems.com/	ABL Space Systems designs and builds low-cost launch vehicles for the small satellite industry
Axiom Space (Estimated valuation: >$1B) https://www.axiomspace.com/	Axiom's Low Earth Orbit platform is planning commercial missions in 2022 to the International Space Station (ISS) and aims to own and operate the world's first commercial space station.
Firefly Aerospace (Estimated valuation: >$1B) https://firefly.com/	Firefly Aerospace is a provider of economical and dependable launch vehicles, spacecraft, and in-space services for small payloads

Horizon Projects and Public-Private Partnerships (PPP)

According to Satsearch, the global space industry marketplace, collaboration and partnership techniques have shown to be one of the most successful ways to achieve common goals in the space sector, and this trend is expected to continue. For example, in December 2021, Europe produced two of the largest consortiums of enterprises united toward the shared aim of improving the NewSpace ecosystem. The consortium "New Symphonie," directed by Euroconsult and ANYWAVES, has brought together 20 firms under one umbrella to lead NewSpace solutions research for space-based communication. Furthermore, the "UN:IO consortium," comprised of Mynaric, Isar Aerospace, Reflex Aerospace, and NanoAvionics, will begin construction on an independent European satellite communications network

Shri S Somanath assumes charge as Secretary, DoS & Chairman of ISRO



Shri S Somanath, Director, Vikram Sarabhai Space Centre (VSSC) has been appointed as Secretary, Department of Space and Chairman, Space Commission. He is known for his contributions to launch vehicle design, particularly in the areas of systems engineering, structural design, structural dynamics, and pyrotechnics.

Shri. Somanath obtained B. Tech in Mechanical Engineering from TKM College of Engineering, Kollam, Kerala and Master's in Aerospace Engineering from Indian Institute of Science, Bangalore, specializing in Structures, Dynamics, and Control with a Gold Medal. He joined Vikram Sarabhai Space Centre (VSSC) in 1985 and was a team leader for the Integration of PSLV during the early phases.

He is the recipient of the 'Space Gold Medal' from the Astronautical Society of India. He received the 'Merit Award' and 'Performance Excellence Award' from ISRO and a "Team Excellence Award' for GSLV Mk-III development.

He is a Fellow of the Indian National Academy of Engineering (INAE), a Fellow of the Aeronautical Society of India (AeSI), Astronautical Society of India (ASI), and a Corresponding Member of the International Academy of Astronautics (IAA). He is in the bureau of the International Astronautical Federation (IAF) and a recipient of the National Aeronautics Prize from the Aeronautical Society of India (AeSI).

Excerpts from interaction with the Media and press...

Shri S Somanath, Chairman, Indian Space Research Organization (ISRO), has made it a priority to open up India's largely state-run space industry to private enterprises and stakeholders and to enable it to operate in its true spirit.

In an exclusive interview with the media, the Chairman discussed his vision for the remainder of his tenure, his thoughts on Indian reusable rocket projects, his expectations of Indian start-ups and conglomerates, the ambitious Gaganyaan Program and its associated international collaborations, and much more.

According to Shri Somanath, the process of easing India's space sector's openness is lengthy. This entails enacting legislation and regulations for new entrants, providing them with possibilities while also lowering their barriers to entrepreneurship and creativity. "My responsibility will be to initiate the process immediately, with the goal of seeing results in a few years. These include new businesses developing and launching rockets from India, private enterprises developing satellites, and applications being utilised to fulfil global demand.

When asked about India's portion of the USD440 billion global space economy being less than 2% and ISRO's efforts to increase it, he stated that the critical element was to serve the demands of Indian consumers economically.

Shri Somanath believes that Indian private enterprises (start-ups and established giants) should play a greater role in space applications by developing, manufacturing, and launching spacecraft and rockets. Additionally, the seasoned rocket scientist sees tremendous promise in ten Indian space start-ups functioning in a variety of fields.

"It is really high; they are motivated and proactive in their efforts...It is not simple... a great deal of expertise is necessary...Sharing expertise from ISRO is critical for their success. I look forward to seeing them succeed, on their own initiative and with the assistance of competent individuals developed by the space programme," he said when questioned about the likelihood of Indian space start-ups launching their own rockets in the next two years.

Concerning ISRO's initiatives to remain competitive in a global market where launch costs (per kg to orbit) are falling dramatically, he stated that it was about simplifying systems, utilising more commercial items to streamline manufacturing processes, and conceiving re-usability of rockets similar to planes.

As Chairman, he also lauded ISRO for its excellent team and center-level leadership. He views his tenure as a chance to motivate his team and to help them realise their goal via the establishment of a support structure. He expressed optimism that the ISRO team will generate more innovative ideas, while he, as Chairman, would assess the ideas' national and futuristic significance and seek government backing to execute them. He is a fervent believer that with the backing of the Indian people and all stakeholders in the space programme, it would become a reality.

S Somanath officially takes charge as Secretary Of DoS & Chairman Of ISRO

Photo credit: @ISRO/Twitter

ISRO's Missions Envisaged during 2022

Some of the ISRO missions scheduled during 2022 include:

Small Satellite Launch Vehicle (SSLV) that is used to launch satellites, and transport 500 kg payload to an altitude of 500 km is set to launch in the first quarter of 2022. SSLV is a three-stage, all-solid vehicle designed to transport several satellite-like nano, micro, and tiny satellites. SSLV would contribute to meeting the worldwide launch services market's need for tiny satellites.

The radar imaging satellite RISAT-1A PSLV C5-2 which is targeted for a February 2022 launch will be the sixth


Photo credit: isro.gov.in

RISAT satellite in the ISRO's RISAT series. The remote sensing satellite was designed to survey terrains and investigate the Earth's various land areas and oceans.

ISRO intends to launch its first mission to investigate the glorious Sun by the middle of 2022.

The Aditya-L1 solar mission was originally scheduled for the first half of 2020 but was postponed to this new date because to the ongoing COVID-19 epidemic. This is ISRO's first mission to


Photo credit: indiatoday.in

explore the Sun's atmosphere and has chosen L1, or Lagrangian point 1, between the Earth and the Sun, as the location for the Aditya satellite. For this purpose, the spaceship will travel 1.5 million kilometres from Earth. It will conduct extensive research on the processes that occur in the Sun's atmosphere, allowing scientists to solve lingering challenges in solar physics.

The ambitious Moon mission successor, Chandrayaan 3 will most likely be launched in the third quarter


Photo credit: aerospace-technology.com

of 2022. In contrast to its predecessor, Chandrayaan 3 will not carry an orbiter, but will instead carry a lander and a rover to examine the lunar surface.

ISRO is also preparing to launch its first unmanned mission in 2022 as part of the Gaganyaan mission. The first crewed Gaganyaan mission is expected to be launched in 2023, positioning India as the fourth country in the world to do so after the United States, Russia, and China. All the systems needed for the first unmanned mission are getting realised. For this mission, a dedicated astronaut training centre that has been established in Bengaluru, meant to offer Gaganyaan-specific training will be utilized.

ISRO is currently working out the exercise recovery of the crew module after impacting in the sea with in-flight demonstrations of the Crew Escape System functioning in the lower atmosphere (less than 10 Kms). Before the Indian space agency's first human spaceflight, two uncrewed flights are planned. Two crewless flights are scheduled before the maiden human spaceflight launch by the Indian space agency. In one of the crewless flights, ISRO has planned to send a humanoid robot named Vyommitra to low-earth orbit. The robot will mimic the space crew activities set for the human flight mission in order to assess all the possible challenges prior to the final mission.

ISRO is also planning to launch other satellites in 2022, including Oceansat-3 (EOS-6) and Microsat (EOS-2). Also planned is the launch of GSAT-21, the first fully funded satellite of NSIL (New Space India Limited). To be completely owned and operated by NSIL, the GSAT-21 will meet the DTH (Direct to Home) application needs.

ISRO has also announced three new space research missions: DISHA (a twin aeronomy satellite mission), TRISHNA (for accurate mapping of land surface temperatures), and a Venus expedition.

ISRO is currently working out the exercise recovery of the crew module after impacting in the sea with in-flight demonstrations of the Crew Escape System functioning in the lower atmosphere (less than 10 Kms)

Engineering in a Cube

Students' driven SmallSats

The idea of creating a compact cube-shaped spaceship first surfaced in 1999. CubeSats were originally designed for educational purposes, assisting students in becoming acquainted with the space environment, and were dubbed university-class CubeSats. CubeSats are rapidly being employed for scientific, governmental, and commercial objectives in addition to education.

Despite the high demand for CubeSat development, CubeSat systems fail on a regular basis due to a lack of technical principles used in the process. This is due to a range of factors, including, to mention a few, the tools utilised, the models, and the students' levels of experience. The value of systems engineering in ensuring the success of these missions cannot be overstated. Because of the use of internal or self-generated requirements emerging from an educational purpose or for other reasons, certain colleges and research institutes may focus on system and component level design while ignoring the comprehensive elicitation of needs required previously.

Institutions that are launching their first CubeSat efforts frequently use one-unit CubeSats with limited missions. Despite their small size, 1U CubeSats can record and send enormous amounts of data to ground stations using commercial off-the-shelf (COTS) components including phone cameras, radiometers, and beacons.

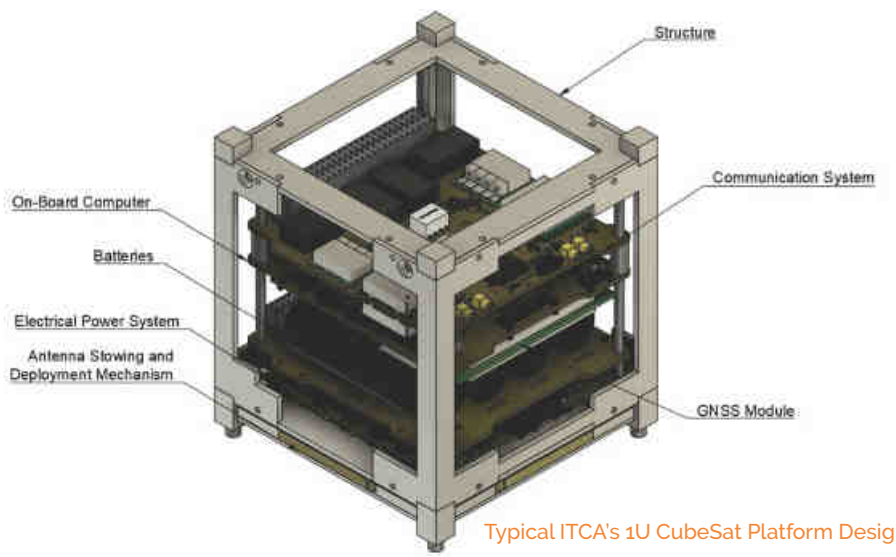
CubeSats are modular, standard, and general-purpose basic structures based on open-source designs. Cubes are several orders of magnitude less expensive while providing nearly the same performance. A massive "cottage industry" has sprung up around the CubeSat design, addressing "professional" applications with space-rated gear. NASA has developed CubeSat hardware (Pi-Sat) as well as software (CFS). It is possible for enthusiasts to contribute to a larger aerospace project or a CubeSat. The unusual CubeSat architecture ushers in a new paradigm for studying our Solar System's numerous components.

A strategy must be devised in order to execute an effective satellite development project. Understanding the principles of systems engineering methodologies is the most critical and first step in every CubeSat project. Any space programme uses systems engineering as an interdisciplinary approach and mechanism for effective implementation. Teams of engineers, testers, and designers from varied backgrounds, ambitions, and levels of expertise will be formed to complete the cubists' intended tasks.

A student-associated CubeSat project's life cycle will include various phases and steps. The diagram represents a typical sequence of steps. A 1U CubeSat experiment could benefit from the agile technique. The phases of a project's life cycle can be divided into tiny iterative steps, and testing scenarios can be devised to detect and remedy flaws early in the project.

The structure is a critical component of all space missions, including CubeSats. In general, the structural subsystem's goal is to build a basic and robust structure that can endure launch forces while also providing a favourable environment for other subsystems to operate in. Furthermore, the framework mechanically supports all other spacecraft components, attaches the spacecraft to the launch vehicle, and permits ordnance-activated separation. In general, structural design should seek for simple load paths, simpler interfaces, and easy integration.

The design of space structural systems is governed by mass, stiffness, and strength criteria. On the one hand, stiffness is required to ensure the endurance of the instruments; on the other hand, by reducing weight, it is possible to increase the payload, thereby extending the mission goals and lowering the launch cost. Because a satellite's structural and mechanical components account for a significant amount of its mass, it is vital to select



Typical ITCA's 1U CubeSat Platform Design

the suitable material and structural architecture to save mass. Finally, the fundamental limits and requirements of stiffness and primary eigen frequency apply to CubeSat design.

Aluminum alloys are the most commonly utilised materials for structural systems, with 6061 or 7075 and comparable grades being the most common, as they meet the condition of having thermal expansion

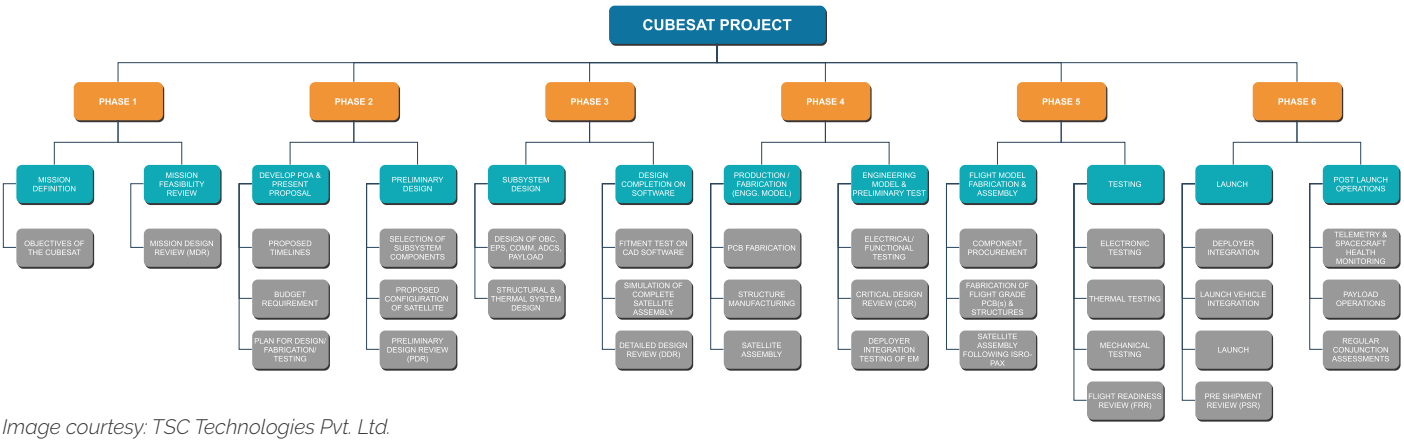


Image courtesy: TSC Technologies Pvt. Ltd.

factors equivalent to the Poly Picosat Orbital Deployer (P-POD) material.

A CubeSat is built with numerous subsystems, including an onboard computer (OBC), communication, EPS, attitude determination and control system (ADCS), data management, and payload. A block diagram depicts the CubeSat subsystem components. Each subsystem can be designed and developed separately by students before being combined with the rest of the components. Based on the precedence of system needs, software engineers, for example, can take one requirement, write and test it, and then go on to the next requirement. Similarly, rather than constructing all of the system needs all at once, the software team might divide the process into small iterations when designing the system's software.

Critical activities performed by onboard computer and digital electronics systems include telecommand and telemetry, attitude control electronics, payload operations, and thermal management. Telecommand is essential for directing satellite functions via orders delivered from the ground station to the satellite, while telemetry allows for the monitoring of satellite health data via RF downlink from the NanoSatellite to the ground station. Because NanoSatellites in low earth orbit (LEO) are not always visible to the ground station, telemetry data will be recorded on an onboard data storage system and replayed when the NanoSatellite becomes visible to the ground station.

The Attitude Control Electronics (ACE) gathers attitude information from various sensors, processes it, and creates control signals for actuators, which is critical for NanoSatellite attitude control. The functions of the ACE are often implemented in the OBC of a NanoSatellite utilising Field Programmable Gate Arrays (FPGAs).

NanoSatellites in low-Earth orbit (LEO) have radio contact with ground stations for roughly 10-15 minutes. During this visibility period, communication devices must be configured to transmit data to the ground and receive signals from the ground, including payload data download. It would be able to network numerous ground stations to improve ground contact time with flexible mission planning.

Satellite communication systems are divided into two types: (i) telemetry, tracking, and command (TTC) systems and (ii) payload data transmission systems. Due to the lack of frequency coordination restrictions and the usage of commercial off-the-shelf communication modules, NanoSatellites are configured in the amateur VHF/UHF frequency bands.

Power systems are essential for generating, controlling, and distributing power to numerous subsystems during the NanoSatellite's operational life. The Sun is the primary source of energy for all satellites' power generation. Solar power generation, storage in rechargeable batteries, and power conditioning and distribution by the power electronics subsystem ensures that all electrical subsystems of the NanoSatellite receive uninterrupted power supply.

Assembly, integration, and testing is a multidisciplinary activity that includes mechanical integration, electrical integration, and ground checkout of the entire NanoSatellite, as well as testing completion, which includes vibration, communication, antenna, and thermo-vacuum tests for nanosatellites. This activity is crucial to the success of the NanoSatellite mission and requires the participation of the AIT team, subsystem design teams, and launch vehicle team.

CubeSats are enabling new applications and business models, and NewSpace is flourishing, with enormous potential to alter the space sector and space-enabled services for the benefit of all global citizens

KGS3Sat - Karnataka Government School Students Satellite

India's First Government School's CubeSat

The Karnataka state government has agreed to provide financial assistance to help a bunch of government high school students to launch a nanosatellite. On 22 January 2022, the government approved the project **'Designing and Launching of Nano Satellite by Government School Kids'** estimated to cost Rs 1.9 crore. The nanosatellite is among 75 such satellites designed across the nation to mark 75 years of Independence.

The project, named **'Karnataka Government School Students Satellite' (KGS3Sat),** will be implemented through the Karnataka Science and Technological Promotion Society (KSTePS) in collaboration with **ISRO** and **Indian Technology Congress Association (ITCA).** The aim is to nurture scientific thinking and promote technological awareness among students," said Higher Education and IT&BT Minister Dr C N Ashwath Narayan on Friday, 22 January 2022. **The KSTePS will enter into a Memorandum of Understanding (MoU) with ITCA** to implement the project, whose objective is to nurture scientific thinking and promote technological awareness among the student community.

The satellite built by the students will be part of the 75 Students' Satellites Mission 2022 in the country that would be put in orbit on the country's 75th Independence Day. The minister said the nanosatellite design project will include students from other neighbourhood government schools.

The minister also added, "KGS3Sat Project Monitoring Expert Committee (KPMEC)" will be constituted to monitor the implementation of the project and a timeline of 12 months has been set to complete it.


DH

State funds nanosatellit designed by govt schoolk

Will be part of 75 sats to be put into orbit n Independence Day

BENGALURU, DHNS

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Ashwath Narayan

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The government has issued an order on providing financial assistance, the minister said, adding that the satellite built

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Nod for stu nano-sat pl designed by govt schoolk Bengaluru: The ment has given adm tive approval for a ning and launching satellite' project by s students at an estin cost of Rs 1.9 crore. This will be among th nano-satellites to be la ched on the occasion of years of independence (A rit Mahotsav) to be celebr ted by the Centre. Source said the government schoo s yet to be decided. "The project, called nataka Government Sc Students Sate KGS3Sat), will be im mented through Karnata Science and Technologic Promotion Society, in coll oration with ISRO and I lian Technology Congres Association. The aim is t urture scientific thinking

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ನ್ಯಾನೊ ಉಪಗ್ರಹ ನಿರ್ಮಾಣಕ್ಕೆ ಅನುದಾನ

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NanoAvionics launched three satellites, aboard SpaceX Transporter-3 mission

NanoAvionics, a leading smallsat manufacturer and mission integrator, confirmed the reception of signals and healthy telemetry data from all of the three satellites launched into low Earth orbit via the successful SpaceX Transporter-3 mission. The rideshare mission that went into orbit on 13 January 2022 included one of the largest and heaviest CubeSats ever built and launched. The 16U small satellite, is the first of five satellites, contracted to NanoAvionics by British company Sen, to establish video streaming media to provide real-time Ultra-High Definition (UHD) videos of Earth.

Also aboard the Falcon-9 rocket was HYPSO-1, a 6U nanosatellite built for the Norwegian University of Science and Technology (NTNU), to conduct ocean research. From its Sun-synchronous orbit, HYPSO-1 (HYPer-spectral Satellite for ocean Observation) will monitor algal blooms and other aspects of ocean health in an autonomous synergy with robotic agents around the Norwegian coast. It is the first of the two satellites NanoAvionics will supply to the programme.

The third NanoAvionics built satellite that went into low Earth orbit (LEO) onboard Transporter-3 is the 3U IoT nanosatellite DEWA-SAT 1. It is part of DEWA's (Dubai Electricity & Water Authority) Space-D programme and will support the digitalisation of Dubai's power and water networks. Through an ambitious programme and with the expertise of NanoAvionics, DEWA intends to enhance its flexibility and agility in monitoring and managing its electrical and water networks. Through Space-D, DEWA also expects to reduce costs, improve its asset utilisation and provide sustainable, efficient and reliable power and water services to its customers.

Following the successful SpaceX launch, the third in a series of dedicated rideshare missions for small satellites, NanoAvionics confirmed signal acquisition and healthy telemetry from all of the three satellites.

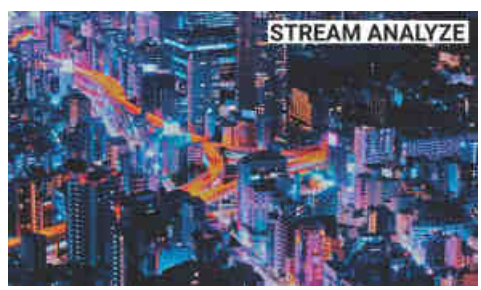
Source: spaceref.com

RUAG Space + Stream Analyze

Connect Together to Enable AI On Satellites

With large new constellations of satellites (satellite swarms) forming a large mesh of interconnected nodes in a constantly moving dynamic global network, it is a huge challenge to orchestrate the communication traffic in an optimal way. Analyzing the network behavior, such as traffic patterns or other characteristics in a software defined satellite dynamic communication network, allows for optimizing data routes through the network and hence the performance of the complete communication system. Stream Analyze' sa.engine allows this network optimization to be performed in real-time onboard the satellite.

Through Stream Analyze' analytics platform sa.engine the operator of the satellite will be able to interact directly with the satellite's sensors and query any kind of questions. The sa.engine itself requires only a few megabytes and is hardware and software independent, so it can be integrated into the complete standard portfolio of RUAG Space's on-board computers and into almost any other satellite computer. As sa.engine is scalable, it will be able to support any fleet of satellites and to interact with and learn from other satellites.



Source: news.satnews.com

Global Space Missions 2022
A Snapshot

As the new space era unfolds, 2021 will be remembered as the year in which organizations and individuals outpaced each other in channeling technological advances and developing business models while establishing new frontiers in space beyond Earth. More than 130 space missions have been carried out in 2021, with most of these missions proving to be successful.

The primary driver of this is that private aerospace companies are making access to space more affordable by developing and testing reusable rockets, and this trend is expected to continue into 2022.

NASA, the Canadian Space Agency, and the European Space Agency (ESA) have launched their $9 billion (€7.9 billion), space observatory James Webb Space Telescope,26 years in the making, on 24 December 2021.The telescope will travel 1.5 million km from Earth where it will orbit the Sun. Webb is only a few days away from reaching its destination in space: L2, or the second Lagrange point, which is a gravitationally stable place in space.L2 is located on the opposite side of the Earth from the sun.The James Webb has been designed to read infrared light and could tell us the most complete story ever of how the universe came to be filled with light.

From new launch vehicles such as SpaceX's Starship, NASA's Space Launch System (SLS) mega rocket, United Launch Alliance's (ULA) Vulcan Centaur rocket, and Blue Origin's New Glenn rocket, to missions to the moon, Mars, asteroids, and beyond, a slew of exciting missions are set to launch or arrive in 2022. .A large number of missions that were postponed in 2021 will also take flight.

2022 is poised to be a big year for "super heavy-lift launch vehicles" (SHLLVs). SHLLVs are big rockets that can lift at least 50 tonnes of payload into low-Earth orbit, and in the history of space, only two have ever done so in space history: NASA's Saturn V, which carried humans to the moon, and the Soviet's Energia. While SpaceX Falcon Heavy is designed to carry that tonnage, it hasn't done so yet. Two new SHLLVs are slated to reach orbit in 2022: NASA's Space Launch System (SLS) and SpaceX's Starship.

Prototypes of Starship's upper stage have already flown several miles above Earth in the past, and SpaceX intends to launch an integrated version of the spacecraft, with both lower and upper stages, into orbit in the first quarter of 2022.NASA intends SLS to play a significant role in human space travel, ferrying astronauts to the moon and possibly Mars; the first uncrewed mission was scheduled for 2016, but several delays have pushed it to February 2022.

SpaceX intends to launch astronauts into space in 2022 with the Houston-based business Axiom Space on a private mission to the International Space Station. Axiom Mission 1 (Ax-1) is now scheduled to launch on February 28, 2022. The private crewed mission originally targeted a 2021 launch. Former NASA astronaut Michael López-Alegra, Larry Connor, Mark Pathy, and EytanStibbe are among the four astronauts on the Ax-1 mission. The tour will most likely last eight days at the station with two days travelling. While tourists have already visited the space station, Axiom claims that this will be the "first-ever entirely private" voyage to the station. The crew intends to conduct 25 microgravity experiments focused on science, education, and outreach.

In May 2022, the European Space Agency (ESA) plans to launch a mission to Jupiter. The probe, codenamed JUICE "Jupiter Icy Moons Explorer," is scheduled to arrive in 2029 and spend three years researching the planet and three of its moons.

ESA is also collaborating with ROSCOSMOS on a Mars mission and plans to launch its second ExoMars probe in September 2022.The second mission is scheduled to arrive at Mars in 2023, with a Russian Lander delivering an ESA rover to the Martian surface to search for signs of life.

In 2022, the ISS could possibly receive Boeing's Starliner. That spacecraft has been in development for more than a decade as part of NASA's Commercial Crew Program, which was intended to deliver the agency's astronauts to the International Space Station (ISS) without the assistance of Russia. An uncrewed Starliner will now fly to the ISS in May, and if it is successful, a crewed test might take place before the end of the year.

The Moon is being targeted by numerous space agencies in 2022. South Korea intends to launch its first lunar mission, the Korea Pathfinder Lunar Orbiter, from Cape Canaveral in August. ROSCOSMOS, the Russian space agency, plans to launch Luna 25 to the Moon's south pole in July – almost 45 years after Luna 24 returned about 200g of lunar soil in August 1976. India has tentative plans to try landing its first craft on the moon this year.

SpaceX, Blue Origin, and Virgin

Galactic all launched their first all-civilian missions to space in 2021, but 2022 is expected to be the year that space tourism truly takes off.Blue Origin has multiple flights planned for 2022, and Virgin Galactic aims to begin commercial flights by the end of the year (their spacecraft is now undergoing "improvement").

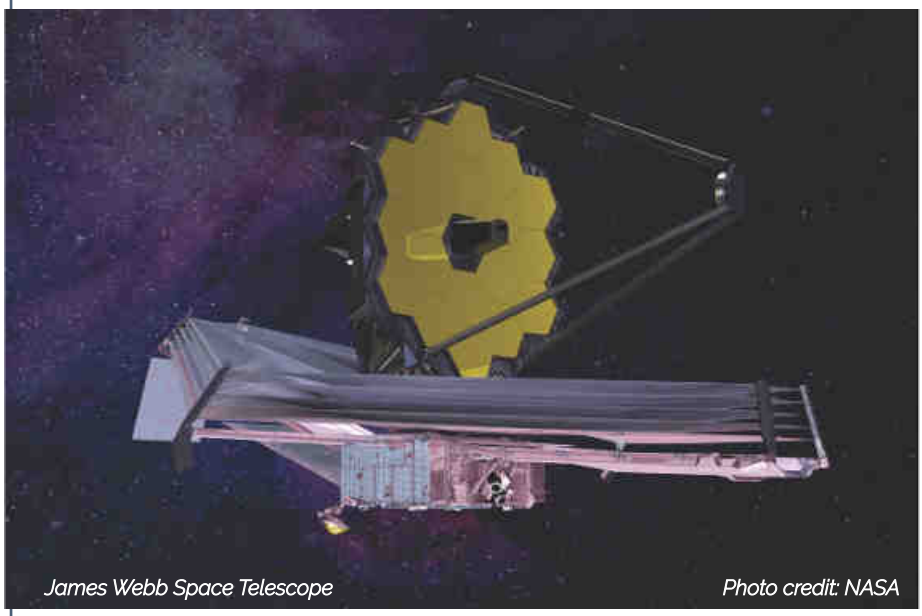
ISRO is moving into 2022 with several ambitious missions, despite multiple delays owing to the COVID-19 epidemic. The year appears to be jam-packed for the space agency, with several exciting launches scheduled for 2022.

According to industry experts quoting ISRO sources, 11 launch windows have been reserved, but more are anticipated to become available during the year. Along with the human space (Gaganyaan) and lunar (Chandrayaan 3) projects, ISRO and CNES are developing additional space missions, including 'DISHA', a twin aeronomy satellite mission, a Venus expedition, and the ISRO-CNES collaborative science mission 'TRISHNA'.

The public sector NewSpace India Ltd (NSIL) has chosen Arianespace's Ariane-5 rocket to launch the communication satellite GSAT-24.The whole satellite capacity on board GSAT-24 will be leased to Tata Sky for its DTH application requirements. The launch is anticipated to take place in the first quarter of 2022.

In addition to India's Chandrayaan-3, other countries have also planned their missions to the moon, and 2022 is likely to be reckoned as the year

James Webb Telescope Overview



James Webb Space Telescope *Photo credit: NASA*

The James Webb Space Telescope (sometimes called JWST or Webb) will be a large infrared telescope with a 6.5-meter primary mirror. The telescope will be launched on an Ariane 5 rocket from French Guiana on 25 December 2021.

The Webb telescope will be the premier observatory of the next decade, serving thousands of astronomers worldwide. It will study every phase in the history of our Universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own Solar System.

The Webb telescope was formerly known as the "Next Generation Space Telescope" (NGST); it was renamed in September 2002 after a former NASA administrator, James Webb.

Webb is an international collaboration between NASA, ESA (the European Space Agency), and the Canadian Space Agency (CSA). NASA's Goddard Space Flight Center in Greenbelt, Maryland, is managing the development effort. The main industrial partner is Northrop Grumman; the Space Telescope Science Institute will operate Webb after launch.

Several innovative technologies have been developed for Webb. These include a primary mirror made of 18 separate segments that unfold and adjust to shape after launch. The mirrors are made of ultra-lightweight beryllium. Webb's biggest feature is a tennis court sized five-layer sunshield that attenuates heat from the Sun more than a million times. The telescope's four instruments - cameras and spectrometers - have detectors that are able to record extremely faint signals. One instrument (NIRSpec) has programmable microshutters, which enable observation up to 100 objects simultaneously. Webb also has a cryocooler for cooling the mid-infrared detectors of another instrument (MIRI) to a very cold 7 kelvins (minus 447 Fahrenheit) so they can work.

JWST arrived at its observing spot, Lagrange point 2 (L2), nearly 1 million miles (1.6 million km) on 25 January 2022, On 28 January 2022, JWST has turned on its science instruments, and would be seeing its first target star-HD 84406, a sun-like star about 260 light years away.

of several nations' first steps to the moon.

Moon Missions of Various Nations

United States' Artemis Base Camp on the Moon and Beyond

NASA has awarded SpaceX a $330 million contract to launch two crucial components of the Gateway lunar base. It's part of Artemis' objective to "create a viable human presence on the Moon."

The first lunar voyage will take place this year and will include the deployment of a swarm of robot spacecraft. These probes, which are being built with NASA assistance by private companies, are designed to map underlying water deposits, explore the moon's deep interior, and deploy robot rovers to survey the lunar surface.

Russia's Moon Landing

Russia's intentions for lunar landings in 2022 are like those of the United States. According to the Russian space agency Roscosmos, the Luna-25 lander will settle on the moon in July. This will be Russia's first lunar mission in 45 years.

China-Russia International Lunar Research Station (ILRS) Station on the Moon

The International Lunar Research Station (ILRS), a joint moon station built by China and Russia, will hold experimental research facilities for a variety of scientific activities such as moon exploration, moon-based observation, and technological validation.

India's Chandrayaan-3

The Chandrayaan-3 mission is scheduled to launch in the third quarter of 2022 by the Indian Space Research Organization (ISRO). It will be the same size as Chandrayaan-2 but will not have an orbiter. Chandrayaan-3 will also be used to land a rover on the moon's dark side, which is thought to include snow and minerals.

Smart Lander from the Japanese Aerospace Exploration Agency (JAXA)

JAXA plans to land a lander on the moon in the second quarter of 2022. This mission will collect data about the moon's craters using a Facial Recognition System. The X-ray Imaging and Spectroscopy Mission (XRISM) space telescope is intended to be installed on the Lander. According to Space.com, the Japanese company ispace will send a small rover to the moon using the commercial HAKUTO-R lander for the Japan Aerospace Exploration Agency (JAXA).

JAXA's "transformable lunar robot" will be the second one carried on ispace's inaugural mission, as the business announced last month that it would also send a rover named Rashid from the United Arab Emirates to the moon.

If the mission is successful, the UAE will join a select handful of countries that have soft-landed spacecraft on the moon, including the United States, Russia, and China.

South Korea's KPLO

The Korea Pathfinder Lunar Orbiter (KPLO), a box-shaped satellite, will be South Korea's first lunar mission, slated to launch in August 2022 on SpaceX's Falcon 9 rocket and reach in lunar orbit by December

Photo credit: in.mashable.com

Member Secretary
PMC

Structuring and Mentoring
International Partnerships for the Success of 75 Students' Satellites Mission

Dr. K. Gopalakrishnan
Project Director
75 Student's Satellites Mission
Advisor,
Nagarjuna College of Engineering & Technology

75 Students' Satellites Mission 2022 has been conceived by Indian Technology Congress Association (ITCA) during the First International Seminar on Students Satellites held during Indian Technology Congress, 5-6 September 2018 at NIMHANS Convention Centre, Bangalore, India. To realize the 75 Satellites Mission, ITCA has organised Indo-Isarel Space Tech Leadership Programmes in association with TMISat, Israel and Israel Space Industries during 2018-19! Academis Institutions/Technical Universities has been represented by Leaders/Vice Chancellors/decisison makers at Higher Engineering Educational Instituituons (EEIs) in India during the ITCA delegations/interactions. Many International Events/Training Programmes have been organised by ITCA-75 Satellites Consortium and encourged more than 80+ Institutions across pan India! Knowledge conferences followed by establishing University Space Engineering Consortium (UNISEC) India Chapters at EEIs and World CanSat/Rocketry Consortium/Championships (WCRC) at National Level-Continental Level-World Finals has been planned at Serbia during September 2022.

The first three student-built satellites known as UNITYSat were successfully developed and deployed with this background. UNITYSat's resounding success opened the door for a plethora of satellite developmental possibilities that leveraged the domain knowledge garnered in SmallSat platforms. With this fulfilment, ITCA mentored and promoted two spin-off companies, TSC Technologies in India and TMISAT in Israel, in 2020, to apply its SpaceTech team's research and consultancy breakthroughs to the development of SmallSats. Thanks to our partners who collaborated and assisted in developing this gigantic mission, the expansion of cooperating Universities/Institutions, industry, and R&D labs is clearly visible. It has been further accelerated by continuous innovation in manufacturing better Satellites systems. ITCA's SpaceTech ecosystem has a deep depth and breadth of domain expertise and interdisciplinary knowledge to deliver consistently on challenging small satellite projects and programs for commercial satellite constellations.

ITCA's SpaceTech committees worked incredibly hard over the lastthree years to make their vision a reality by developing advanced skills in various SmallSats Platforms, including Product Development, System Engineering, and Project Management insights and providing students with extensive international exposure. Most significantly, ITCA's collaborative partner ecosystem hasdemonstrated that the coveted 75 Students' Satellites Mission isachievable and realistic. This is only possible by accumulating asubstantial knowledge base to address complex engineering issues, inculminating in the construction of SmallSats in a shorter time frame employing commercial off-the-shelf (COTS) components and subsystems. ITCA demonstrated to the nation's Scientific and Engineering fraternity that students from Indian academia can confidently develop and deploy SmallSats with pride. Even required funding has also been arranged by ITCA-SYMBA-Maz, Isarel to EEIs.

Global Exposures of ITCA-UNITYSat Team

- Attended Samara University International Summer School at Samara National Research University, Russia (Made World's 1st Satellite "Sputnik" and Pioneer in Space Research; Also, have sent World's 1st Cosmonaut to Space)
- Core Team Members have been Trained at International Space University, Strasburg, France
- Participated Trained at Indo-Israel Space Tech Leadership Programme at Tel Aviv University, Israel and COSPAR/UNOOSA
- Core Team Members have been Trained at Tokyo University, Japan
- Core Team Members have been Trained at Sapienza/Rome University, Rome, Italy and Portugal
- Indo-Israel, Indo-Serbia, Indo-Russia, Indo-Japan, Indo-Italy, Indo-Germany, Indo-Portugal, Indo-Canada events by ITCA
- UCAL-USA, Samara-Russia, Skoltech-Moscow, Russia, ISU, France, Tokyo University, Japan, Tel Aviv University & Teknion, Israel, COSPAR/UNOOSA, Israel, IBM OpenPOWER Foundation, USA and IIT Kanpur etc.

7th University Space Engineering Consortium (UNISEC) Global Meeting held at Japan

The University of Tokyo, Institute for Open Innovation

30 November-05 December 2019 at Koshiba Hall, Hongo Campus, the University of Tokyo, JAPAN

Dr. Blumberg Presented Certificates of Award to the Successful Delegates from ITCA SpaceTech Institutional Consortia

ITCA-UNITYsat Team with Ms Lucille Baudet, Open Cosmos, UK, Dr. Margarita Safonova, Russia/Visiting Scientist, Indian Institute of Astrophysics and Dr. J. Ramkumar, Professor, IIT Kanpur during Interaction held on 03 September 2019 at Bangalore

16 Members' UNITYsat Team with from INDIA to 2019 CanSat/Rocketry International Competition held at Serbia

ITCA-UNITYSat Indo-Italy Delegation: Interaction with Prof. Fabio, Visited Sapienza University, Rome, Italy

Indo-Israel Space Tech Leadership Programme at Tel Aviv University, Israel and COSPAR/UNOOSA

ITCA Team has regularly interacting with Chairman, ISRO, Scientific Secretary, Director, ISRO Satellite Centre at ISRO-HQ and Dr. Prakasha Rao, Director, SIPO has been nominated as Chairman, 75 Satellites' Project Monitoring Committee and the realization of building 75 Satellites by Indian academics and launching it successfully in Aug 2022 is now has becoming a reality with the support of Space Eco-system in India!

TEVEL - Nanosatellite Project

An Ingenuity of Israeli School Students

Eight nanosatellites built by Israeli school students were launched into orbit on 13 January 2022, aboard a SpaceX Falcon 9 rocket launched from Cape Canaveral in Florida, USA. These nanosatellites we're built by eight school student teams as part of the "Tevel Project," a collaboration between the Israel Space Agency and the Science and Technology Ministry, Israel.

The "TEVEL ("world" and "strong" in Hebrew) mission consists of eight packet-size satellites that serve as an infrastructure to promote and advance space studies in Israel and carry amateur radio FM transponders. The satellites built by the students are more than just a novelty; they will be able to communicate with ground control, perform a variety of tasks, and conduct important scientific research.

The SpaceX Falcon 9 Transporter-3 mission, which launched 105 satellites from various companies and organisations around the world, also carried AMSAT-(AMSAT-EA) EA's EASAT-2 and HADES payloads. The Transporter-3 mission is the company's third spaceflight under the SmallSat Rideshare Program, which allows organisations to share a Falcon 9 rocket with dozens of other SpaceX customers to get payloads to space at a lower cost.

These students' three-year efforts have resulted in satellites equipped with radio FM transponders that will broadcast signals to Israeli communication stations. The TEVEL satellites join the three Duchifat satellites successfully launched by the Herzliya Science Centre (HSC) and the Tel Aviv University's TAUSAT satellite.

All 8 satellites will have the same frequencies, so as long as the footprints are overlapping, only one FM transponder will be activated. The satellites were built by 8 schools in different parts of Israel. The control station will be 4X4HSC at HSC with the following frequencies

Beacon transmissions on 436.400 MHz, (9600bps BPSK G3RUH); FM transponders uplink frequency: 145.970 MHz; FM transponders downlink frequency: 436.400 MHz

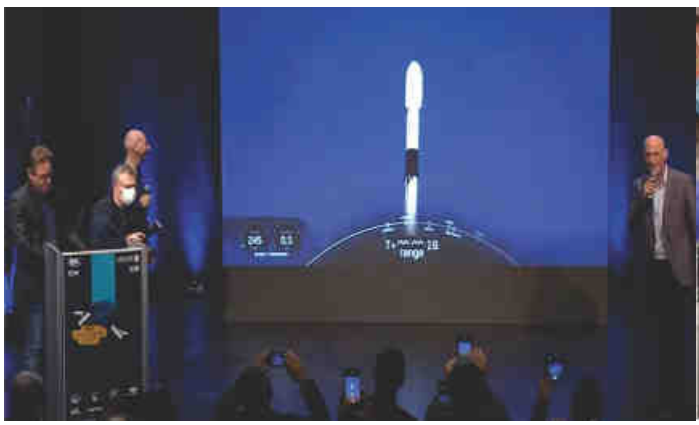
About the students in the program

About 250 high school students from all over the country: Ofakim, Yeruham, Sha'ar Hanegev, Ma'ale Adumim, Taibeh, Givat Shmuel, Kiryat Ata and Nazareth who are studying science and technology participated.

The students came from different backgrounds, including students from the state, state-religious education and the Arab sector who have worked together for three years.

"I was fascinated by this incredible programme," said Orit Farkash-Hacohen, Minister of Innovation, Science and Technology, Israel in a video address to the event.

"To see groups of students from all across Israel-from Nazareth to Givat Shmuel, Jews and Arabs, from the south and the center-shows how much science and technology connects people."



Israel Space Agency officials and students watch from Herzliya as the SpaceX Falcon Rocket Launches in Florida, on January 13, 2022. (Screenshot)

Israeli school students work on a small satellite launched into space, on January 13, 2022 (Science and Technology Ministry)

Dr. Meir Ariel, Director General of the Herzliya Science Center and Director of the Tel Aviv University Nano-Satellite Center has been a driving force in Israel's student-built nanosatellite activity. He has over 30 years of experience in signal processing and wireless communication research and development. Under his direction, thirteen scientific nanosatellites have been built and launched in the last few years.

Dr Meir Ariel is a member of ITCA's SpaceTech Leadership Team and provides strategic and technical oversight for ITCA's 75 Students' Satellites Mission.

ITCA has a long association with HSC and other agencies of Israel working on space programmes. Along with Dr Meir Ariel, Prof Chaim Eshed, Co-Founder, Israel Space Agency and Retd Brigadier General, Israel's Military Intelligence guided ITCA's Space programmes.

Many ITCA teams visited HSC and other Israeli Space labs to gain hands-on experience with student-built satellites. Along with Dr. Meir and his technical teams, visited India and participated in capacity building programmes under ITCA initiatives, including at the Indian Technology Congress.

Along with Dr. Meir Ariel, Prof. Chaim Eshed, Mr. Leo Vinovezky, Director, Israel Space Agency, Mr. Kfir Damari, Founder, SpaceIL, Dr. Ran Ginosar, CEO, Ramon Chips, Mr. Arie Leizer, Chief Space Systems Engineer, Elbit Systems ISTAR, Mr. Elad Sagi, Project Manager, Ministry of Science, Technology, Ms. Sharon Mishaal, HSC Pedagogical co-ordinator, Prof. Pini Gurfil, Head, Asher Space Research Institute, Technion, Dr. Dan Blumberg, Vice-President & Dean (R&D) Ben-Gurion University, helped ITCA's Programmes..

File Photo

Prof. Chaim Ershed, Chairman, Space Committee, Ministry of Science, Technology, Israel discussed on Creativity and Innovation in Israeli Space Programme with Indian delegation

India and Israel unveil a commemorative emblem to mark the 30th anniversary of diplomatic relations

India and Israel have a long and rich history of engagement and cooperation, which has evolved into a strategic partnership across numerous sectors in recent years. To commemorate the 30th anniversary of the two countries' diplomatic relations, the two countries unveiled a commemorative logo at an online event attended by India's Ambassador to Israel, Sanjeev Singla, and Israel's Ambassador to India, Naor Gilon.

The design incorporates the Star of David and the Ashoka Chakra, both of which appear on the national flags of both nations, to form the figure 30 to commemorate the 30th anniversary of bilateral relations.

Herzliya Science Centre (HSC)

The Herzliya Science Centre (HSC) is the science campus for Herzliya's middle and high schools, and over the last few years, more than 2000 students are attending HSC advanced labs, studying and carrying out experiments in sciences-physics and chemistry, engineering-electronics, computer science, robotics and biotechnology. HSC's space and satellite lab has emerged as Israel's only lab where high school students are designing, building satellites, and flying them to space.

HSC has the unique distinction of designing, developing, testing, launching, and monitoring more than ten satellites that have been built by students, and are helping students across the country to "observe the Earth". Students have been at the centre of the project, and have contributed to satellite planning, writing the airborne and ground software, and testing it for satellite launch", with the participating space professionals being in a consultative role.

HSC is spearheading the projects under robust expertise. Duchifat series of satelittes is the earlier series of nanosatellites that have been built by high school students, has also been the brainchild of HSC. Duchifat 3 was the third in the series of Israeli student-built satellites that was launched from the Sriharikota spaceport by ISRO's PSLV C48 on 11 December 2019. Duchifat 3 was a remote sensing satellite for ecological studies including air pollution, water source pollution, forest monitoring, amongst other earth observation studies.

Small Satellite Launchers
Significant Growth Prospects

Over the last few years, a new era of small satellites has developed, which are supplementing and, in some cases, replacing larger spacecraft. Small satellites are emerging as the "new normal" due to their rapid development, low cost, flexibility, robustness, and ability to operate as constellations.

Small Satellite Drivers

Small satellites can be launched 'piggybacking' or ridesharing on larger launch vehicles with extra capacity. The secondary payload paradigm has a shortcoming in that it does not provide distinct orbital and launch-timing requirements for small satellite launches.

To fill this void, businesses all around the world are building launch vehicles aimed specifically at the SmallSat industry. The likelihood of having to launch many SmallSats to create big constellations is a distinguishing aspect of this new SmallSat market, and this drives many of the new launcher requirements.

While the cost of launch was once the only deciding factor, the new requirements for getting SmallSats into orbit on schedule and in a precise orbit have become key decision factors.

Frost & Sullivan analysts believe that spaceport-based business models that can allow many such new launch service providers using smaller rockets for dedicated small satellite launch service would likely constitute a new business segment within the launch industry.

In this context, worldwide firms offering SmallSat launch vehicles such as Rocket Labs' Electron (225 kg), Astra's Rocket 3.0 (100 kg), and Virgin Orbit's LauncherOne (500 kg) have emerged as important players. The availability of funding for space start-ups has also aided over 30 groups throughout the world in their efforts to construct dedicated small satellite launchers.

The Electron launch vehicle from Rocket Lab is the first orbital launch vehicle planned and constructed as a two-stage vehicle to service the expanding small satellite industry, and it has been developed with a high flight rate in mind. Electron can launch 150 kg to a nominal 500 km sun-synchronous orbit from both our Rocket Lab Launch Complex in New Zealand and domestic ranges in the United States.

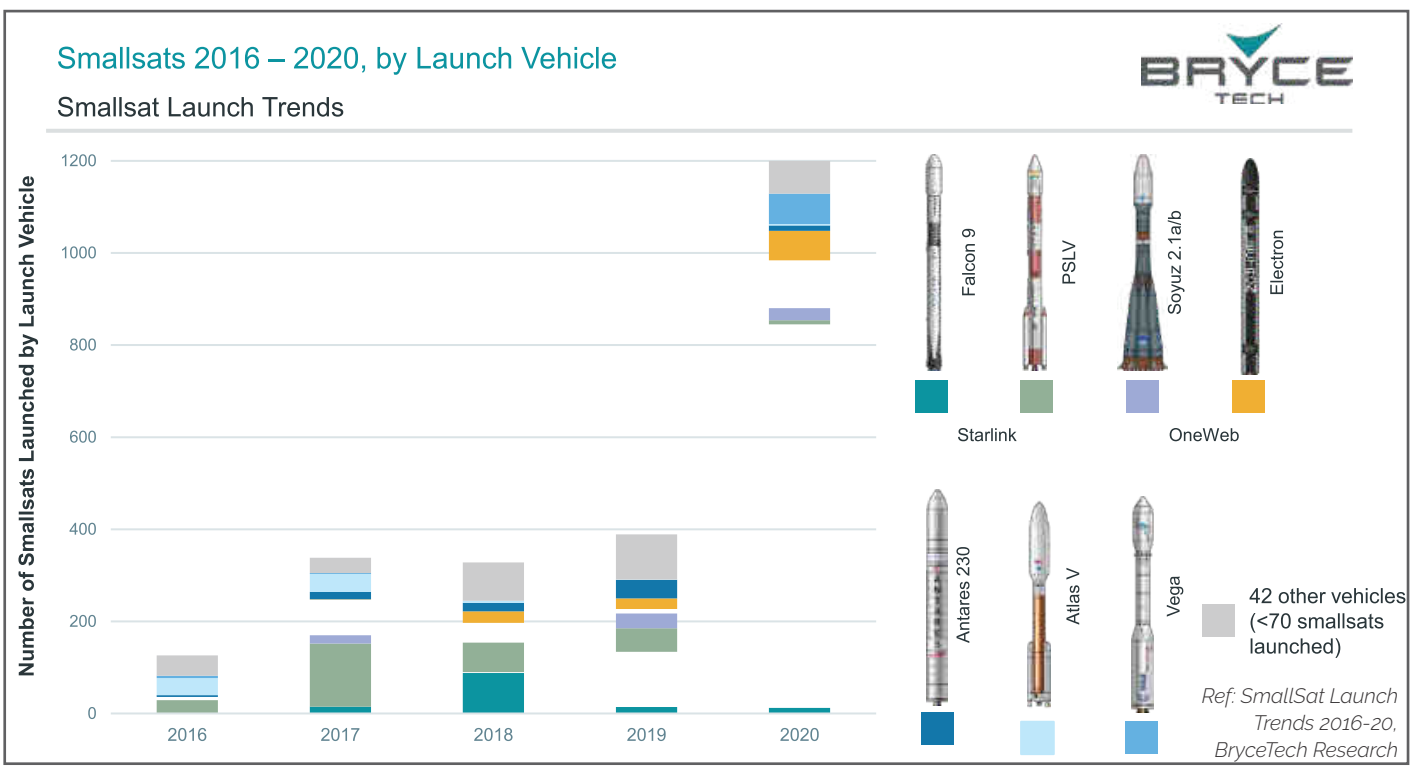


Image courtesy: Rocket Lab

Rocket Lab has reported an increase in the Electron's payload capacity to Low Earth Orbit from 225 kg to 300 kg thanks to improved lithium polymer batteries (LEO). The pump speed of the Rutherford pump is 40k rpm, which allows it to have a small pump impeller diameter and thus a compact pump footprint.

Rocket Lab intends to employ additive manufacturing to shorten the time required to construct an Electron to just 7 days. 3D printing is used to create the combustion chamber, pumps, injectors, and valves. The engine's primary components can be 3D printed in 24 hours, substantially shortening manufacturing delays.

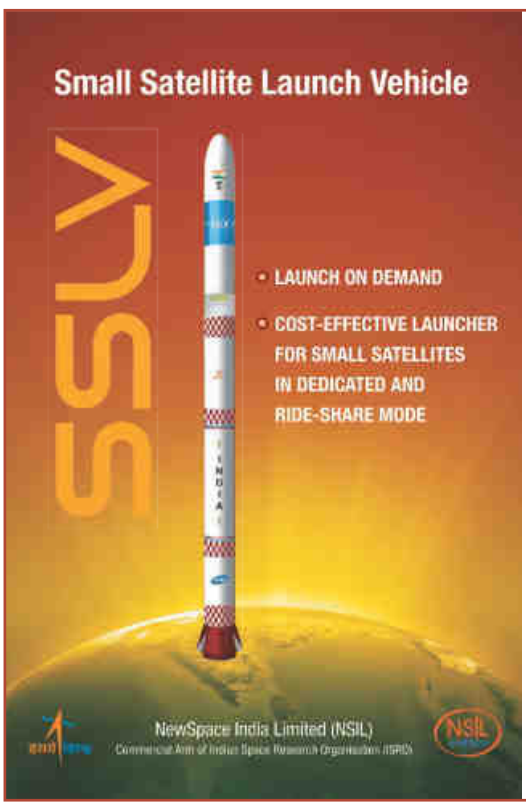
Image courtesy of The Verge.
An artist's impression of Virgin Orbit's Cosmic Girl, which is carrying LauncherOne.

LauncherOne is a 70-foot-long (21-meter-long) two-stage rocket that can deliver up to 1,100 pounds (500 lb) of cargo to orbit. One element that distinguishes LauncherOne is its air-launch approach, which involves separating from Cosmic Girl at a height of approximately 35,000 feet (10,700 m) and shoving into LEO from there. Representatives for Virgin Orbit argue that this strategy, at least in the case of LauncherOne, increases flexibility and reactivity as compared to vertical launches.

Kulasekarapattinam is India's second spaceport

ISRO has chosen Kulasekarapattinam as the site of its second spaceport. This will enable ISRO to launch smaller satellites more regularly using the Small Satellite Launch Vehicle (SSLV), which is currently being developed.

The second spaceport will give strategic benefits such as allowing vehicles to reach polar orbits directly without having to veer to avoid flying over Sri Lanka, as is required for vehicles departing from Sriharikota. This manoeuvre necessitates more fuel, forcing smaller launch rockets to reduce their payload.



The Small Satellite Launch Vehicle (SSLV), an indigenous new launch rocket developed by the Indian Space Research Organization (ISRO), will make its maiden development flight in April 2022.

The SSLV seeks to serve the market for the launch of tiny satellites into Earth's low orbits that has grown in recent years to meet the needs of developing governments, universities, and private enterprises for small satellites.

Small satellite launches had previously relied on 'piggybacking' on big satellite launches on the Polar Satellite Launch Vehicle (PSLV) – ISRO's workhorse with over 50 successful launches. As a result, modest satellite launches have been dependent on ISRO completing launch contracts for larger spacecraft.

The SSLV can launch satellites weighing up to 500 kg into low orbit, but the PSLV can launch spacecraft weighing more than 1000 kg.

SSLV is ISRO's smallest vehicle, weighing 110 tonnes, and would take 72 hours to integrate, as opposed to the 70 days required for other launch vehicles. It is predicted that the entire operation will only require six employees rather than 60, and that it will be done in a short period of time at a low cost of roughly Rs 30 crore.

ISRO-NSIL anticipates a requirement for 15 to 20 SSLVs per year based only on national demand.

Hall Thruster from Aliena Pte. Ltd.

Empowers NuSpace's NuX-1 Smallsat

The Hall thruster was integrated on a 3U smallsat — NuX-1 — made and owned by satellite IoT company NuSpace, and was brought to orbit by a SpaceX Falcon 9 via the Transporter-3 mission. The Hall thrusters that were developed for this mission are GEO-Hall thrusters that are sub-10 W class systems that were designed specifically to cater to meet the most demanding smallsat operations.

A constraint in the operational deployment of conventional Hall thrusters include the power consumption of such systems that make it challenging for incorporation onboard smallsats, due to the limited power generation and storage capacities available on such small platforms.

The GEO-Hall thrusters were designed to operate below the 10 W regime and have demonstrated capability to fit within extremely small form-factors, thereby heralding new potential opportunities for smallsats to consider the use of such systems for emerging missions and operations.

Aliena has achieved a milestone reduction in power consumption for Hall thrusters through the use of a novel ignition and neutralization scheme that was developed internally by the company. Additionally, this novel system allows for instant-ignition of the systems without requirement for the engines to be in a hot-standby mode or for warm-up cycles prior to firing, which are common drawbacks of systems that

utilize active cathode neutralizers or solid fuel.

This unique feature enables more agile operations to be executed through on-demand propulsion while not compromising on the form-factor and power budgets of the satellites, making it an extremely attractive option for smallsat operators through provision of more payload volume, and power budgets to be diverted for actual operations.

Aliena also has microsatellite-class engines (MUSIC) that will be first deployed on a 12U smallsat platform in 2023 with Orbital Astronautic's ORB-12 Strider mission and has since secured separate orders from an undisclosed customer.

Source: news.satnews.com

SpaceX Launches 49 More

Starlink Satellites, Takes Total to Over 2,000

Elon Musk-founded SpaceX has successfully launched 49 more Starlink satellites aboard a Falcon 9 rocket to take the total number to more than 2,000. The Falcon 9 rocket lifted off from the Kennedy Space Centre in Florida, US, on 19 January 2022. About nine minutes later, the rocket's first stage returned back to Earth for a pin-point touchdown on a SpaceX drone ship called "A Shortfall of Gravitas," which was stationed in the Atlantic Ocean off the Florida coast.

Musk has been billing the Starlink project, operated by SpaceX, as a way to provide low-latency broadband Internet services around the world through hundreds of small satellites. The project is particularly focused on remote areas that are not fully covered by the terrestrial Internet infrastructure. Following the recent launch, Musk tweeted a magnificent image of the Falcon 9 rocket against a rising Moon. Musk is also eyeing to undertake a lunar mission as part of NASA's plan to return humans to the Moon after almost 30 years. "Back to the Moon soon," the SpaceX CEO replied to his own tweet.

Source: news.satnews.com

Kalpana Chawla Centre
for Research in Space Science & Technology
Chandigarh University

Dr. Priestly Shan
Dean-Academics
Chandigarh University, India

The Kalpana Chawla Centre for Research in Space Science and Technology (KCCRSST) has been established at Chandigarh University and inaugurated by Defence Minister Shri. Rajnath Singh on 3rd January 2022, which is said to be an essential step towards strengthening the country's space and geospatial sectors. The center is named after the India-born astronaut Kalpana Chawla, who lost her life in the 2003 Columbia shuttle disaster.

In his speech, Rajnath Singh called the establishment of the research centre an important step in strengthening the country's space sector, stressing that only through these efforts can India become a leader in future technologies. Shri Singh pointed out that the space sector is closely related to our lives from national development to national security, and the government understands the potential of this space and is committed to elevating it to new heights, setting a new direction for the development of the space industry. nation. On Monday, Defence Minister Shri Rajnath Singh Ji reiterated the government's commitment to strengthening the private sector for the overall development of the country, saying that strong long-term public-private partnerships are key to advancing education and global science and transforming India into a knowledge economy.

He also praised the Indian Space Research Organization (ISRO) for being one of the best space agencies in the world for decades due to its hard work and vision. He praised Chandigarh University for its work in research and innovation and called its achievements a symbol of the growing involvement of the private sector in education. Speaking on the occasion, Chandigarh University Chanditor S. Satnam Singh Sandhu said that since its foundation, the university has strived to provide its students with quality, innovative and experiential education, and the establishment of this center is one of the steps in this direction. "We have always been pioneers in research and development and this center of excellence will further strengthen our position in aerospace technology.

The space centre will further strengthen the university's relationship with various academic and research institutions through research and technology transfer cooperation, he said. The state-of-the-art KCCRSST, designed to educate students in space science, satellite development, and future space exploration challenges, will be the ground control station for the Chandigarh University Student Satellite (CUSat), an in-house student-developed nanosatellite and Geospatial Research Center, etc. The Defense Department said in a statement Monday. CU Chancellor Satnam Singh Sandhu said the university took a big step by launching the centre, named after India's first female astronaut in space. The Kalpana Chawla ISU Scholarship Fund was established in 2010 by alumni of the International Space University (ISU) to support Indian students in international space education programs.

The center has been established with the objective of training students in space science and satellite development and to meet future challenges in the area of space research, this state-of-the-art space centre would be the Ground Control Station (GCS) for the Chandigarh University's Student Satellite (CUSAT), an in-house developed nano-satellite being designed by the students of Chandigarh University, and a Geospatial Centre for research, besides other important projects. Chandigarh University is the first university in India to send an IoT and AI-based satellite in space and run real-time ground station operations from the Kalpana Chawla Center for Research in Space Science & Technology.

The nano-satellite has been designed under the mentorship of Padma Shri Prof. R.M. Vasagam, Vice President, Indian Technology Congress Association (ITCA), Advisor, 75 Students' Satellites Mission 2022, Former Project Director, India's First Geo Stationary Communication Satellite, "APPLE", Eminent Scientist, ISRO, Former Vice Chancellor, Anna University, Padma Shri Dr. Y.S. Rajan (Honorary Distinguished Professor and Scientist, ISRO, Former Vice Chancellor, Punjab Technical University, Author of INDIA 2020: A Vision for New Millennium along with Dr. APJ. Abdul Kalam, Former President of India), Padma Shri Dr. Mylswamy Annadurai, Advisor, 75 Students' Satellites Mission 2022, Chairman, National Design and Research Forum, (Outstanding Scientist, ISRO, Former Director, ISRO Satellite Centre, Project Director, Chandrayaan 1 & 2 and Mangalyaan (Mars Orbiter Mission),), Dr. L.V. Muralikrishna Reddy, President, ITCA & UNISEC - India, President, 75 Students' Satellites Mission 2022 and Dr. K. Gopalakrishnan, Project Director 75 Students' Satellites Mission 2022, Secretary General, ITCA, BRICS FEO, and UNISEC India.

KCCRSST has two important divisions, first is designing, developing and deployment of Low Earth Orbit (LEO) student satellite in collaboration with Indian Space Research Organisation (ISRO), Indian Technology Congress Association (ITCA), and Geospatial Research Center (GRE).

GRE will predominantly focus on mapping, monitoring and surveillance. Geospatial technology is one of the three emerging technologies, along with nanotechnology and biotechnology. According to National Geospatial Policy, Indian geospatial market will grow at 12.8% to Rs 63,000 cr by 2025. GRC is established with a vision to serve society, coordinate, educate, guide and assist the implementation, maintenance, and development of GIS (Geographic Information Systems) technology in the country. GRC is working in the field of space application to resolve the issue related to climate change, smart city, geospatial modeling, geo-hazard, forest cover mapping and monitoring, Landuse and Landcover (LULC), snow and glaciological parameters assessments, connectivity facilities, speedy transportation, weather forecast, disaster management as well as border security, etc. for India.

The state-of-the-art facility will include the Chandigarh University Student Satellite Ground Control Station (CUSat), a NanoSatellite developed by university students with the support of ITCA as well as projects such as a Geospatial Research Centre.

CUSAT will be one of 75 student-created satellites launched into space on the eve of this year's 75th Independence Day. Chandigarh University joined the ranks of 13 institutions including Indian Institute of Technology (IIT) Kanpur and IIT Mumbai, becoming the first university in North India to design and develop satellites by itself. The research center was established to develop students' knowledge in space science, satellite development, and space exploration. The newly launched state-of-the-art space center will facilitate the development of satellite research and satellite launches in countries that have not yet developed satellite technology.

In addition, GCS will help develop satellite research centers and launch satellites in countries that have not yet developed satellite technology.

With the launch of CUSAT, Punjab will become the first border state in India to have its own satellite in space. The launch of the university's nanosatellite-CUSAT will prove to be an important step for the country, as it will collect data related to border intrusion detection, agriculture, weather forecasting, natural disaster forecasting, which will be helpful in research and study of various problems in these areas. In addition, the GCS will help develop satellite research facilities and launch satellites in countries that do not have developed satellite technology. The GCS under the KCCRSST will monitor majority of Low Earth Orbit Satellites including CUSAT and being a member of SatNOGS project, will be monitoring more than 380 satellites with over 810 transmitters in more than 50 countries

DAVOS Agenda 2022

Space and Economy

The World Economic Forum's Annual Dialogue

The Davos Dialogue, hosted virtually from January 17 to 21, 2022, featured addresses from global leaders, scientists, economists, and an astronaut who is now in space. Shri Narendra Modi, amongst other heads, presidents and prime ministers from across the world, spoke at the event, highlighting the Indian government' sprogress in implementing reforms that boost the economy, including deregulation in several industrial domains such as drones, space, and geospatial mapping. This annual event, which is the World Economic Forum's (WEF) signature programme, draws a lot of attention worldwide and proposes solutions to global issues, including Pandemic response, economic recovery, climate, technology innovations and global collaborations.

Crowding and Competition in Space- Excerpts from "The Global Risks Report 2022"

The World Economic Forum publishes the Global Risks Report in strategic partnership with March McLennan, SK Group and Zurich Insurance Group. The Global Risks Report series tracks global risks perceptions among risk experts and world leaders in business, government, and civil society.It examines risks across five categories: economic, environmental, geopolitical, societal, and technological. While space has immense potential benefits for future generations, it is also becoming increasingly crowded and commercialised. The report's risks are worthwhile to tackle, and they may be addressed through effective collaboration, strong citizen participation, and prudent use of advanced technologies.

Some of the report's highlights pertaining to space are:

- Climate change and other environmental concerns dominate the list of the most serious risks. But threats in cyberspace, the metaverse and outer space are also very real.
- Space programmes are still widely seen as a sign of national prestige, as they project geopolitical and military power as well as have scientific and commercial significance. Powers such as China, Europe (EU and ESA), France, Germany, India, Japan, NATO, Russia, the United Kingdom and the United States have publicly announced space forces and continue to build space infrastructure, with plans for at least five new space stations by 2030 in the works.
- The traditional Geostationary Orbit (GEO) commercial satellite market, which has dominated the communications sector for decades, is now losing commercial value because of competition from new players seeking to provide services from LEO or MEO.
- Financing of new applications for space-based initiatives has grown rapidly over the last decade. Businesses, start-ups and research entities are proliferating, raising money in the billions, and thereby driving down the cost of launch systems, particularly in LEO.
- Satellites in LEO as well as in MEO and GEO are used for multiple purposes that include climate and natural resource monitoring, broadband internet, and radio and television broadcasting, as well as position, navigation, and timing services.
- Smaller, low-cost satellites are also proliferating because of lower costs and fewer barriers to entry. While the risk is still relatively low, an increase in the number of satellites also increases the opportunity for collisions, or, at the least, a need to engage in emergency manoeuvres to avoid contact.
- Space is more accessible than ever, as evidenced by a record 145 orbital space launches globally in 2021. Space tourism also got off the ground with several private-sector rocket launches, and the first commercial space station was announced with operations slated to commence by 2024.
- Space junk, cyber threats and terrestrial infrastructure failures require effective and responsive public-private action - on a cosmic scale.
- The diversification of actors is an exciting development but dated space governance frameworks are coming under considerable pressure, exposing fault lines between the ambitions of different players and the acceptability of their actions.

Astronaut Matthias Maurer

However, if we can successfully manage these emerging risks, we'll realize the full potential for technological and human advancement that space presents, especially with longer-term missions to the moon and Mars in play and enhanced orbital satellite capabilities being launched to monitor and respond to climate change events.

Can space tech save the planet? Astronaut Matthias Maurer joins Al Gore and other expertsfrom space

For the first time, at the Davos Agenda came live from beyond our atmosphere."The Live from Space: The Next Frontier for Knowledge and Action" session saw astronaut Matthias Maurer take part in a debate from the International Space Station. He joined former US vice president Al Gore, UAE Minister Sarah Al Amiri, Astra founder Chris Kemp and ESA Director-General Josef Aschbacher in a discussion about what comes next for space exploration.

Excerpts from astronaut Matthias Maurer's discussion:

"The effects of life in space on astronauts can be significant, he added.But this impact can help scientists understand more about diseases that affect people on Earth."

"The cross-country and international collaboration aboard the space station

should also be a model for how we tackle major challenges on Earth - in particular, climate change."

"But the reverse is also true. We need to learn from our mistakes on Earth to inform the future of space tech and space exploration."

And, as Al Gore, Vice-President of the United States (1993-2001); Chairman and Co-Founder, Generation Investment Management, explained, technology like the James Webb Telescope, will give us a chance to see into the distant past. But, it's up to us to "use our moral imagination to see the future of humanity and to see the grave danger posed by all the global warming pollution we're putting into the atmosphere every day."

"And access is increasing all the time thanks to significant falls in the cost of putting satellites into space", explained Chris Kemp, the Founder, Chairman and Chief Executive Officer of Astra."This has enabled a new generation of entrepreneurs."

"But the data and knowledge that's gained from space should not be limited to those who own satellites", explained Sarah Al Amiri, the Minister of State for Advanced Technology, Ministry of Industry and Advanced Technology of the United Arab Emirates.

"And the volume of satellites means that regulation is important", explained Josef Aschbacher, the Director-General of the European Space Agency, echoing the message from the Risks Report.

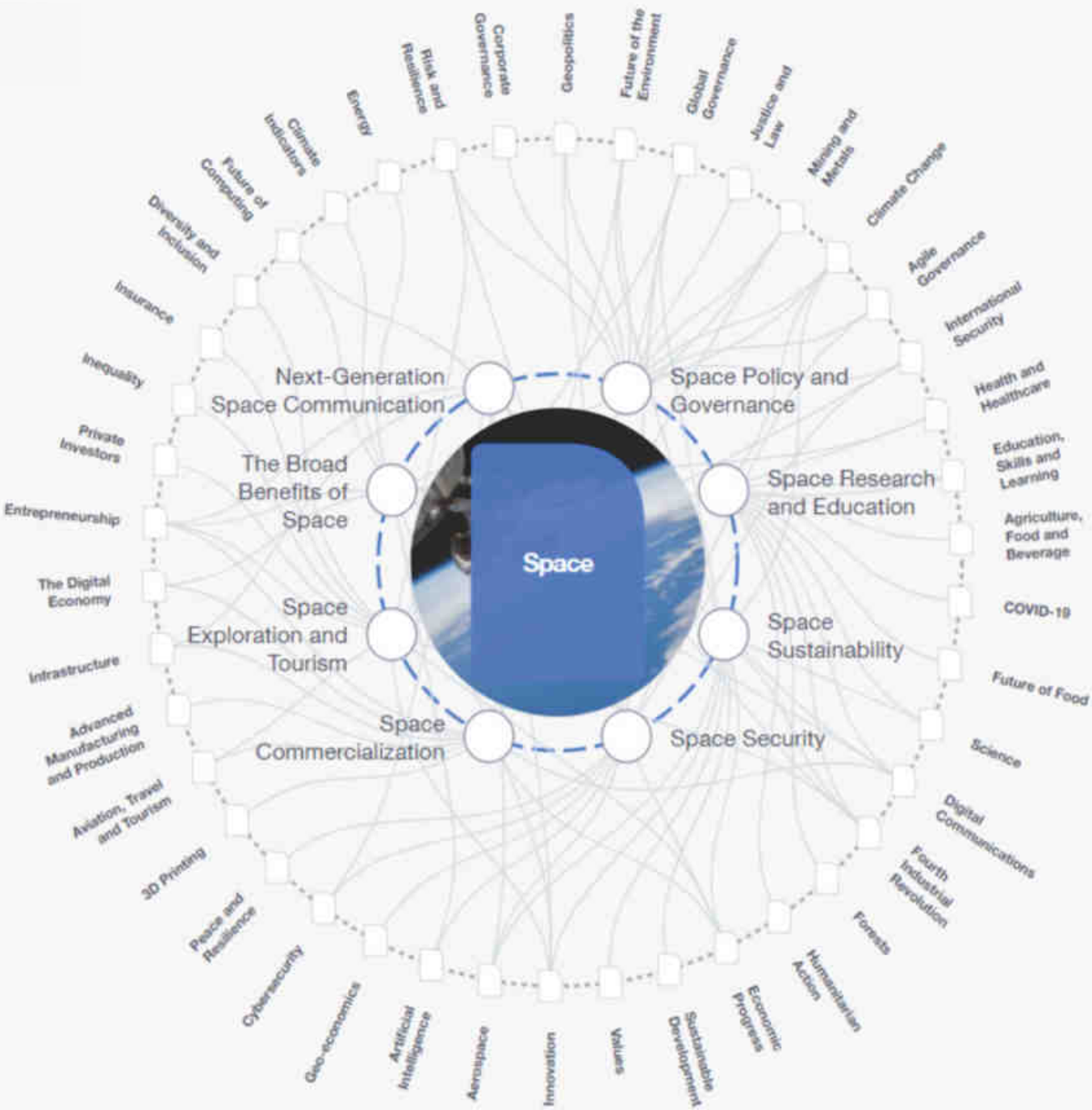
Transformation Maps for Space

Transformation Maps are used by World Economic Forum to explain to citizens, policymakers and strategists the interplay of the complex and related forces that are transforming economies, industries and global issues.

Our interaction with space is reshaping the global economy and geopolitics. We rely on it for navigation, climate change research and weather forecasting, communication, and military operations. Many different countries are now active in space, and much of the world depends on space-based services.

Private interests are increasingly pushing the boundaries of related technology and norms, and their funding of space exploration has created new capabilities and the potential for broadly shared benefits.

Transformation Maps for Space



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* Source : Times Engineering Survey 2021, TOI

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NTTF CanSat
Development & Launch

CanSats are simulation of satellites, built into the shape of a coke can. CanSats allow students to replicate the entire process of building a satellite, which helps them comprehend the project flow. A CanSat uses comparable technologies to a typical tiny satellite. Following in this tradition, TSC Technologies, an ITCA-incubated NewSpace start-up has introduced students to the world of cansats and student-built satellites. In October 2021, TSC held a CanSat workshop at Nettur Technical Training Foundation in Bangalore's Electronic City. The programme aimed to simulate the experience of constructing nanosatellites without requiring students to develop and test one from start. This workshop comprised ten NTTF student teams from diverse departments.

The Indian Technology Congress Association (ITCA) created a consortium of students from several Indian colleges and universities to pursue the aim of launching 75 student-built satellites to commemorate 75 years of Indian independence, in line with Hon'ble Prime Minister's vision articulated at the UNGA. Launching a satellite requires a thorough understanding of its subsystems. The programme was designed to provide students with both theoretical and practical exposure. The well-balanced academic and practical lectures also helped students develop the efficacy required to build satellites.

TSC infused information for CanSat development by teaching theory first and following it up with comprehensive practical sessions. The workshop taught everything about subsystems and the components needed to model them. The workshop began with an overview of nanosatellite theory. Information on small satellites and how they compare to CanSats was delivered to enthusiastic students. These include proof-of-concept missions, carrying special electronics payloads, remote inspection of larger spacecraft, disaster detection constellations, in-orbit repair and re-energization of failed systems, larger spacecraft refuelling, guarding and warning spacecraft, attacking and destroying any spacecraft, and many more.

The students worked with satellite components such batteries, OBCs, and sensors. They were taught about small satellites and this new entrance platform, which allows them to learn more about satellite construction and space technology.

Padma Shri Awardee Prof. R M Vasagam, Vice President, ITCA, Dr. L V Muralikrishna Reddy, President, ITCA; Dr. K Gopalakrishnan, Project Director, 75 Students' Satellites Mission 2022 & UNISEC-India; and Dr. Wooday P Krishna, President, Indian Institution of Production Engineers were present at the CanSat Launch on 29 November 2022.

A total of ten Nettur Technical Training Foundation (NTTF, Electronics City Campus, Bengaluru) teams took part in the CanSats. The satellites were then deployed from a drone at a height of 100m. Each satellite used its own communication system to transfer telemetry and sensor data to the relevant ground stations. The TSC professors inspired students to learn more about satellite building and finally build their own satellite. The entire process was conducted on campus, from design to launch. TSC Technologies trained the pupils.

NTTF's CanSat initiative was a groundbreaking interdisciplinary endeavour that exposed students to Space Technology. Given the quality of training delivered and the response of students through the hands-on sessions, which made the CanSat programme a success, it is obvious that the NTTF satellite will be a success.

NTTF has signed an MoU with ITCA for joint development of a 1U NTTF Satellite to be launched as part of the 75 Students' Satellites Mission in 2022

National Infrastructure
for Small Satellites Missions

Over the last six decades, India's space technology has advanced by leaps and bounds, beginning with the humble beginnings of developing and launching sounding rockets from a town called Thumba near Thiruvananthapuram. Indian industry's involvement in India's national space agency, the Indian Space Research Organization, began with the industry providing manufacturing support for the fabrication of satellite and rocket components and subsystems.

The prior engagement model comprised ISRO investing and developing intellectual property in its R&D facilities, as well as employing industry for manufacturing support for the production of components and subsystems essential for ISRO's missions. ISRO assisted the sector by providing designs and training, as well as entering into buy-back agreements to ensure procurement and reduce commercial risk for industry participants. Over the years, this methodology has resulted in the establishment of over 350 industry partners who contribute to ISRO's space missions, as well as the birth of more than 50 start-ups.

Since 2020, the Government of India has advanced a series of systemic reforms aimed at encouraging and advancing private sector operations and entrepreneurship in India's space sector These reforms have made it possible for the private sector to flourish and cater to both the domestic and global marketsofferingstate-of-the-art goods, solutions, and services

There is enormous potential for young and agile Indian NewSpace entities to participate and contribute to the development, manufacture, and integration of launch vehicles and satellites of various classes, as well as to integrate with the foundation built by ISRO and increase the velocity and volume of order execution. The clustering of private companies around ISRO centres is a distinct trend that is being seen.

According to industry analysts, more over a third of commercial businesses focused on the spacetech sector are headquartered in Bengaluru, indicating the depth of domain experience available among ISRO workers and veterans.

Role of Industry 4.0 Technologies in the Evolution of Indian Space Sector

Digitalization-driven Industry 4.0 technologies are the foundation of the spacetech sector's ability to catalyse the development of new goods and services that fulfil stringent precision, reliability, and quality standards.

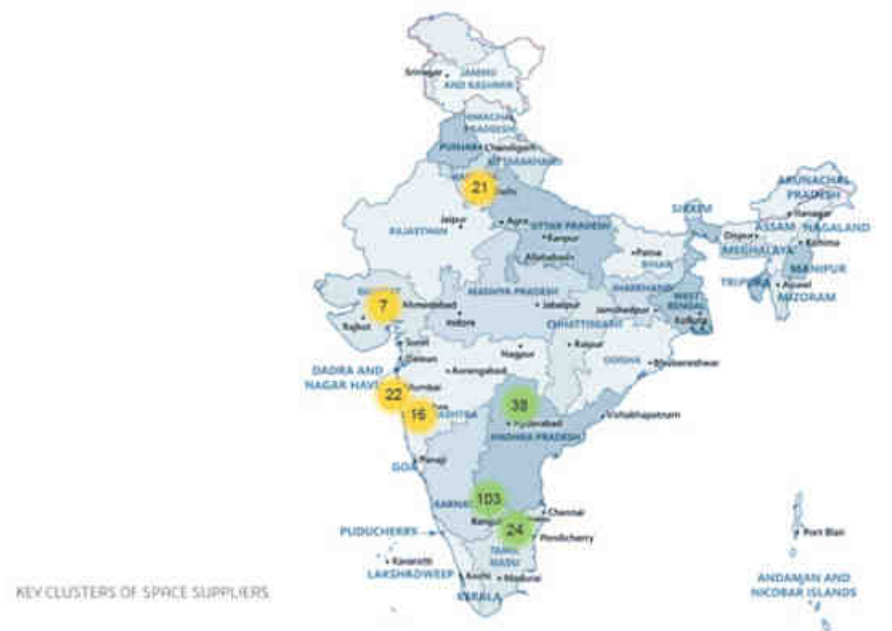
The adoption of an Industry 4.0 technology stack, including 3D printing, engineering tools for 3D modelling, prototyping, and simulation for designing satellites, payloads, and launch vehicles, is continuously meeting the requirements for precision and automation in the space industry. This saves space engineers a significant amount of time because the production time is greatly reduced. Complex payload and engine designs are increasingly being produced using computer-aided modelling and then manufactured utilizing additive manufacturing techniques.

Opening of the Indian Space Sector

The opening up of the Indian space sector aims to increase private space missions and expand India's contribution to the global space economy.The government has established the Indian National Space Promotion and Authorisation Centre (IN-SPACe), with the goal of involving private companies in space-related activities and boosting India's part of the global space economy to at least 10%.

Earlier, in October, Prime Minister Narendra Modi established the Indian Space Organisation (ISpA), a leading industry association of space and satellite firms formed to serve as the collective voice of the Indian space industry. Prime Minister Modi stated during the event that the "space industry is a vital medium for the progress of 130 crore countrymen."

While the government has taken significant steps in the creation of an



KEY CLUSTERS OF SPACE SUPPLIERS

active investor mindset by rolling out programmes like 'Make in India' and including space as a sector within the campaign, there is a need for developing a strategy on how the potential of the space sector can be leveraged under this programme. There are significant opportunities in manufacturing including development of small satellitesfor which engagement frameworks needs to be developed.

Enabling Policy Directives

Commercial exploitation of space technology requires certain key infrastructure that may be very expensive for individual private entities to establish on their own. Policy initiatives by central and state governments to create shared infrastructure would go a long way in creating a level playing field and helping start-ups and private entities become profitable and productive in shorter time periods. Policy initiatives that could be considered for implementation would include:

Rapid Prototyping

Rapid prototyping and 3D manufacturing facilities that are set up in various Centres of Excllence (CoEs) and academic/research institutions could be opened for use by private entities on a pay-per-use model. This would allow access to expensive fabrication and testing equipment along with associated skilled labour to enable prototyping of various satellite/launch components.

Development of Materials with Unique Properties

Many times, manufacturing of satellites and launchers requires materials that have specific characteristics or relies on proprietary materials. To support the industry in this procurement process, it is suggested that state governments leverage their network of suppliers to identify vendors who can deliver the optimal solution. To minimize imports, it is suggested that SpaceTech sector entities should partner with institutions and specialized organizations of the Government of India to progress efforts on material research, standardization and product development.

Shared Test Facilities

Satellites and launch vehicles undergo extensive testing before being qualified for flying into space. The flight hardware and systems undergo various environmental and operational tests, and the requirement is not just for the entire spacecraft, but for each individual part. Currently, there is a huge dependency on ISRO's capabilities for completing these tests, and this brings in inherent bottlenecks. While certain infrastructure would only be available with ISRO, a set of infrastructure labs and testing facilities being set up as national facilities would go a long way in promoting spacetech sector activities in the country. As a first step, facilities available in public sector enterprises and organizations like the DRDO and CSIR could be opened for private sector use.

Shared R&D Labs

The SpaceTech industry undertakes cutting edge research that is both time and resource intensive, and at times the output volume may not justify the cost of exclusive infrastructure and facilities. It is suggested that academic institutions like IITs, IISc, IIITs and universities could make available their existing infrastructure to the industry on mutually agreeable terms. The partnership may even be further extended to pooling of skilled human resources to jointly undertake and deliver projects by sharing of IP rights.

Facilitating Partnership

India has a robust industrial ecosystem across many states, and in close proximity to ISRO's centres of space activity. There is a need to leverage synergies in the existing ecosystem and foster collaboration amongst Indian and global R&D centres, PSUs, foreign and domestic OEMs, IT companies, manufacturers, start-ups, academia, MSMEs, and local industry associations. Partnerships envisaged could extend to mentorship, technology transfer, market entry strategies, research, manufacturing, and material development as may be required by the market in collaboration with the state and central governments.

Familiarization Sessions on Financing and Insurance

SpaceTech activity in the country has been largely driven through the governmental agencies, and there has been minimal connect between the spacetech industry and the Indian banking, finance and insurance sectors. SpaceTech activity especially the development of satellites and rockets is highly capital-intensive, and the risk profile of the business is distinctly different from conventional industries. Hence, there is a need to organize workshops, seminars, and interaction sessions between the industries in the spacetech sector and BFSI entities to highlight the financing options available.

Skill Development and Training

Qualified and competent workforce is essential for success in the SpaceTech sector, and there is an urgent need for promoting skill development and building the required skillsets. Universities and Institutes of Higher Learning in the country should engage with the spacetech industry and roll-out specialized graduate and post-graduate courses to address the industry needs for qualified engineers and researchers.

It is also essential to develop faculty development programmes in institutions to progress specialized study and research in aerospace technologies; and training programmes for school and college-level teachers. Upskilling programmes for facilitating lateral entry of working professionals should also be given adequate attention to address short-term needs.

To address the need for skilled labour force at the bottom of the pyramid, there is a need to conceptualize and roll-out courses for roles in manufacturing, assembly, integration, and testing.

ITCA's SpaceTech Ecosystem

ITCA's SpaceTech leadership has built actionable partnerships and alliances with leading institutions, industries, and space research facilities in India and abroad to have continuous access to the global, best-in-class research, manufacturing, and testing facilitiesto deliver consistently on challenging small satellite projects and programs for constellations

Project Monitoring Committee
of 75 Students' Satellites Mission 2022

Dr. K. Sivan, Chairman, ISRO and Secretary, Department of Space (DOS), Government of India has constituted Project Monitoring Committee (PMC) of 75 Students' Satellites Mission 2022 to launch 75 Students' Built Satellites to Low Earth Orbit successfully during August 2022. As envisaged and announced by our Honourable Prime Minister of India, Shri Narendra Modi Ji in the United Nations General Assembly during Sept 2021.

PMC has been headed by Dr. Prakasha Rao, Outstanding Scientist and Director, Space Infrastructure Programme Office, ISRO-HQ and have representatives from Launch Vehicles, both Project Directors of PSLV and SSLV from VSSC, Director (Technology & Strategy) from NSIL, Chairman (Standing Review Committee), URSC, Director, STOP and Assistant Scientific Secretary, OSS, IN-SPACe-ISRO-HQ. Also nominated Representatives from Industry, Academia, ITCA-TSC UNITYSat Students' Start-up Teams and Eminent Scientists of ISRO as Mentors. The PMC has been scheduled to meet periodically once in 15 days and monitor the progress and do the needful for meeting the timelines and milestones as planned.

It has also been planned to update to PMO periodically once in a month by ISRO-HQ on the progress of design and development of 75 Students' Satellites and launch successfully to "Celebrate India's Freedom 75 Years" during 2022.

Indian Technology Congress Association (ITCA) has initiated "75 Students' Satellites: Mission 2022" during Indian Technology held in 2018 at Bangalore and has identified Interested Engineering Educational Institutions (EEIs) across India and have arranged various Space-Tech Leadership Programmes in Israel during 2018-19. Also has signed an MoU with University Space Engineering Consortium (UNISEC) India, Committee for Space Programme Development (CSPD), Serbia for networking with Satellite Ground Stations (SATNOGs) and evolved UNITYSat with open collaboration philosophies across institutions. ITCA has also established World CanSat/Rocketry Consortium/Championship with likeminded Space Organisations, such as CSPD. Serbia, TMISAT, Israel and has sponsored passionate students' teams to get trained at Samara University, Russia, Japan, ISU, France, Italy and Israel during last 3 years.

75 Satellites-PMC-ISRO-HQ Review held on 07 Jan 2022

75 Satellites-PMC-ISRO-HQ Review held on 21 January, 2022 14:00 hrs

Dr. Prakasha Rao P.J.V.K.S, Outstanding Scientist, Director, Space Infrastructure Programme Office, ISRO-HQ, and Chairman, Project Monitoring Committee (PMC)

Mr. S.R. Biju, Project Director, PSLV, VSSC

Mr. S.S. Vinod, Project Director, SSLV, VSSC

Mr. A. Arunachalam, Director (Technology & Strategy), New Space India Ltd (NSIL)

Dr. Aloke Srivastava, Chairman, SRC, URSC

Mr. Anurup M.S., Director, STPO

Ms. Sreerekha U, Asst. Scientific Secretary

Office of Scientific Secretary, IN-SPACe-ISRO-HQ

Mr. B.N. Sharma, Co-opted Member from SAC, Ahmedabad

Dr. GNV Prasad, Former Deputy Director, ISRO Satellite Centre, URSC/ISRO, Space Industry Representative

Dr. Priestly Shan, Dean (Academics), Chandigarh University, Academic Representative

Dr. K. Gopalakrishnan, Secretary General, Indian Technology Congress Association (ITCA), Member Secretary, PMC and Project Director, 75 Students' Satellites Mission 2022

Mr. Nikhil Riyaz, Technical Team, Representative from UNITYSat Students' Team Startup "TSC Technologies P Ltd" and ITCA

Mr. Jegan Mani, Technical Team, Representative from UNITYSat Students' Team Startup "TSC Technologies P Ltd" and ITCA

Invitees: **Mr. Denzel George, Mr. Ashwin Reddy, Mr. Sainath, Mr. Sanketh, Ms. Bhavana,** Technical Team, Representative from UNITYSat Students' Team Startup "TSC Technologies P Ltd" and ITCA

Mr. Gautam, Launch Services, New Space India Ltd (NSIL)

Padma Shri. Prof. R.M. Vasagam, Eminent Scientist, ISRO, Special Invitee

Padma Shri. Dr. Mylswamy Annadurai, Outstanding Scientist, ISRO, Special Invitee

Information to:

Dr. K Sivan, Chairman-ISRO, Secretary-Department of Space (DOS), ISRO

Shri. R. Umamaheswaran, Distinguished Scientist & Scientific Secretary, ISRO-HQ

Dr. Pawan Kumar Goenka, Chairperson, IN-SPACe

Shri. D. Radhakrishnan, CMD, NSIL

Shri. M. Sankaran, Distinguished Scientist and Director, URSC, ISRO

Dr. L.V. Muralikrishna Reddy, President, ITCA

And ISRO Council Members

On the Cusp of NewSpace Economy

Unveiling the New LEO Economy and its future business opportunities...

Space economy can be considered as the entire range of activities and the utilization of resources to create value for citizens through the lifecycle of exploring, researching, managing, and utilizing space. It encompasses the space industry's core activities in satellite operations and space manufacturing that have been performed by both the private and public sectors to develop and use space-derived products and services.

Industry analyst reports (Ref: Space Report 2021 Q2) point out that the global space economy was valued at about $447 billion in 2020, 55% higher than a decade ago, and is forecast to become a trillion-dollar industry by 2040. This phenomenal growth has become possible because the new space economy is finally connecting to the larger economy. Most of the revenue earned in the space sector has been from the space-for-earth economy. On the other hand, the space-for-space economy-that is, products and services produced in space for use in space, such as mining asteroids or the Moon for minerals are yet to gain significant and meaningful traction.

Commercial space infrastructure and support industries include satellite manufacturing, launch services, ground stations, and related equipment; while commercial space products and services encompass satellite broadcasting, communication, Earth observation, geo-location, and global navigation equipment and services. Businesses in various industry sectors/verticals are presently leveraging satellite technology and affordable access to space to drive innovation and enhance efficiency in their earthbound products & services.

There is the Space Economy Initiative, a recently launched (and the first of its kind effort) under the UN Office of Outer Space Affairs (UNOOSA) to build a global space ecosystem by bringing together emerging and non-space faring countries together to strengthen their space economies.

Integrating affordable access to space and engineering innovation would help create a robust low-Earth orbit (LEO) economy for the next generation.

Contemporary advancements in manufacturing spurred by the ongoing research in space manufacturing would leverage the microgravity environment to produce advanced materials. Space manufacturing brings in new processes and technologies beyond additive manufacturing resulting in the production of high-value materials. Space manufacturing is a new area where high-value products are produced in space for customers on Earth. Space manufacturing will be a driver of LEO commercialization for the space-Earth value chain that promotes space exploration, delivers a competitive advantage for customers, and opens new markets.

Photo credit: NASA

Japan Aerospace Exploration Agency (JAXA) astronaut Norishige Kanai with the Made In Space Fiber Optics miniature pulling machine (MIS Fiber) and the Additive Manufacturing Machine (AMF) onboard the ISS. MIS Fiber manufactures ZBLAN fiber in microgravity.

Space-enabled manufacturing leverages microgravity and its effects on materials and manufacturing processes. It is based on the premise that materials would behave differently in microgravity than they do on Earth. Space-enabled materials are realized through a unique microgravity environment that has the ability to modify materials at their atomic level to create a superior product in space compared to the terrestrial twin (analog) of that material. Manufacturing space-enabled materials would create a demand for products that can be made in space, creating the need for space infrastructure to produce these materials. Space-enabled manufacturing results in the growth and expansion of new markets and increased demand for terrestrial partners.

Redwire, an early-mover in space-based manufacturing has developed three new advanced manufacturing facilities for the International Space Station. Each of these facilities focuses on a specific manufacturing process, including ceramic manufacturing, superalloys, and crystal manufacturing. These new capabilities are expected to deliver new-generation, superior products addressing terrestrial markets with robust and expanding revenue forecasts.

Space-based manufacturing is an innovative approach in how space is utilized, creating an opportunity to scale up LEO manufacturing processes to support the Earth-based supply chain. A growing LEO economy will push affordable access to space, increased innovation, growth, and expansion of new markets, and result in overall demand for commercial space infrastructure

Investment Opportunities
Emanating from NewSpace

With increased backing from government entities and the business sector, the New Space industry has garnered several billion dollars in investment so far, and this sum is likely to grow in coming years. Over the next several decades, the myriad of technical improvements that have occurred on Earth—miniaturization of components, lower-cost computing power, amongst others are gradually finding their way into mainstream space, enabling the development of new applications, and structuring new business models.

The global space industry is currently valued at around $447 billion USD in 2020. In this multibillion-dollar sector, the United States, Russia, and a few European countries are the most significant stakeholders. Due to the inherent risks associated with investing in such a cutting-edge business, investments in space have historically been closely reviewed. By leveraging technological advancements, the New Space industry and its associated companies hope to lower the cost of access to space, allowing for lower-risk, more agile business models that will facilitate iterative improvements and, ultimately, create a more prosperous space economy for all to benefit from.

The New Space paradigm developed in the United States is the most successful example of close collaboration between the government and the private sector. Over the past two decades, the United States government has offered significant assistance to start-up space enterprises, the most known of which is SpaceX, which has received many NASA launches as a result of the government's support. After multiple SpaceX failures, the American government lent its support to the corporation in order for it to expand its wings and explore new space options.

This type of collaboration between the public and commercial sectors will continue to be beneficial to the development of New Space enterprises in the future. California's Silicon Valley has been a major source of inspiration for the New Space movement. Many successful American New Space companies, such as Planet, Orbital Insight, and Spire, have received investments from well-known venture capital firms such as Sequoia, RRE Ventures, and Khosla Ventures, among others. These companies have lifted the bar in terms of research and development of inexpensive space solutions, as well as contributing to the growth of the American New Space ecosystem.

According to a recent report published in early January 2022 by New York-based firm Space Capital, private investment in space companies reached a record level last year. In 2021, space infrastructure businesses received $14.5 billion in private investment, a new yearly record and an increase of more than 50% over 2020 levels. This includes a record-breaking fourth quarter in which Sierra Space, Elon Musk's SpaceX, and Planet Labs raised $4.3 billion through "mega-rounds" of $250 million or more. Space Capital's quarterly report categorises industry investment into three technology categories: infrastructure, distribution, and application. Infrastructure includes what are often referred to as space companies, such as rocket and satellite manufacturers.

The recent surge in public interest in the space industry, fuelled by highly publicised successes by private and public players, has heightened the sector's attractiveness even more: investors are tempted to invest in the nascent and uncertain Special-Purpose Acquisition Companies (SPACs) in the hope of securing an early ticket to the next (publicly traded) SpaceX success storey. SPACs had a banner year in 2021, with two firms going public via this route: Rocket Lab ($RL) and Planet Labs ($PL). It's critical to remember that the financial markets have been flush with cash during the pandemic, resulting in some inflated values for public equities and growth capital for high-performing privately owned enterprises.

With the projected launch of SpaceX's Starship in 2022, the NewSpace sector has entered a new phase of infrastructure development. Elon Musk has stated that orbital rocketry's "holy grail" is "complete and quick reusability." Starship is on the verge of becoming the grail; nothing like it has ever existed. Starship's ability to launch 1,100 cubic metres and 100 tonnes into orbit for the cost of fuel will fundamentally alter how organisations operate in space. With the Falcon 9, SpaceX dramatically altered the economics of space ten years ago, and Starship will have a similar effect, significantly reducing the cost of orbit, allowing Emerging Industries, and rendering existing infrastructure obsolete. This is a chance for space visionaries to foresee the future and bring that vision to fruition.

Space-based technologies have evolved into global innovation platforms that generate exponential value by building technological and application layers on top of space-based infrastructure to distribute data to individuals, businesses, and governments for widespread adoption. As an early adopter, the Indian Technology Congress Association (ITCA) recognised the economic value that space can generate and partnered with SYMBA-MAZ (an Israeli investment fund with global operations and presence) to provide affordable financing options for private entities in India to structure and accelerate space-related start-ups

BUILD FUTURE SATs BY GREAT MINDS

TMISAT is an Israeli New Space company founded by committed professionals and entrepreneurs interested in exploring business prospects in the space sector.TMISAT has the distinct advantage of being present in all aspects, including designing and developing SATs for the ITCA's ambitious 75 Student Satellites Mission.

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Satellites for Everyone
and Space for Everyone

Report on 9th Indian Technology Congress 2021

ITC-2021 is a flagship event of the Indian Technology Congress Association (ITCA), a dedicated association for technologists focused on facilitating collaboration between professionals from the industry, R&D laboratories, government, academic institutions and professional bodies. Over the years, ITC has emerged as a leading global forum for the confluence of thought leaders in technology, sciences and businesses working on deploying technology-intensive solutions for contemporary challenges. ITC-2021 has been organized by Foundation for Education Excellence, UNISEC-India, with participation by The Institution of Engineers India, World Federation of Engineering Organizations, the Institute of Electrical and Electronics Engineers (IEEE), American Society of Mechanical Engineers, World Academy of Engineers, Indian Institution of Production Engineers, FKCCI, AIMO, and other professional bodies.

The 9th edition of Indian Technology Congress, ITC-2021 was unique in that it facilitated exploring space technologies for sustainable development, sustainable design paradigms for student-built satellites and nanosatellites. Space Technology Gurus, Subject Matter Experts and 'Techpreneurs' shared their vision on contemporary technologies and how these are likely to influence our way of life.

The special focus on this year's congress was on "Satellites for Everyone and Space for Everyone and was organized in collaboration with Chandigarh Universityas an India – International Online event.ITC-2021 had over 25 Speakers and Thought Leaders sharing their expertise over two days with about 3000 Delegates joining the online video conference from the Industry, Academia, Research Organizations and Entrepreneurs. We also have more than 15000 student registrations across 75 nations participating on social media platforms. The 9th edition of ITC also has the global launch of the World-UNITYSat Programme celebrating the 75th year of India's independence and its march to becoming a technological superpower, and this takes the ITC platform to the global arena.

The previous editions of ITC and Team Tech (the earlier version of ITC) since 2004 have attracted over 13900 delegates, 1410 research paper presentations, 80 parallel sessions / workshops, 480+ exhibitors showcasing their products, 1936 speakers, 116 Best Paper Awards and 68 Technology Awards being presented to renowned technical experts from engineering and technology.

More than 20 eminent speakers from National & International space agencies and organizations across the globe including the United Kingdom, Japan, the United States of America, Germany, Italy, Israel, Portugal, France, Canada, Netherlands, Serbia, and Peru participated during the 2-day technology congress. Indian Technology Congress is the country's largest conference in the field of satellite and space. More than 15,000 students and professionals from educational institutions, space agencies and manufacturing institutes from across the country and abroad participated in the virtual event.

The emphasis of all ITCA initiatives, including this edition of the Indian Technology Congress, highlighted and encouraged interdisciplinary engineering and associated specialties to develop new products, solutions, and services for societal requirements.

ITC-2021 had active participation by representatives from the Skolkovo Institute of Science and Technology, Russia, UNISEC-India, TMISAT, Israel, SYMBA-MAZ Business Consortium, Israel, BRICS Federation of Engineering Organizations (BRICS-FEO), World CanSat/Rocketry Championship

(WCRC), Committee for Space Programme Development (CSPD), Serbia, Valles Marineris International, and many others.

Day - 1, Friday, 24 September 2021
Conference Inauguration

The Inaugural session had the participation of the representative of Ms. Orit Farkash-Hacohen, Minister for Science and Technology, Israel, as the Chief Guest. Dignitaries at the Inaugural Programme included Alejandro J. Roman Molinas, General Director of Space Development, Paraguayan Space Agency, Paraguay; Prof Dr R S Bawa, Pro-Chancellor, Chandigarh University; Dr H B Raghavendra, Vice Chancellor, Chandigarh University; Prof R M Vasagam, Padma Shri Recipient, Chairman, National Advisory Committee, ITC 2021; Dr. L.V. Muralikrishna Reddy, Chairman, Indian Technology Congress; Dr. Wooday P Krishna, National President, Indian Institution of Production Engineers; and Dr. K Gopalakrishnan, Council Member, The Institution of Engineers (India).

Dr. L.V. Muralikrishna Reddy stated in his Welcome Address that the Indian Technology Congress is appreciative for the assistance and patronage received from the Karnataka Government since its foundation. He went on to say that the focus is on developing and publicizing research techniques in Space and Satellite technology.

Dr. Wooday PKrishna emphasized the relevance of this initiative for achieving the Sustainable Development Goals of the United Nations by deliberating on the role of nanosatellites in addressing critical societal concerns such as climate change. He pointed out that as per the United Nations, satellites have unique potential for observing systematically and globally 31 of the 50 Essential Climate Variables (ECVs) identified by the Global Climate Observing System.

Prof. H. B. Raghavendra, Vice Chancellor, Chandigarh University elaborated on the theme of the event where he elucidated on the needs and challenges in using space and science technology for the benefit of mankind.

Addressing the delegates, Alejandro J. Roman Molinas said, "The whole world has realized the need to collect data through space technology for the challenges like corona pandemic crisis and climate change." "Space technology is playing an important role in our daily life. There is an utmost need to set up infrastructure and invest in the field of space and technology," added Alejandro.

Prof R.S. Bawa, Pro Chancellor, Chandigarh University was the guest of honor, and he discussed the theme which is based on the philosophy of our Honorable Prime Minister Sh. Narendra Modi Ji and stated that this event was going to provide a hands-on experience on space and satellite technologies to aspiring faculty members and students.

Padma Shree Awardee Prof. R M Vasagam, Chairman, National Advisory Committee, ITC2021 talked about, "The launch of Sputnik-1 in 1957 started a new Space Age in the space sector, which ushered a new political, security, technological and scientific development. Prior to this, there were no man-made satellites in space, but since its inception, thousands of satellites have been active in space orbit and student-made satellites are also playing an important role." R.M Vasagam further said, "IoT based technologies are one of the emerging tools for the data collection globally, while nano satellites act as a guide in data collection." "The cloud-based storage and cloud computing are important technologies for smooth functioning of ground stations. Massive advancement in the field of space & technology have proven to be instrumental in making things affordable, dynamic, and quality-oriented".

ITC-2021 Lifetime Achievement and Technology Excellence Awards were presented to individuals and organizations who have contributed in the field of space, satellite, technology, research, innovation, manufacturing, automobile, and health. The Lifetime Achievement Award was given to Dr. V. Abhaikumar, CEO, TCE-TBI, Thiagarajar College of Engineering, Madurai; O.P. Khanna, Chairman, Needy Heart Foundation; Dr. S.K. Prasad, Professor of Management, REVA University. Apart from this, Prof. Alejandro J. Roman Molinas, General Director of Space Development, Paraguayan Space Agency, Paraguay; Dr Guido Parissenti, GP Advanced Projects SRL, Italy; Dr Jayakumar Venkatesan, CEO, Valles Marineris International and Visionary, Up great Technology Contests (RVC, Skolkova Foundation, ASI) Russia, New Tech Solutions Bangalore, Nagarjuna College of Engineering and Technology,Devanahalli, Bangalore, Mangalam College of Engineering,

Kottayam, Kerala conferred with 'Technology Excellence Award'.

World UNITYSat Programme was launched during the Inaugural Function.TIP-Technology, Innovation and Productization magazinehas content curated by eminent professionals on the theme"Satellites for Every One, Space for Every One".

During the event, Chandigarh University launched the CU-UNITYSat program, in which students and scientist from 75 countries would be participating. The program will introduce cutting-edge space & satellite applications and solutions, ushering in a 'new space age' for space development. DAA, Chandigarh University, Dr. B. Priestly Shan said, "The CU-UNITYSat program aims to impart knowledge on satellite and space technology and build a ground station and technology centre for the development of student satellites.". The program creates a sense of opportunity, inspiration and success in countries that are not able to be a part of the space program and launch a satellite into space. International Technology Congress Association announced the hosting of 10th edition of Indian Technology Congress at Chandigarh University in 2020 with theme 'Pathways for Intelligent, Digitized and Sustainable Execution of Mega Projects'.

Dr. K. Gopalakrishnan, Council Member, The Institution of Engineers (India), proposed the Vote of Thanks to all the Dignitaries, Speakers, Delegates and Supporters.

Plenary Session

While talking about the role of satellites, Padma Shree Awardee Dr. YS Rajan said, "In the present era there is a need to develop new technology in the field of space and satellite keeping in view the increasing needs of the people." Describing the UNITYSat program as historic, he also said, "The Indian Technology Congress program has proved to be a forum for network building and collaboration, where various academic institutions and national and international space agencies have exchanged ideas in the field of space and satellite."

Padma Shree Awardee Dr. Mylswamy Annadurai, said, the idea of a satellite and space for everyone is fantastic and exciting. Satellites have delivered a lot of benefits for society, and now policy initiatives are being taken to open up the space sector for participation by all.

Session 3

Dr. Margarita Safonova, Visiting Professor, Indian Institute of Astrophysics, Bangalore, spoke on the existence of microscopic organisms in space and their various actions for the benefit of atmosphere.

Brig Gen (res) Prof Chaim Eshed, Co-Founder of the Israel Space Agency in Israel, spoke on the future of space and science technology in a variety of sectors during his presentation. He also stated that Israel and India have a long and excellent relationship in the fields of science and technology, engineering, and education in space, with India emerging as one of the world's top four space powers today. In the context of our collaboration with India on the 75 Students' Satellites Mission in 2022, there is no doubt that keeping in mind the spirit of Dr. Vikram Sarabhai and Dr. APJ Abdul Kalam, this innovative mission will bring in transformation in the field of education.

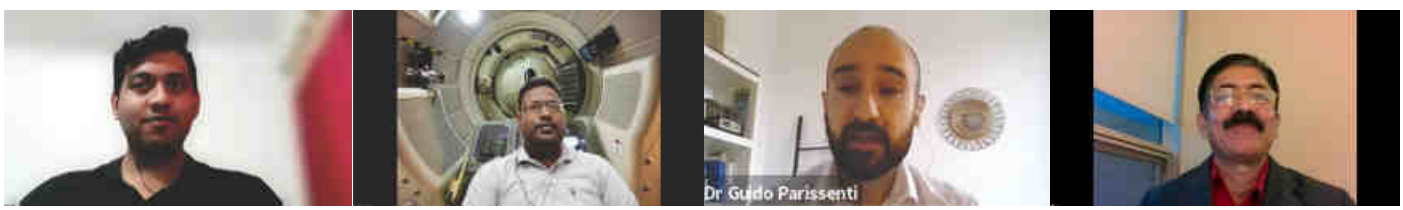
In his presentation, Dr. Meir Ariel, Director General of the Herzliya Science Center and Director of the Tel Aviv University Nano-Satellite Center, emphasized the utilization of space science as a multidisciplinary field, as well as the fundamental aspects that contribute to the success of nanosatellite missions. He also stated that Israel is open to establishing fruitful and productive collaboration and cooperation between Israeli and Indian universities; that the global space sector has been able to operate independently of governments.

He referred to nanosatellites as symbols of the New Space era, and remarked that Israeli Partnership can deliver on several transformative aspects: delivering reliable and space proven hardware; tools for promoting education, science, and technology; comprehensive, curated training programmes to assist in the development of competencies in space and satellite technologies; launching and progressing student-centric satellite development programmes in educational institutions, which includes education and training, twinning courses with the University of Tel Aviv, the establishment of dedicated infrastructure and equipment for satellite development; and student-built satellite development programmes for commercial applications.

Session 4

Dušan Radosavljevi, Founder and Head, Committee for Space Programme Development (CSPD), Serbia Founder, World CanSat/Rocketry Championship, Advisor, TSC Technologies Private Ltd discussed the design aspects to be considered while designing a nanosatellite.

Mr. Jorge Monteiro, CEO, Spaceway, National Point of Contact in Portugal for SGAC (Space Generation Advisory Council) Research Fellow, C-MAST (Centre for Mechanical and Aerospace Science and Technologies) at University of Beira Interior, presented his views on "CubeSat missions in Portugal - An overview from SpaceLAB at University of Beira Interior".



Day - 2, Saturday, 25 September 2021

Session 5

Mr. Shaun Whitehead, Founder, Creationeer/Scoutek Ltd, London, UK stated that he is particularly interested in encouraging the younger generation to pursue careers in space engineering. The average age of the Apollo flight controllers was 26 years old when they were sent to the moon for space training. The average age of NASA engineers has now risen to 49 years. When there was a younger population working on the project, there were some fascinating things that happened. ITCA's student space programme has reawakened his interest again.

Er. Nikhil Riyaz ,Founder TSC Technologies, talked on "UNITYSat - Indigenous Design and Development of Nanosatellites".

According to Ms. Rei Kawashima, Secretary General of the University Space Engineering Consortium (UNISEC) Global, Japan, primary goal is "to contribute to the creation of a world in which space science and technology is used by individuals and institutions in every country, rich or poor, for peaceful purposes and for the benefit of humanity." Its objective is that by the end of 2030, we will have created a world in which university students can participate in practical space initiatives in all countries and regions of the planet. Furthermore, she asserted that differences between space-faring countries and non-space-faring countries can be narrowed very readily in the sphere of education and research. She reiterated UNISEC's commitment to create an environment in which university students can teach younger generations and the general public.

Session 6

Dr Jayakumar Venkatesan, CEO, Valles Marineris International and Visionary, Upgreat Technology Contests (RVC, Skolkova Foundation, ASI) Russia, gave a technical presentation on the theme. He also revealed how his firm, Valles Marineris International, partnered with a Russian company that is developing Soyuz manned spacecraft training simulators for professional cosmonaut training. Valles Mariner is prepared to provide crew training for professional cosmonauts as well as amateur learning experiences using manned spacecraft training simulators on an international scale. Additionally, we have Soyuz Spacecraft Simulators for youngsters ages 8 and up. This can provide educational opportunities for children. It will be a platform for educational entertainment. Additionally, he reiterated the organization's commitment to offer an augmented reality/virtual reality spacewalk experience, which allows learners to feel the sensation of spaceflight and visualize the space environment.

Dr. Guido Parissenti, Aerospace Professional, Co-Founder and CEO, GP Advanced Projects and Drone design, Italy, stated that, Cube-Sat experimental projects demonstration-by their Flexible Experimental Embedded Satellite (FEES), this standard demonstration is used to validate electronic components in-orbit, the demonstrations done so far by them has resulted in validating 300 grams 100x100x30 mm, launched during 22 March 2021, and another radio amateur project transmitting Lo-band signals.

Session 7

Dr R Venkatesan, Scientist G, Aerospace Group-Ocean Observation Systems, National Institute of Ocean Technology, Ministry of Earth Sciences, Government of India stated that few nations have the human capacity to deal with marine zones, of which there are six separate zones. Internal waters, territorial sea, contiguous zone, executive economic zone, continental shelf and high seas, and deep ocean floor have all had an impact on study for the fundamental necessity of marine sciences for rational administration of ocean space and resources.

Satellite designing and related technology were described in detail by Mr. R.K. Rajangam, Former Outstanding Scientist at ISRO Satellite Centre (ISAC), President of Planet Aerospace, and Mentor of IIT Madras/MSRIT StudentsSats. The success of student-centric satellite projects is dependent on the effectiveness of mission management. The constellation method of small satellite development is the emerging paradigm in tiny satellite development

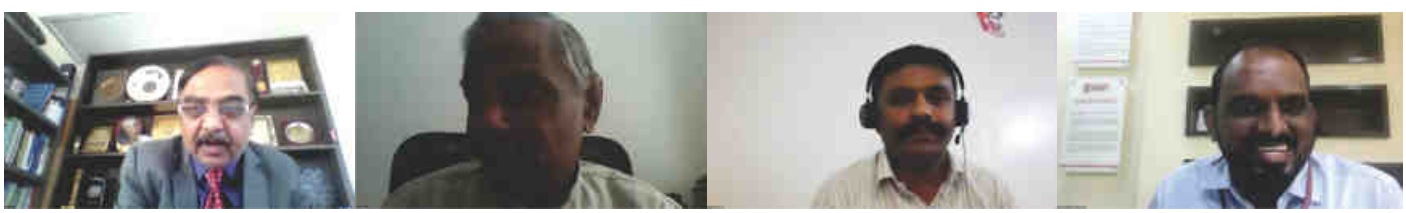
Dr. Javeed Ahmed Khan, Professor Engineering and Environmental Technologies at Georgian College in Canada, discussed the use of remote sensing technology to satellite design. He also discussed the solar satellite power system concept (SSPS). Satellites in geosynchronous orbit convert solar radiation to microwaves or lasers, or simply concentrate and beam solar rays to receiving stations on Earth. Microwaves, lasers, and focused sun rays are all sources of energy that can be turned to electrical power. The conversion is in the terawatt (TW) range. Because space has no demarcation of day and night, solar energy is available at all times. The storage idea is abolished, resulting in a decrease in investment. Continuous power in the TW range.

Valedictory Session

Valedictory address by Dr. S.K. Prasad, Professor of Management, REVA University, Founder Fellow, ITCA.

Valedictory Report by Prof B Priestly Shan, Dean Academic Affairs, Chandigarh University

Vote of thanks by Ms. Shefali Verma. Associate Director- Academic Planning and Monitoring, Chandigarh University



Future Space Technologies
and Experiments in Space

Dr. Igor V. Belokonov
Head of Department of Space Research
Professor of Dynamics Flight and Control
Systems of Samara State Aerospace University,
Vice-President and Executive Director
Volga Branch of Russian Academy of Cosmonautics
and General Director of Samara Scientific
Center of Space Technologies

The school will be held in Samara University (Kuibyshev, 1935-1991) which is one of the most significant scientific, industrial and cultural centres of Russia. Samara is situated on the left bank of the Volga River closed to the Zhiguly mountains. There are a lot of theatres, museums and very nice places for rest. The Workshop possibly might be held on board of the river ship, travelling from Samara to Volgograd (Stalingrad) and back.

Samara lies at the junction of main highways, airlines, rail and water ways.The overall aims of the school are to involve young people from multidisciplinary backgrounds into the development of micro/nanosatellites and implementation of experiments in space, to provide new fundamental knowledge and skills in applied technologies.

Attending the School participants have an opportunity to share their challenging ideas of new space missions with many new friends from Russia and other countries and establish interuniversity cooperation. Discussing the results of realized space projects, visiting lectures and seminars given by leading scientists and experts in the field of space technologies and space experiments. According to the concept of competitive activity participants included in one of the teams working on nanosatellite projects with regard to their interests and background. The final event of the school program is the public discussion of the projects designed by each team with their colleagues and invited experts.

The school consists of two stages: the distant education stage and the full-time education stage. Key dates are shown in the calendar of events. Final year bachelors, master students, PhD students and young professionals are invited for participation.

In the first week, participants will have lectures on the basics of nanosatellite technologies (design and construction of nanosatellites, features of the dynamics of motion, navigation, control, etc.). Training will be held on the use of MATLAB software for nanosatellite mission analysis and other simulations. In the second week, several lectures on advanced space technologies will be given. Besides, all participants will be divided in four teams. For each team will be offered nanosatellite mission for studying. Main goals of these missions will be announced at the beginning of the full-time stage. School participants can also propose their own missions. Each team will perform mission analysis, prepare a presentation and defend the results of their work in front of the experts. At the end of the school, all the participants will receive certificates confirming successful completion of 5 ECTS training in the Advanced Space Technology and Space Experiments program(ECTS - European Credit Transfer and Accumulation System).

Main goals and topics of the school program:

- Establishing cooperation between universities in the field of space technologies and experiments in space.
- Projects of scientific-educational nanosatellites.
- Advanced technologies (methods

and devices) for research of space environment and remote sensing.

- Attitude control technologies for nanosatellites.
- Advanced space navigation technologies/Space Physics.
- Design principles of onboard electronic systems (sensors, onboard computers, communication systems, power supply systems) for nanosatellites.
- Relative motion in space (formation flight).
- Piggyback launch of nanosatellites.
- State-of-art technologies used in the design of nanosatellite's (Solid Works / Altium Designer).

Every year Samara National Research University (Russian Federation) organizes the International Summer Space School "Future Space Technologies and Experiments in Space".

The overall aim of the School is involving young people into the development of micro/nanosatellites and implementation of experiments in space, to provide new fundamental knowledge and skills in applied technologies.

All participants are involved in practical work with real onboard nanosatellite systems and test equipment. According to the concept of competitive activity participants included in one of teams working on nanosatellite projects with regard to their interests and background. The final event of the school program is the public discussion of the projects designed by each team with their colleagues and invited experts.

International Space School

International Space School has been organized by Samara University in collaboration with the United Nations Office for Outer Space Affairs, International Astronautical Federation, Paris, and UNISEC-Samara Chapter.

ITCA has sponsored Student's Team to Samara Summer School, Russia every year, since 2019.

World's First Satellite "Sputnik" was built and launched by Samara University Lab Only! Also, the World's First Astronaut/ Cosmonauts have been sent to Space and brought back them alive by Samara Lab only! during the then USSR (Russia)!

It is always a pride for students to get selected for International Summer Space School at Samara, Russia!

ITCA has encouraged and facilitated Students from INDIA to participate in Samara Summer Schools

The next **17th School** will start with distant (online) education stage (April 4 – April 18, 2022). During this stage 40 people will be selected for the full-time (in Samara) education stage (June 20 – July 2, 2022). After the full-time (in Samara) education stage participants will be awarded a certificate with 5 ECTS. **Deadline for applications is April 3, 2022.** For more information and application, **please, visit https://volgaspace.org/school 2022**

SamSat-ION
Project for Ionosphere Research

Primary Mission

- Research of the Earth's upper Ionosphere by contact method
- Research of NanoSatellite motion dynamics

Secondary Mission

- Development of technology for high-precision time-coordinate referencing of scientific data
- Verification of on-board data processing algorithms
- Verification of orientation and stabilization algorithms
- Popularization of university astronautics among applicants and students of aerospace universities
- Development of advanced education program «Project-based aerospace education»

The basic design of SamSat-ION is determined by the requirements of the CubeSat standard for the mounting holes of the electronics boards, the dimensions of the placement area inside the deployer, and the design requirements for the transceiver antennas.

On the lateral faces of the satellite, there are solar panels mounted on aluminum plates. A set of aluminum plates and radiation-resistant glass, which covers the photovoltaic converters. This solution provides a sufficient degree of shielding of the onboard electronics from high-energy particles during orbital flight. Transceiver antennas are fixed on the end faces of NanoSatellite frame. Antenna locking devices are integrated

SamSat-ION satellite

Inside the SamSat-ION there is a subsystems stack. The mechanical connection of the stack to the board is realized using three intermediate frames and four threaded rods. The electrical communication inside the stack and the data bus are implemented using the PC104 interface and a set of wires. The satellite is equipped with a navigation receiver, which provides high-precision time-coordinate referencing of scientific and telemetry information.

SamSat-ION scientific equipment consists of plasma parameter sensor

Plasma Parameter Sensor

(PPS) and deployable magnetometer. PPS is used for measuring the electronic component of the plasma concentration along the trajectory of the satellite and concentration

The radio telemetry link operates in half-duplex mode at a frequency of 433 MHz. It is equipped with a turnstile antenna and allows to transmit data at a rate of up to 9600 bit/s.

Many students, graduate students and young scientists of Samara University have been involved in the creation of SamSat-ION. This will help them gain valuable hands-on experience to be successful in the aerospace industry.

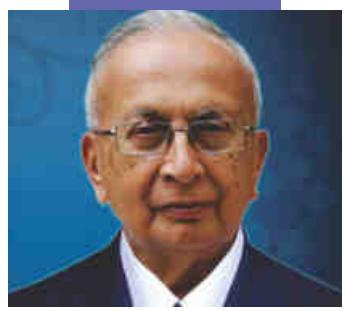
The launch of the NanoSatellite is scheduled for the second half of 2022. The entire development team hopes that the created NanoSatellite will allow obtaining qualitatively new data on wave processes in the earth's upper ionosphere. Moreover, the NanoSatellite platform, on which SamSat-ION was built, will make it possible to create families of nanosatellites for studying geophysical fields.

http://spaceresearch.ssau.ru/en

Invited Article

Experience gained through Student-Built Satellites

A Transformational Educational Paradigm



Dr. Ing. B V A Rao, FNAE, FIE
Prof. (Retd.) IIT Madras,
Founder Fellow, ITCA

The first Indian Satellite Aryabhata designed and built in India in Ahmadabad was launched by a Soviet Rocket in Russia in the year 1975 under the guidance of late Prof. Vikram Sarabhai. Later Vikram Sarabhai Space Centre (VSSC) was created in Trivandrum, Kerala for designing and building Rockets needed for launching Satellites. The first experimental launching of SLV-3 in August 1979 was a failure, but was a success in July 1980. This was under the guidance of late Dr. A P J Abdul Kalam, who became later the President of India. He was a great visionary and planner and utilized the services of many Scientists and Engineers, who were working in the country in many Research laboratories and Higher Institutes of Technology. IIT Madras was one such Institution that helped VSSC in good number of initial Projects that were needed specially for launching of SLV-3. This was during 1970 to 1980 where I was serving as a Professor and heading the Machine Dynamics Laboratory. Following Projects were carried out by my group under my guidance, which were all successful in finally launching SLV-3 in 1980 from Sriharikota. This SLV-3 was the first experimental Satellite Launch Vehicle, which was an all solid four stage Vehicle weighing 17 Tonnes with a height of 22 meters and capable of placing 40 Kg class payloads in Low Earth Orbit (LEO). This is to show that the entire design and development of Rockets and Satellites have taken place indigenously and the Academicians in the Engineering field in Higher Institution of Technology played a great role with the support and guidance of ISRO Scientists with coming out from the initial teething troubles in this gigantic venture. ISRO showed their capacity to design, develop and launch many more higher range Satellites such as Ariane-5, PSLV-C48 (RISAT), PSLV-C47, (CARTOSATE—3) GSLV-MK III (Chandrayan-2) etc., It is reported that 342 foreign Satellites of 34 countries have been launched by ISRO.

It is gratifying to note that this major organization ISRO, which is working on its own merit and confidence in this field has extended its support to many educational institutions to train students for the future.

Over the last two decades, a new class of satellites, often referred to as CubeSats, with masses ranging from 1 to 12 kg has flourished in the academic sector, establishing itself as a feasible alternative for college and university students to receive hands-on technical training. Globally, institutions created CubeSats ranging in size from 1U to 3U, while larger satellites ranging in size from 3U to 12U were utilised for technology demonstrations with applications in pollution monitoring, weather prediction, and ocean monitoring, among other things.

The combination of low launch costs, the use of commercially available components and subsystems, and universities' capacity to afford the creation and launch of satellites has resulted in the spread of student-built satellite programmes worldwide. This widespread adoption of hands-on learning methodologies corresponds to a tendency in STEM subjects toward lecture-based instruction to boost learning objectives. Pursuing student-built satellite programmes has also been successful in strengthening team-based, active-learning strategies by allowing students to collaborate on complex engineering challenges as a multifunctional team.

Interdependent subsystems and systems engineering have historically been one of the most difficult concepts to teach in aerospace engineering. While there are several theoretical textbooks, new engineers must actively participate in system development to grasp how their work fits into the wider system. CubeSats are a great learning platform since they have a shorter development lifecycle, a smaller set of requirements, and a shorter mission life overall. Small satellite development programmes present huge prospects for space technology and space scientific capacity growth.

Coordinated and guided by the faculty of the institution, the student teams will be guided and mentored by space specialists throughout all phases of the student-built satellite development programme, with the goal of ensuring that the satellite undergoes accurate verification and validation prior to being cleared for space flight.

As mentioned, I would like to share my experience in dealing with many of the earlier Projects of VSSC Trivandrum in designing and testing their Rockets (especially the SLV-3 designed and launched by none other than our late President Bharata Rathna A P J Abdul Kalam, who was in-charge of this project.), I was closely involved with him in developing many of the earlier requirements needed for Rocket Design and launching. Following Projects were undertaken at IIT Madras, which were all successful:

- The very first Project was Design and Development of a Hydraulic Vibration Machine of 1 Ton capacity to consolidate the solid Propellants used in Rockets. Design and Fabrication was carried out at IIT Madras and erected at VSSC. This project received Imports

Substitution Award by the Govt. of India in 1973.

- The second Project was Design and Development of an Angular Motion Simulator for simulating three Degree motion of Satellites. Towards this a 10" stainless steel ball carrying a platform and raised by pure air jets to provide the needed angular motions to Platform. This project took almost two years with two of their Scientists working with my group at IIT Madras.
- The third Project was conducting an Acoustic Qualification Test on the first SLV-3 Rocket that was designed and built at VSSC by impinging the outside surface of the Rocket to 160-180 dB noise level (very dangerous levels for human exposure!) and to verify the inside levels did not exceed more than 80-90 dB. This requirement was essential to safeguard the payload and sensitive equipment within the Rocket. This was successfully carried out at IIT Madras. This Project was essentially needed by the Satellite Centre, Bangalore.
- The fourth Project was Design and Development of a three dimensional Accelerometer to measure the accelerations in all the three directions of Satellites. This was a major challenge and was successfully carried out by incorporating the Accelerometer in the Sounding Rockets launched at VSSC. This project was carried out at VIT University, Vellore, essentially carried out by undergraduate students.
- Similarly, a Wire-Spool unwinding machine was designed and built for Bharat Dynamics Ltd. Hyderabad for testing the wire guided Missile in the Laboratory, thereby saving the Missiles from direct launching. These Missiles were supposed to hit the target upto 4 Km. This project was carried out in 1978 at IIT Madras, which received an Invention Award by the NRDC Govt. of India.

The above illustrated Projects closely related to the wide field of Rockets, Missiles and Satellites is giving the students an idea about the various initial gadgets needed before the Satellites are launched. All the above mentioned Projects were totally indigenous and carried out by an interdisciplinary group created for the purpose at IIT Madras between the years 1970 and 1980.

By participating in such a real satellite programme, students gain a valuable practical experience working through the entire lifecycle of a real space project, from design to manufacturing, assembly, integration, and testing, as well as preparing project documentation, participating in a launch campaign, operating their own small satellite, and preparing for its disposal in accordance with space debris mitigation requirements.

The student-built satellite programme was consistent with the Government of India's New Education Policy (NEP-2020), as it promoted hands-on, transdisciplinary learning and prepares students to enter the workforce. This fundamental transformation of the educational system, which fostered competitiveness, creative thinking, innovation, and a systems approach, would result in exponential growth for the sector, as each member of the workforce would be a contributing individual.

Today's nanosatellites have transformed space in the same manner that the personal computer (PC) transformed computing. Small satellites' low cost of entry into orbit, combined with their expanding capabilities, have enabled many nations, government departments, individuals and universities to have afoordable access to space. It is imperative that institutions and enterprises that want to take their initial steps in space should build on the prior experience of earlier space users and build a cadre of skilled professionals.

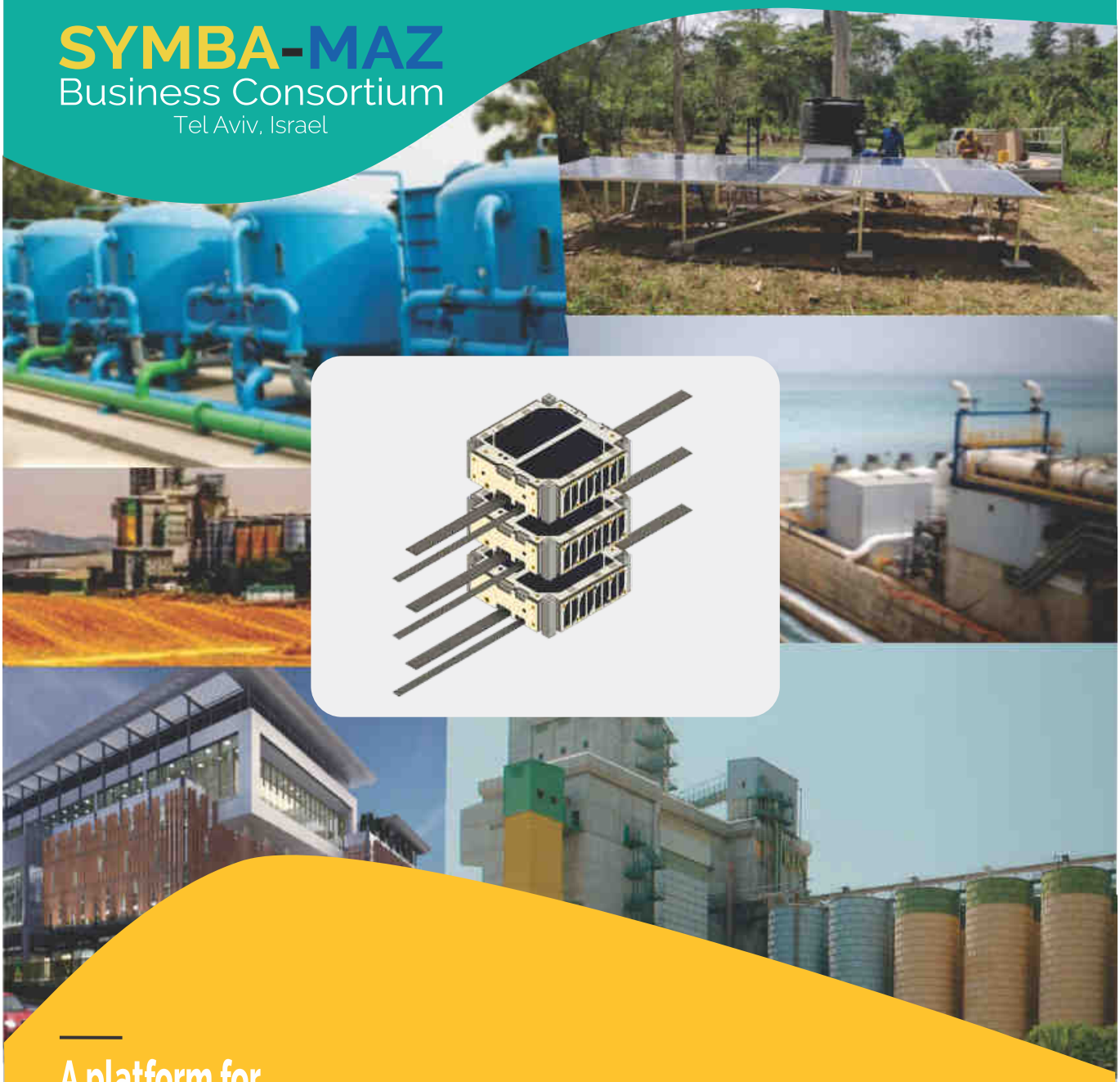
To address the challenges of the future, the growing space industry and its ancillary organizations require a continual flow of enthusiastic, qualified, and competent young engineers and scientists. Although nanosatellites are physically small, they share a scale of complexity that is similar to that of large satellites. This makes them especially suited as a focus for the education and training of engineering students in academic institutions, as they provide direct, hands-on experience at all stages and in all aspects (both technical and managerial) of a real satellite mission—encompassing design, production, test, launch and post-launch monitoring.

Berlin Space Technologies GmbH led a very effective model to achieve this knowledge training and skills transfer using affordable small satellites through a 30-year tradition of small satellites made in Berlin with first-hand design, construction, and management of associated small satellites that have flown on more than 100 missions. The training programmes helped build many more international capacity building programmes around the world.

UNISEC-Global, an international non-profit organisation with local chapters all over the world including India and was founded in 2013 in Japan, has provided a collaborative forum for promoting practical space development efforts. It supports cooperation and knowledge sharing on designing, developing, manufacturing, launching, and operating micro/nano/picosatellites and rockets, primarily among university level students, young researchers, and their tutors.

Lastly to mention that the contribution of Indian Technology Congress Association (ITCA) in promoting this field of study in Satellite Launching is worthy and commendable. In many of its earlier conferences that were held by ITCA gave considerable importance to Space Projects involving contributions by Engineering Students of both Karnataka and Tamilnadu. Thus both ISRO and ITCA have shown to the academic world, specially involving students, the importance of such collaborations between them and the industry go a long way to improve our indigenization in several other fields of great importance to our society as well as to meet the global challenges in various technological fields

SYMBA-MAZ
Business Consortium
Tel Aviv, Israel



A platform for
FUND RAISING
ENGINEERING CONSULTING
and
PROJECT IMPLEMENTATION

EMBRACING SPACE INGENUITY

Fund Aggregator for India's 75 Satellites Mission

Reflections...
by Emasofia Carolina Garcia

My name is Emasofia Carolina Garcia and 14 years ago I watched science TV channels and followed with enthusiasm the space program when John Glenn had orbited the Earth. And I fell in love with Mission Control, the way they had used their knowledge of spacecraft to find a way to rescue the astronauts. That made a big impact on me and I wanted to know who was running it, and I knew it was the aerospace engineers and I believed it from then on.

When I turned 12, I loved space even more than the swings. But that year I not only turned 12, I also discovered how hard it would be to get to NASA as a Mexican girl. I remember turning on the monitor and searching Wikipedia for "Mexicana en NASA" and finding the greatest inspiration a Latin American girl could have. "The Mexican girl who followed her dream and is now a NASA scientist, Dorothy Ruiz Martinez."

And the seed was planted in me, maybe I could be part of the team that solves the problems? It would be a cool job!

Another important inspiration in thinking about where I would study my dream career was my cousin. At that time, he was one of the most outstanding aerospace engineering students at the Autonomous University of Baja California. He told me about all his subjects and projects. One of his biggest projects was the development of the "CIMARRON 1" rocket in collaboration with NASA.

And that was when I knew that I would study Aerospace Engineering at the Autonomous University of Baja California.

The clock started ticking along with my passion for science, mathematics, and physics. I was anxious to enter the university and be next to brilliant minds with the same dreams.

My last semester of high school came along with a life-changing opportunity, situation, and perspective.

My cousin saw a lot of enthusiasm and potential in me and presented me with the opportunity to attend a CanSat course at his university, my dream university! I was really excited to go, but at the same time, my fear and nerves were exponential. "I don't know anything about CANSATS, I barely know how to solder resistors", "They are college students and I'm just a girl who hasn't even taken her college entrance exam, no one will want to be my team", "I'm not ready, maybe when I'm older". This was the first time I faced imposter syndrome.

But despite the fear I remembered little Emasofia with all the energy and joy of eating the world. And I took courage in me again.

And I realized that we should not be afraid. We will never feel nor be ready, that's why I should start as soon as possible so that when I really need that knowledge it will be there. Also, all lovers of learning and knowledge will support you. You might even find a team that needs the best resistor solderer, and that's what a CanSat course is for, to go learn about them.

Once the lesson was learned, hungry for knowledge about space sciences I started to develop a challenging project "The construction and launching of Cansat's".

Emasofia Carolina Garcia
Student, Aerospace Engineering
Autonomous University,
Baja California, Mexico

I learned that developing this type of project was an effective educational tool as hands-on training to learn basic space technology and satellite

My team from my first CanSat. I am the one wearing yellow and show off my Cansat.

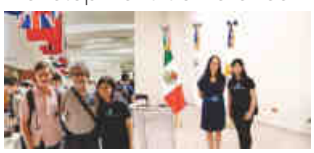
engineering, where we students can gain practical experience in the life-cycle of a space project, and it helped me to continue challenging more advanced missions.

Once I entered university I would not stop with this inertia generated by a dream that was becoming a goal. I enrolled in all possible courses and competitions related to CanSats and CanSats, I joined all the lectures, I didn't care that I didn't know about the subject, because I knew I would learn it and study it. I even went on a summer science trip to NASA Ames. What they didn't realize until I got back from the trip was that a first-semester freshman had managed to attend. (Normally these programs are geared towards 3rd-year students).

Met another Mexican woman who works at NASA, Ali Guarneros Luna.

Once I knew enough about CanSats, I wanted to get into the world of rovers. I am fortunate enough to live on the border, so I opted to take some courses and do a little research at NASA JPL about them.

Then I knew it was time to put my knowledge into practice. I entered a national rover competition, in which I developed a lot of new skills, and in the process, met a lot of people who were experts in the field. Being my first rover competition, my team and I were crowned 2nd place champions, and invited to present our rover at the International Space Development Conference.



David Chevront-Engineer from NASA Johnson Space Center, judge of the competition. Another Mexican woman who worked at NASA with the Hubble telescope and was the organizer of the competition, Aida Nava.

I learned quite a few things about rovers, but the most important is that I discovered that I am not a big fan of them.

My goal was to learn as much as possible about space systems, since as a controller I had to know how to interact with any vehicle or artifact that will be put into orbit or leave the planet. I was only missing the most important one, the rockets.

I started my learning process again. Going to thousands of conferences, courses, workshops, classes, certifications, and doing research. When the day came to test my knowledge, I was not so lucky.

With each mistake I learned so much more, each day I got involved with a new system, and the spark to continue never went out.

I kept trying for a long time with model rockets (which do not reach heights of more than 7m) until I succeeded! I got so good and created such an efficient recovery mechanism that I was encouraged to do my L1 certification with a high-power rocket that would reach 2 km, at the Tripoli International Rocket Association. But it failed again.

Moments before the tragedy

But I immediately knew what had gone wrong, So after a couple of months, I went back to prepare myself and my rocket and tried again. This time the flight and recovery were a success.

I became the first Mexican girl to be certified by the United States High Power Rocket Association, which consists of designing, building, launching, and recovering your own rocket.

Level 1| 2.5 km, successful recovery

With this motivation and the joy of knowing that step by step I was getting closer to my goal, I decided to prepare myself for the L2.

The theory exam and the level 2 launch were a success and the rocket mission worked as expected. I was really proud of my achievement and progress but I felt that I was missing something else.

First Mexican girl to achieve this level of certification.

I was always a child of extracurricular activities, I was fascinated to complement my career classes with all these activities to put space systems in practice. Since I started university, I took refuge in my classmates of more advanced semesters because I was fascinated by the way they taught me new things and the way they gave me the advice to keep moving forward in this competitive world regardless of my nationality. So I was always the youngest in my group of friends.

So with this group of friends who had developed a love and talent for rockets together, we decided to do something big, and we applied for the world's biggest high-power rocket competition, the Spaceport America Cup 2020. In which we were classified as the first and only Mexican team. In which I was the leader of the testing and recovery system.

Quarantine came and many things changed, for a long period I was very discouraged and about to give up my dream and give up my goals, I thought that someone from Latin America could not aspire to the stars. In a moment of desperation and as a last hope I decided to write to my greatest inspiration in the aerospace industry, Dorothy Ruiz Martinez, leaving my destiny to chance in a reply.

I couldn't believe it, but Dorothy answered me and encouraged me to keep fighting for my goal. Not only that, she took me in as her apprentice.

To this day we continue to have sessions and she has taught me and supported me throughout my career to one day become a space mission controller.

I got hugely inspired again and got back in the game. And I remembered that all this time in my career, I had only met 2 women with the same passion to shake up

the aerospace industry and that minority baffled me. So I looked for international support network groups for women engineers and the Women of Aeronautics and Astronautics (WoAA) welcomed me with open arms, with them I have learned a lot of things about the world of aerospace engineering and I have met with different students from prestigious universities around the world sharing information to help us get ahead in this industry. We have organized different events in which we invite very emblematic female characters in the world of space sciences, in which they give us guidance and advice in order to involve more girls in this international support network.

With this new mentality that I was bringing to make community, I decided to implement a Club in Mexico with my group of friends, as we had the motivation of having made a difference nationally in the area of experimental rockets and we awakened in the university and in the country a curiosity for rocket science, so I motivated them to leave a legacy in our university. And we created the University Space Systems Development Research Club directed by students for students. In which, we strive to inspire and encourage student interest in space and technology issues. And provide experience in collaborative work and innovation projects for their professional growth nationally and globally.

First-generation Club members

The first competition we participated in as a team was the Mexican Experimental Rocketry Engineering Meeting 2021 (ENMICE), a national experimental rocketry event and competition. Our team was positioned in first place in this national competition. This time I was the leader of the project.

One afternoon I procrastinated by learning a new language (Russian), and by accident, without realizing it, I joined a classification process for a summer program in Russia. At first, there were days where I imagined myself in that interchange in that country at the vanguard of aerospace. But like everything else, they were also days of worries and wasted hours fighting anxiety and imposter syndrome. "Would I really be good enough to qualify?"

After several assignments and tests on ballistics, classical dynamics, and orbital mechanics. According to the results of the assignments and exams, participants are selected for the full-time stage in Samara, Russia.

Surprisingly for my whole family! I qualified within the 30 places that were offered worldwide and were able to attend a summer research stay in Russia at the International Summer Space School Future Space Technologies and Experiments in Space.

It was one of my greatest experiences as a professional and personally. I think aerospace engineering appreciates that diversity. Meeting different people from other cultures who are passionate about space exploration is the most rewarding and uplifting.

So far, finishing my degree, I have had a trajectory in different engineering and space science projects such as rovers, satellites, and rockets at a national and international level, along with the writing of scientific research articles. I have given lectures to young people and children on different space topics, and also motivational talks for STEM girls, I support groups of students as a mentor, and my university has just awarded me with the "Outstanding Engineering Student Award".

I am now working towards becoming a space mission controller and training to become responsible for the necessary ground systems infrastructure and ground communications in which to conduct the planning, training, testing, execution, and evaluation of human spaceflight mission operations in the Mission Control Center (MCC) at the Johnson Space Center.

As an aerospace engineering student, I don't believe in "male or female careers", but rather in people and their passions: Belief in yourself! If you stay in fear, you won't be there. I encouraged myself and here I am.

I hope this will motivate more girls, not only from Latin America but from all over the world, to join these STEM disciplines, pursue their dreams, set short and long-term goals, be persistent, and not give up. Dream big, learn from our mistakes, this seems very important to me because then you know how to act when you find yourself in a situation similar to the one you already overcame. Not to be afraid and to educate ourselves. Expect the best, be grateful and be ourselves. I learned that life puts obstacles in our way and we don't know what is going to happen later. And finally, don't let circumstances define your life, you define your destiny and you have the power to do it.

And remember if your goals don't shake you, they are not for you.

Space Advocacy
by National Space Society

Avinash Shirode
Ex-ISRO Engineer
Director and Space Ambassador,
National Space Society (USA)
President, NSS(USA)-Nashik India Chapter

National Space Society (NSS), the premier global space advocacy organization promoting the concept and technologies of human settlement in space. NSS is the result of a merger in 1987 of the National Space Institute (founded by Wernher von Braun) and the L5 Society (founded by Gerard O'Neill). NSS is incorporated in the District of Columbia as a 501(c)(3) organization

NSS is dedicated to the creation of a spacefaring civilization that provides a citizen's voice on space exploration, development, and settlement. Its mission is to promote social, economic, technological, and political change in order to expand civilization beyond Earth, to settle space and to use the resulting resources to build a hopeful and prosperous future for humanity.

As a Project of NSS, SSDCs have authority to operate as a non-profit tax-exempt entity in all U.S. states and territories. The two organizations conduct mutual fund-raising projects, and NSS headquarters conducts business-to-business Invoice transactions on behalf of SSDCs. NSS provides visibility for SSDCs at its conferences and events, including the International Space Development Conference (ISDC) and Space Settlement Summit. SSDC events have been featured in the award-winning NSS magazine, Ad Astra.

The two organizations are working on strengthening this mutually beneficial partnership, including more presentations by SSDC student participants at NSS events, and NSS is considering sponsorship of new events for students based on SSDC concepts and Intellectual Property. Indeed, NSS is actively looking at making SSDC activities available to college students—the experience is different for college students than high school students; a college aerospace engineering student in an SSDC event said "until now, I had no idea this Human Engineering stuff is so important".

The National Space Society (NSS) recently celebrated the 50th anniversary of the first manned moon landing at its 38th Annual Space Exploration Conference (ISDC) in Arlington, Virginia, across the Potomac from Washington, DC.

NSS Vision

The Vision of NSS is people living and working in thriving communities beyond the Earth, and the use of the vast resources of space for the dramatic betterment of humanity.

NSS Mission

The Mission of NSS is to promote social, economic, technological, and political change in order to expand civilization beyond Earth, to settle space and to use the resulting resources to build a hopeful and prosperous future for humanity. Accordingly, we support steps toward this goal, including human spaceflight, commercial space development, space exploration, space applications, space resource utilization, robotic precursors, defense against asteroids, relevant science, and space settlement oriented education.

NSS Goals

Defending Earth: Protecting humanity from dangerous space objects

Clean Energy from Space: Enabling everyone to benefit from space solar power.

Developing Space: Making the vast resources of space available to all.

Communities in Space: Supporting the establishment of space settlements, making us an interplanetary species

Education

NSS believe space with its infinite resources holds the key to the future of life on Earth. The National Space Society therefore provides many educational opportunities to advance the careers of space-interested students from around the world. Our educational competitions, lessons, activities, and programs span grades K-12, university, and post-doctoral age levels. We engage teachers, students and the community in learning programs that use space science and space themes as we work to inspire the next generation of space leaders.

Why Space Matters

space solar power
Space Settlements
The Space Movement
Roadmap to Space Settlement
Settling on Mars
Lunar Bases and Settlements
Orbital Space Settlements

Why Join NSS? - Because You Can Make a Difference!

Membership Benefits
Read about current advances in space development
Stay connected to NSS activities
Promote the space agenda
Meet and engage with space leaders
Participate in NSS activities
Share your passion for space
Take advantage of the financial benefits

NSS is a leader in space-related educational activities for students. The NSS is also active on the political front, producing numerous position papers on space policy and supporting space defense volunteers. Join NSS and learn about the benefits of joining NSS by visiting nss.org or space.nss.org. SEDS fulfills this mission by educating people about the benefits of space, maintaining a network of interested students, offering members the opportunity to develop their leadership qualities, and inspiring people through their participation in space projects

Space Entertainment Enterprise (SEE)

Announces World's First Entertainment Arena and Content Studios in Space, built by Axiom Space

Space Entertainment Enterprise (S.E.E.) the UK-based media company developing multi-platform, space-based entertainment today announces a ground-breaking new venture – SEE-1 – the world's first content and entertainment studios and multi-purpose arena in space. The space station module will be built by Axiom Space, the leader in human spaceflight services and human-rated space infrastructure.

SEE-1 is planned to launch in late 2024 and dock with Axiom's world's-first commercial space station, Axiom Station, while it is connected to the International Space Station.

The module will allow artists, producers, and creatives to develop, produce, record, and live stream content which maximizes the Space Station's low-orbit micro-gravity environment, including films, television, music and sports events.

"SEE-1 is an incredible opportunity for humanity to move into a different realm and start an exciting new chapter in space," said Dmitry and Elena Lesnevsky, co-Founders, S.E.E. "It will provide a unique, and accessible home for boundless entertainment possibilities in a venue packed with innovative infrastructure which will unleash a new

Space Entertainment Enterprise

world of creativity. With worldwide leader Axiom Space building this cutting-edge, revolutionary facility, SEE-1 will provide not only the first, but also the supreme quality space structure enabling the expansion of the two trillion-dollar global entertainment industry into low- Earth orbit."

Source: spaceref.com

LEO B'Band Connectivity

Coming to India From Hughes + OneWeb

The arrangement between OneWeb and Hughes Communications India Private Ltd. (HCIPL), a joint venture between Hughes and Bharti Airtel Limited ("Airtel") follows the Memorandum of Understanding (MoU) signed by the companies in September of 2021.

As the leading satellite broadband provider in India , HCIPL is well positioned to deliver services to enterprise and government with OneWeb capacity, especially in areas outside the reach of fiber connectivity. OneWeb will connect towns, villages, and local and regional municipalities in those hardest-to-reach areas, playing a critical role in bridging the digital divide.

This agreement expands upon an established relationship between the two companies. Hughes, through its parent company, EchoStar, is a longstanding and supportive OneWeb shareholder. The company is also an ecosystem partner to OneWeb, developing gateway electronics — including for those in Gujarat and Tamil Nadu — and the core module that will power every user terminal for the system.

OneWeb plans to commence global service by the end of 2022 as demand continues from telecommunications providers, aviation and maritime markets, ISPs, and governments worldwide for its low-latency, high-speed connectivity services.

Source: news.satnews.com

Space Education
for a Changing World

Prof. Pascale Ehrenfreund
President, International Space University and Research Professor of Space Policy and International Affairs, Space Policy Institute/George Washington University

The International Space University develops the future leaders of the world space community by providing interdisciplinary educational programs to students and space professionals in an international, intercultural environment. ISU also serves as a neutral international forum for the exchange of knowledge and ideas on challenging issues related to space and space applications.

ISU programs impart critical skills essential to future space initiatives in the public and private sectors while they:

- Inspire enthusiasm
- Promote international understanding and cooperation
- Foster an interactive global network of students, teachers and alumni

Encourage the innovative development of space for peaceful purposes: to improve life on Earth and advance humanity into space.

The International Space University is a private non-profit institution, formally recognized as an institute of higher education in France by the French Ministry of Education (decree MENS0400386A of 27 February 2004). ISU is also recognized by other agencies and universities.

It specializes in providing graduate-level training to the future leaders of the emerging global space community at its Central Campus in Strasbourg, France, and at locations around the world. In its one-year Master of Science in Space Studies (MSS), two-month Space Studies Program (SSP) and 5-week Southern Hemisphere-Space Studies Program, ISU offers its students a unique Core Curriculum covering all disciplines related to space programs and enterprises, space science, space engineering, systems engineering, space policy and law, business and management, and space and society. Each of these programs also involve an intense student research Team Project providing international graduate students and young space professionals the opportunity to solve complex problems by working

The International Space University has joined forces with the South African Space Agency SANSA to offer a one-off edition of the Executive Space Course for the African region. The program will be held online from 01-04 February 2022 from 9.00 to 14.00 SAST/UTC +2 hours.

together in an inter-cultural environment.

For more details of about Programs delivered each year on a regular basis: https://www.isunet.edu/

The Interactive Space Program (ISP)

ISU's online Interactive Space Program (ISP) is a 5-week full-time professional development opportunity designed for university graduates from any discipline and for professionals with any background wanting to pursue a career in the space sector.

It will be conducted in English and follow the international, interdisciplinary and inter-cultural learning methodology for which ISU is well known. ISP will prepare participants wanting to enter one of the face-to-face ISU programs such as the Master of Space Studies (MSS), the Space Studies Programs (SSP and SHSSP) or the Commercial Space Program (CSP). The program is also a refresher for ISU alumni seeking an update on the latest developments in the international space arena and wanting to enlarge their network of professional contacts.

ITCA-UNITYsat Team @ International Space University, Strasburg, France

UNISEC India was Approved during 6th Global Meeting of UNISEC held in 18 October 2018 at Strasburg, France. ITCA-UNITYsat Team was Instrumental for establishing University Space Engineering Consortium-India Chapter

Since its founding in 1987, ISU has graduated more than 5000 students from over 110 countries. Together with hundreds of ISU faculty and lecturers from around the world, ISU alumni comprise an extremely effective network of space professionals and leaders that actively facilitates individual career growth, professional activities and international space cooperation.

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How to Grow Microgreens inside a CubeSat - Mission GreenCube

Prof. Fabio Santoni
Department of Astronautic Electric and Energy Engineering (DIAEE), University of Rome La Sapienza, Italy

The rise of new in-orbit and on-ground experiments in gravitational biology and astrobiology has the purpose of discovering the behaviour of living beings in the challenging environment of space, where organisms can be exposed to microgravity, radiations, different circadian cycles and lighting conditions imposed by in-flight Biological Life Support Systems (BLSS). When experimenting on plants, in-orbit cultivation is often performed with the aim of optimizing the growth of the cultivars for future nutrition of astronauts in long-term missions, such as in lunar missions or when thinking on the future human exploration of Mars. On the International Space Station, biological experiments have been conducted leading to the astronauts eating in-orbit cultivated plants for the first time in history. Further steps can be undertaken for optimization of the cultivation and for improving the autonomy and miniaturization of cultivation systems in the perspective of a broad contribution to tomorrow's astronauts' diet.

In this perspective, the S5Lab (Sapienza Space Systems and Space Surveillance Laboratory) at Sapienza University of Rome is carrying out the GreenCube project for the design of a 3U CubeSat aimed at cultivating microgreens in a miniaturized BLSS to be hosted in approximately two of the three satellite units (for an approximated volume of 20 x 10 x 10 cm). The project is developed together with ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and University of Naples "Federico II" and coordinated by the Italian Space Agency under an agreement with Sapienza University of Rome.

The project has won a launch opportunity on-board the maiden Vega-C launcher flight, led by the European Space Agency, which will take off towards Medium Earth Orbit in mid-2022.

Plants growing inside the satellite vessel during an on-ground experiment

The satellite mission, whose development has been kicked off in 2019, is aimed at verifying and demonstrating the performances of the miniaturized BLSS in MEO. The growth cycle of the plants will last around 20 days, when the BLSS will be able to autonomously manage the life support of the microgreens. The cultivation payload consists of a pressurized vessel, with an internal pressure kept at 0.5 atm, and all the needed sensors and actuators for the cultivation, including:

- monitoring and control of air composition, with particular attention to carbon dioxide and oxygen concentrations
- air recirculation, for avoiding the creation of air bubbles with abnormal gaseous concentrations;
- temperature monitoring and control, ideally aiming at temperature intervals between 15 and 25 °C;
- lighting and circadian cycles control, aiming at 16 hours of light per day to allow the plants growth and photosynthetic cycles regularization;
- humidity monitoring and control, for maintaining a suitable environment for the plant growth;
- nutrients administering and watering control, for the growth of the seeds;
- air pressure monitoring and control, both for maintaining the plant at 0.5 atm and for obvious safety reasons;

The plant seeds are placed in a so-called "seed matrix", featuring all the containment systems that are essential to fix the seeds in position for transportation and launch and to support the plants germination while in-orbit.

The satellite design shares the orbital platform with the previous satellites of S5Lab, and in particular WildTrackCube-SIMBA and LEDSAT, 1U CubeSat missions that were launched in 2021 and are nominally performing their mission in LEO orbit. The adaption of the orbital bus to the very peculiar payload is one of the key challenges of the GreenCube mission.

While the final assembly and qualification tests for launch are being carried out at Sapienza University of Rome, several growth tests have been performed in the prototype pressurized vessel, with good results in terms of plants growth and hardware controllability when in representative conditions, e.g. with limited access to the flight hardware, as per common practice during mission tests. The pictures of the plants test show the different stages of the germination and growth. If successful, the GreenCube mission will demonstrate the functionality of the design autonomous cultivation laboratory as a "ready-to-fly" facility for gravitational biology missions with short development cycles.

Growth experiment concluded successfully

NewSpace, New Technologies, New Policy, and New Strategy- 75 Satellites Initiative

Gautham Balasubramanya
Chief Strategy Officer
The Productivity Academy Limited
Grimsby, United Kingdom

Partaking the right business development is one of the most significant necessities for NewSpace technologies to become or remain successful. Focus on business development does not only include the inputs that a technology has proven access to, such as knowledge and resources, but also the economic outputs a technology produces. By targeting a specific segment example imaging, remote-sensing, satcom, agriculture, fisheries, security, the technology may only hope to find customers that may support generating required economic outputs for the technology. In NewSpace Technologies there needs to make choices on all these mentioned components in command to find a lucid business focus development, tailored to the space technology target segment, and that also takes into account the NewSpace in which the cube-sat application is present and the set of partners with which the technology collaborates or hopes to collaborate.

A common misconception is that successful companies instantly found the right business focus. By contrast, these companies also started with a different business focuses. Demonstrating and experimenting with business development requirements is thus important for NewSpace Technology Companies from cubesats to the launch vehicles. Moreover, NewSpace Technologies are often present in emerging companies, that is, companies in which there is no dominant business focus yet, where it is still unclear who the customers will be, are only governments or independents. Demonstrating and experimenting with different business developments is thus even more important in NewSpace Industry, in creating value-add and becoming successful product driven company.

The Institute of Productivity, is avid supporter of 17 Sustainable Development Goals ranging from no poverty to Sustainable Cities & Communities and climate change and beyond. With this technology framework, this is perhaps implementing how much of a positive impact NewSpace can, and do, have.

Focusing across CubeSat payload systems, which in turn are instrumental in helping many areas of productivity to improve in efficiency and effectiveness. Precision positioning and navigation are growing aquaculture/agriculture/ oil & gas production aggressively, while plummeting the ingesting of resources – helping to address the global issue of hunger and poverty. Precision timing network constellation of CubeSats are bringing greater efficiency to the monitoring and measuring. Sensors empowered by CubeSat constellations that will endure to improve efficiency and safety, from oil & gas, farming lands, forestry, aquaculture open waters such as inland, rivers and oceans.

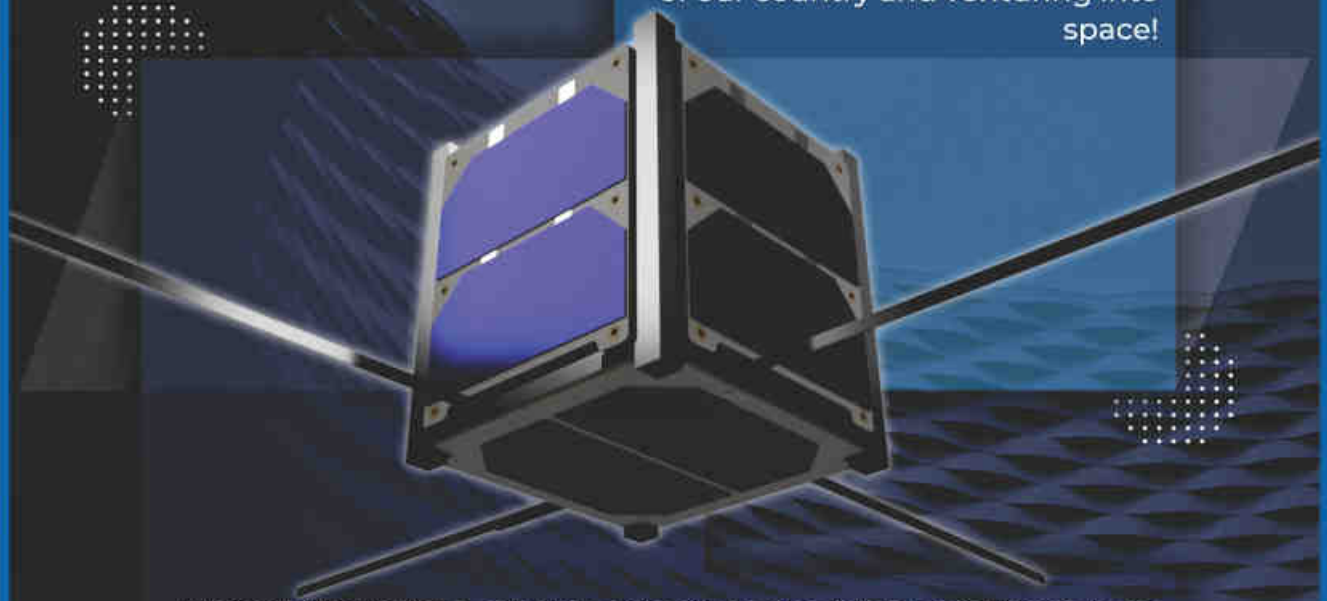
Possibly most importantly, the access to monitoring and measuring technology systems, will be very global impacting, operating as an empower to the regions. The tropical and polar area monitoring, accessing to highly accurate data metrics opens up enormous potential for economic productivity, reduced inequality and regional co-operation. Access to monitoring and measurement systems is becoming a fundamental expectation and mainstay of this present situation in the world and extended.

Most of the NewSpace Tech companies, I know, normally agree that the reliability and the technical quality of Technologies are very pressing problems. It is been discussed that the majority of Space Tech Companies are having problems in orbit that are affected by defects or flaws which may be avoided through a more effective testing phase system. Frequently, most of these demonstrative technologies suffer from setbacks during the design and assembly phases, resulting in less time for testing and verification. The testing phase is extremely important and it deserves appropriate allocated resources in improving the performance of the demonstration, experimenting to commercial phase of the NewSpace development

Prof. Pini Gurfil
Head, Asher Space Research Institute, Technion

75 Students' Satellites Mission 2022

Join us now! and be a part of this National Mission of building an ecosystem for the young minds of our country and venturing into space!



Among the various mission objectives, the larger emphasis is on academia laying a foundation of science-based education and experience-based learning to build an innovation culture in the country and prepare the future workforce in the emerging space arena and related sectors.

Azadi Ka Amrit Mahotsav

आज़ादी का अमृत महोत्सव

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