＜付属資料＞

PROFILES – KEY INDIAN MARKET PLAYERS
インド主要関連機関・企業リスト

記号の解説

- A Satellite Communication/ 衛星通信
- B Earth Observation/ 地球観測
- C Satellite Navigation/ 衛星ナビゲーション
- D Launch Vehicle/ ロケット
- E Space Security/ 安全保障
- F Space Aeronautics/ 宇宙航空
- G Human Space flight/ 有人宇宙飛行
- H /Space & Science exploration/ 宇宙・科学探査
- I Emerging Space Activities/ 新規宇宙事業

Players in India’s Space sector by sub-segments

A1 Non-GEO SatCom Satellite Manufacturing

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Private Players

- Vesta Space Tech
- Azista-BST Aerospace
- Satellize

Top Satellite parts’ manufacturers

- Avasarala Technologies Limited
- Centum Electronics Limited
- Godrej & Boyce
- MTAR Technologies

A2 GEO SatCom Satellite Manufacturing

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Top Satellite parts’ manufacturers

- Avasarala Technologies Limited
- Centum Electronics Limited
- Godrej & Boyce
- MTAR Technologies
- Bharat Electronics Limited (BEL)
- Hindustan Aeronautics Limited (HAL)

Source: Arthur D. Little analysis

Players in India's Space sector by sub-segments

A3 Ground Segment (SatCom)

ISRO

- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)
- Satish Dhawan Space Centre (SDSC) SHAR
- ISRO Telemetry, Tracking and Command Network (ISTRAC)

Private Players

- Dhruva Space

Top Satellite parts' manufacturers

- Alpha Design Technologies Pvt. Ltd.
- Centum Electronics Limited
- Bharat Electronics Limited (BEL)

A4 Satellite Operations (SatCom)

ISRO

- U R Rao Satellite Centre (URSC)
- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Master Control Facility (MCF)

Top Satellite parts' manufacturers

- SatSure

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

A6 Broadcasting (Satellite TV and Radio)

ISRO

- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Space Applications Center (SAC)

Private Players

- DD Free Dish
- TATA Sky
- Sun Direct
- Videocon d2h + Zing Digital + Dish TV
- Airtel Digital

A7 Other Fixed & Mobile satellite services (FSS & MSS)

ISRO

- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Space Applications Center (SAC)

Top Satellite parts’ manufacturers

- BSNL

Source: Arthur D. Little analysis

Players in India's Space sector by sub-segments

B1 Non-GEO nano & micro EO satellite mfg. (< 50 kg)

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Private Players

- Pixxel

Top Satellite parts' manufacturers

- Avasarala Technologies Limited
- MTAR Technologies
- Walchandnagar Industries Limited (WIL)
- Paras Defence & Space Technologies Ltd.

B2 Non-GEO small EO satellite mfg. (50-500 kg)

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Private Players

- Pixxel
- Azista-BST Aerospace

Top Satellite parts' manufacturers

- Avasarala Technologies Limited
- MTAR Technologies
- Walchandnagar Industries Limited (WIL)
- Paras Defence & Space Technologies Ltd.
- Godrej & Boyce
- Larsen & Toubro

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

B3 Non-GEO large EO satellites mfg. (>500 kg)

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Top Satellite parts’ manufacturers

- Avasarala Technologies Limited
- MTAR Technologies
- Walchandnagar Industries Limited (WIL)
- Paras Defence & Space Technologies Ltd.
- Godrej & Boyce
- Larsen & Toubro

B4 GEO satellites manufacturing (for EO)

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Top Satellite parts’ manufacturers

- Avasarala Technologies Limited
- MTAR Technologies
- Walchandnagar Industries Limited (WIL)
- Paras Defence & Space Technologies Ltd.
- Godrej & Boyce
- Larsen & Toubro

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

B5 EO data collection and com.

ISRO

- National Remote Sensing Centre (NRSC)
- North Eastern-Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Pixxel

B6 Meteorology and environmental monitoring

ISRO

- National Remote Sensing Centre (NRSC)
- North Eastern-Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Ambee
- Earth Analytics India
- Pixxel

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

B7 Business and Industry Intelligence

ISRO

- National Remote Sensing Centre (NRSC)
- North Eastern-Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Pixxel
- Esri India
- Kawa Space

B8 EO civil government uses & sub-app.

ISRO

- National Remote Sensing Centre (NRSC)
- North Eastern-Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Earth Analytics India
- Pixxel
- Esri India
- Ambee

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

B9 EO security & intelligence (space recon.)

ISRO

- National Remote Sensing Centre (NRSC)
- North Eastern-Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Esri India

Source: Arthur D. Little analysis

Players in India's Space sector by sub-segments

C1 GNSS Satellite Manufacturing

ISRO

- ISRO Inertial Systems Unit (IISU)
- Laboratory for Electro-Optics Systems (LEOS)
- Liquid Propulsion System Centre (LPSC)
- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)

Private Players

- Azista-BST Aerspace

Top Satellite parts' manufacturers

- Avasarala Technologies Limited
- MTAR Technologies
- Walchandnagar Industries Limited (WIL)
- Paras Defence & Space Technologies Ltd.
- Godrej & Boyce
- Larsen & Toubro

C2 Ground Segment (GNSS)

ISRO

- U R Rao Satellite Centre (URSC)
- ISRO Satellite Integration and Test Establishment (ISITE)
- Satish Dhawan Space Centre (SDSC) SHAR
- ISRO Telemetry, Tracking and Command Network (ISTRAC)

Top Satellite parts' manufacturers

- Alpha Design Technologies Pvt. Ltd.
- Centum Electronics Limited
- Bharat Electronics Limited (BEL)
- Paras Defence & Space Technologies Ltd.

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

C3 User Segment (GNSS)

ISRO

- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- National Remote Sensing Centre (NRSC)

Top Satellite parts’ manufacturers

- Alpha Design Technologies Pvt. Ltd.
- Centum Electronics Limited
- Bharat Electronics Limited (BEL)
- Paras Defence & Space Technologies Ltd.

C4 GNSS Augmentation Infrastructure

ISRO

- Satish Dhawan Space Centre (SDSC) SHAR
- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- National Remote Sensing Centre (NRSC)

Top Satellite parts’ manufacturers

- Alpha Design Technologies Pvt. Ltd.
- Centum Electronics Limited
- Bharat Electronics Limited (BEL)
- Paras Defence & Space Technologies Ltd.

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

C5 GNSS Operations

ISRO

- U R Rao Satellite Centre (URSC)
- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Master Control Facility (MCF)
- National Remote Sensing Centre (NRSC)

India has its own regional GNSS - NavIC (Navigation with Indian Constellation), also known as The Indian Regional Navigation Satellite System (IRNSS). Developed by ISRO to provide accurate positioning in India and around Indian mainland, NavIC has seven satellites. It is considered to be at par with Russia’s Glonass, EU’s Galileo, and Japan’s QZSS

C6 Positioning / timing services for consumers

ISRO

- National Remote Sensing Centre (NRSC)
- North-eastern Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Pixxel
- Esri India
- Kawa Space
- GeoSpoc

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

C7

Positioning / timing services for civil gov’t & enterprises.

ISRO

- National Remote Sensing Centre (NRSC)
- North-eastern Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Marvel Geospatial
- GeoSpoc
- Earth Analytics India

C8

Positioning / timing services for security

ISRO

- National Remote Sensing Centre (NRSC)
- North-eastern Space Applications Centre (NE-SAC)
- Space Applications Center (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Esri India

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

D1 Small lift launch systems (<2 tons to LEO)

ISRO

- ISRO Inertial Systems Unit (IISU)
- Liquid Propulsion System Centre (LPSC)
- ISRO Propulsion Complex (IPRC)
- Vikram Sarabhai Space Centre (VSSC)
- Satish Dhawan Space Centre (SDSC) SHAR

Private Players

- Agnikul Cosmos
- Skyroot Aerospace
- Urvyam

Top Satellite parts’ manufacturers

- MTAR Technologies
- Hindustan Aeronautics Ltd.
- Walchandnagar Industries Limited (WIL)
- Godrej & Boyce
- Larsen & Toubro

D2 Medium lift launch systems (2 to 20 tons)

ISRO

- ISRO Inertial Systems Unit (IISU)
- Liquid Propulsion System Centre (LPSC)
- ISRO Propulsion Complex (IPRC)
- Vikram Sarabhai Space Centre (VSSC)
- Satish Dhawan Space Centre (SDSC) SHAR

Private Players

- Urvyam

Top Satellite parts’ manufacturers

- MTAR Technologies
- Hindustan Aeronautics Ltd.
- Walchandnagar Industries Limited (WIL)
- Godrej & Boyce
- Larsen & Toubro

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

D4 Launch Sites and Facilities

ISRO

- Satish Dhawan Space Centre (SDSC) SHAR

Private Players

- Urvyam

SDSC is ISRO’s only launch site but makes India self-reliant in terms of launches. ISRO also helps other countries with launches - recently, India launched 31 replacement satellites with another 30 in the pipeline for other countries

ISRO is creating another spaceport at Toothukudi in Tamil Nadu. ISRO is also encouraging private players to build launch sites. The 2021 draft of New Space Transportation Policy of the DoS creates pathways for the same.

D5 Launch Services

ISRO

- Vikram Sarabhai Space Centre (VSSC)
- Satish Dhawan Space Centre (SDSC) SHAR
- Master Control Facility (MCF)

Private Players

- Vesta Space Tech
- Bellatrix Aerospace
- Dhruva Space

ISRO’s PSLV was developed to launch LEO satellites an GSLV to launch heavier INSAT class of GEO satellites, and sounding rockets to launch smaller rockets on sub-orbital and atmospheric flights

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

E1 Secure communication (payloads & end user terminals)

ISRO

- Laboratory for Electro-Optics Systems (LEOS)
- U R Rao Satellite Centre (URSC)
- Master Control Facility (MCF)
- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Space Applications Centre (SAC)

DRDO

ISRO demonstrated its capability in free-space quantum communication for 300m, a major milestone achievement for unconditionally secured satellite data communication using Quantum Key Distribution technology

E2 Early warning and signal intelligence remote sensing

ISRO

- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- National Remote Sensing Centre (NRSC)
- North-Eastern Space Applications Centre (NE-SAC)
- Space Applications Centre (SAC)
- Development and Educational Communication Unit (DECU)

DRDO Defence Space Research Agency

Private Players

- Esri India

The Defence Space Research Agency (DSRA) is working on enhancing the Signal Intelligence (SIGINT), Communication Intelligence (COMINT) and Electronic Intelligence (ELINT) capabilities of the India’s space military plans

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

F1 Spacecraft safety & efficiency

ISRO

- ISRO Propulsion Complex (IPRC)
- ISRO Satellite Integration and Test Establishment (ISITE)
- Space Applications Centre (SAC)
- Physical Research Laboratory (PRL)
- National Atmospheric Research Laboratory (NARL)
- Semi-Conductor Laboratory (SCL)

Private Players

- Bellatrix Aerospace
- Manastu Space
- TritonArc
- Urvyam

Private Players

- TATA Advanced Systems
- Hindustan Aeronautics Limited (HAL)

F4 Unmanned Aerial Vehicles (UAVs)

DRDO

Private Players

- IdeaForge
- General Aeronautics

Other Players and aerospace components’ supplier

- TATA Advanced Systems
- Hindustan Aeronautics Limited (HAL)
- Paras Defense & Space Technologies
- Bharat Electronics Limited (BEL)
- Mahindra Aerospace
- Godrej & Boyce
- Walchandnagar Industries

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

G4

Human Transport Spacecraft

ISRO

- Laboratory for Electro-Optics Systems (LEOS)
- ISRO Inertial Systems Unit (IISU)
- ISRO Propulsion Complex (IPRC)
- ISRO Satellite Integration and Test Establishment (ISITE)
- Human Space Flight Centre (HSFC)

ISRO’s Human Space Flight Center is responsible for implementation of the Gaganyaan project, India’s first crewed flight planned for 2022 on a home-grown GSLV-III rocket

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

H1 Scientific Data Processing & Distribution

ISRO

- National Remote Sensing Centre (NRSC)
- North-eastern Space Applications Centre (NE-SAC)
- Space Applications Centre (SAC)
- Development and Educational Communication Unit (DECU)

Private Players

- Vesta Space Tech
- Pixxel

ISRO’s Indian Space Science Data Centre (ISSDC) is the gateway to India's Space Science Data, designed to host the science data archives and the custodian of all the science data from the Indian science missions

H2 Observational Science

ISRO

- National Remote Sensing Centre (NRSC)
- North-eastern Space Applications Centre (NE-SAC)
- Space Applications Centre (SAC)
- Development and Educational Communication Unit (DECU)
- Master Control Facility (MCF)

Various observational and experimental missions and satellites of ISRO include SRE-1, SROSS-C2, INS-1A, INS-1B, INS-1C, etc. for purposes of earth observation and satellite navigation for several applications like agriculture, water resources, urban planning, rural development, mineral prospecting, environment, forestry, ocean resources and disaster management

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

H3 Exploration sciences

ISRO

- Space Applications Centre (SAC)
- U R Rao Satellite Centre (URSC)
- Human Space Flight Centre (HSFC)
- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Master Control Facility (MCF)

Private Players

- Dhruva Space

ISRO’s various exploration missions such as Mars Orbiter Mission (MOM), Chandrayaan-1 and 2, AstroSat mission, and its ambitious goals of Mangalyaan-2, Venus mission, human lunar mission, is testament to its exploration science abilities.

H4 Spacecraft control and deep space network

ISRO

- Space Applications Centre (SAC)
- ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Master Control Facility (MCF)

ISRO’s Indian Deep Space Network (IDSN) with their stations DSN-32 and DSN-18 at Byalalu near Bengaluru under ISTRAC was launched in 2008, especially to support Chanrayaan-1, and now supports all major deep space missions

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

H5

Scientific Instruments

ISRO

- Laboratory for Electro-Optics Systems (LEOS)
- ISRO Inertial Systems Unit (IISU)
- Physical Research Laboratory (PRL)
- National Atmospheric Research Laboratory (NARL)
- Semi-Conductor Laboratory (SCL)
- Space Applications Centre (SAC)

Private Players

- Paras Space & Defence
- H P Instruments
- Alpha Design Technologies Pvt. Ltd.
- Bharat Electronics Limited (BEL)

ISRO’s SAC developed imaging infra-red spectrometer (IIRS) to understand mineral composition of lunar surface, on-board Chandrayaan-2, which detected the presence of hydroxy and water molecules on Moon

Source: Arthur D. Little analysis

Players in India’s Space sector by sub-segments

I4

Space Situational Awareness & Debris Mitigation

ISRO

- Directorate of Space Situational Awareness and Management (DSSAM)
- ISRO SSA Control Centre at ISRO Telemetry, Tracking and Command Network (ISTRAC)
- Physical Research Laboratory (PRL)
- Space Applications Centre (SAC)

Private Players

- Digantara

ISRO’s Space Debris Mitigation Requirements are being firmed up in accord with UN & IADC and has built capability for COLIlision Avoidance (COLA) analysis and Space Object Proximity Analysis (SOPA) for safeguarding of its space assets

Source: Arthur D. Little analysis

Several players plan to enter the satellite internet market in India

Tata's Nelco plans to partner with Canada's **Telesat** to offer B2B LEO satellite broadband

Bharti backed OneWeb to offer global satellite service incl. India by May 2022

SpaceX founder Elon Musk plans to launch **Starlink**, satellite internet in India soon

Amazon is eyeing India's satellite internet space through its **Project Kuiper**

BSNL partnered with **Inmarsat** and **Skylo** to provide **satellite IoT based solutions** in India, with applications in precision farming, fishing, disaster management, etc.

Hughes India plans to invest $500 mn in SATCOM in India; $50 mn invested in OneWeb

Viasat established its R&D center in 2016, now focused on launching sat internet soon

Source: The Mint, Arthur D. Little analysis

ISRO Players – Satellite Parts' Developer (Upstream)

ISRO Inertial Systems Unit (IISU)

IISU in Kerela is responsible for the design and development of Inertial Systems for Launch Vehicles and Satellites and production of Sensors, Systems, Actuators and Mechanisms for launch vehicle and spacecraft applications. Inertial Navigation System, Attitude Reference System, Rate Gyro Packages, Accelerometer Packages are designed and used in space missions.

A1	Non-GEO satcom satellites manufacturing	B1	Non-GEO nano- & micro- EO satellites mfg. (< 50 kg)	D2	Medium lift launch systems (2 to 20 tons)
B3	Non-GEO large EO satellites mfg. (>500 kg)	A2	GEO satcom satellites manufacturing	F1	Spacecraft safety & efficiency
C1	GNSS satellites manufacturing	B2	Non-GEO small EO satellites mfg. (50-500 kg)	G4	Human transport spacecraft
B4	GEO satellites manufacturing (for EO)	D1	Small lift launch systems (<2 tons to LEO)		

Laboratory for Electro-Optics Systems (LEOS)

LEOS in Bengaluru is responsible for the design, development and production of electro-optic sensors and optics for spacecraft use including earth sensors, star sensors, sun sensors, magnetic sensors, optics for remote sensing cameras, radiometers, etc.

A1	Non-GEO satcom satellites manufacturing	B1	Non-GEO nano- & micro- EO satellites mfg. (< 50 kg)	E2	Early warning and signal intelligence remote sensing
B3	Non-GEO large EO satellites mfg. (>500 kg)	A2	GEO satcom satellites manufacturing	G4	Human transport spacecraft
C1	GNSS satellites manufacturing	B2	Non-GEO small EO satellites mfg. (50-500 kg)		
B4	GEO satellites manufacturing (for EO)	H5	Scientific instruments		

Source: Arthur D. Little analysis

ISRO Players – Propulsion (Upstream)

Liquid Propulsion System Centre (LPSC)

LPSC in Kerela and Karnataka is responsible for design, development and realization of liquid and cryogenic propulsion stages for ISRO's Launch Vehicles, remote sensing and communication satellites and other scientific missions

A1	Non-GEO satcom satellites manufacturing	B1	Non-GEO nano- & micro- EO satellites mfg. (< 50 kg)	D2	Medium lift launch systems (2 to 20 tons)
B3	Non-GEO large EO satellites mfg. (>500 kg)	A2	GEO satcom satellites manufacturing	F1	Spacecraft safety & efficiency
C1	GNSS satellites manufacturing	B2	Non-GEO small EO satellites mfg. (50-500 kg)		
B4	GEO satellites manufacturing (for EO)	D1	Small lift launch systems (<2 tons to LEO)		

ISRO Propulsion Complex (IPRC)

IPRC Mahendragiri is equipped with the state-of-the-art facilities necessary for realizing the cutting-edge propulsion technology products for Indian space program. The center is responsible for assembly, integration and testing of liquid and cryogenic propulsion systems for operational and developmental launch systems.

A1	Non-GEO satcom satellites manufacturing	B1	Non-GEO nano- & micro- EO satellites mfg. (< 50 kg)	D2	Medium lift launch systems (2 to 20 tons)
B3	Non-GEO large EO satellites mfg. (>500 kg)	A2	GEO satcom satellites manufacturing	F1	Spacecraft safety & efficiency
C1	GNSS satellites manufacturing	B2	Non-GEO small EO satellites mfg. (50-500 kg)	G4	Human transport spacecraft (50-500 kg)
B4	GEO satellites manufacturing (for EO)	D1	Small lift launch systems (<2 tons to LEO)		

Source: Arthur D. Little analysis

ISRO Players – Satellite Manufacturing and Integration (Upstream)

U R Rao Satellite Centre (URSC)

URSC Bengaluru is the lead center for design, development and integration of satellites for communication, remote sensing, navigation, scientific studies and small satellites. URSC is actively involved in research and development in the area of advanced state of-the-art technologies, total management of all satellite missions.

A1	Non-GEO satcom satellites manufacturing	B1	Non-GEO nano- & micro- EO satellites mfg. (< 50 kg)	A3	Ground segment (satcom)
B3	Non-GEO large EO satellites mfg. (>500 kg)	A2	GEO satcom satellites manufacturing	A4	Satellite operations (satcom)
C1	GNSS satellites manufacturing	B2	Non-GEO small EO satellites mfg. (50-500 kg)	C5	GNSS operations
B4	GEO satellites manufacturing (for EO)	E1	Secure comm. (payloads & end user terminals)	C2	Ground segment (GNSS)

ISRO Satellite Integration and Test Establishment (ISITE)

ISITE established in 2006 is equipped with facilities for the complete assembly and test sequence that can enable rolling out of a flight worthy spacecraft from the stage of a bare structure. It is replete with integration and environmental test facilities under one roof, namely a large clean room for spacecraft assembly, integration and testing, compact antenna test facility specific to communication satellites

A1	Non-GEO satcom satellites manufacturing	B1	Non-GEO nano- & micro- EO satellites mfg. (< 50 kg)	G4	Ground segment (satcom)
B3	Non-GEO large EO satellites mfg. (>500 kg)	A2	GEO satcom satellites manufacturing		
C1	GNSS satellites manufacturing	B2	Non-GEO small EO satellites mfg. (50-500 kg)		
B4	GEO satellites manufacturing (for EO)	F1	Spacecraft safety & efficiency		

Source: ISRO, Arthur D. Little analysis

ISRO Players – Launch Vehicles and Services (Upstream)

Vikram Sarabhai Space Centre (VSSC)

VSSC in Kerela, is responsible for the design and development of launch vehicle technology including Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV), GSLV Mk III, Small Satellite launch Vehicle (SSLV) and Rohini Sounding Rockets apart from developing capabilities towards advanced technology vehicles and modular heavy lift launch vehicles.

D1	Small lift launch systems (<2 tons to LEO)	D2	Medium lift launch systems (2 to 20 tons)

Satish Dhawan Space Centre (SDSC) SHAR

SDSC in Sriharikota, the Spaceport of India, is responsible for providing Launch Base Infrastructure for the Indian space program with facilities for solid propellant processing, static testing of solid motors, launch vehicle integration and launch operations, range operations comprising of telemetry, tracking and command network and mission control center.

D1	Small lift launch systems (<2 tons to LEO)	D2	Medium lift launch systems (2 to 20 tons)	D5	Launch services
D4	Launch sites and facilities	C5	GNSS operations	C2	Ground segment (GNSS)
A3	Ground segment (satcom)	A4	Satellite operations (satcom)	C4	GNSS augmentation infrastructure

Source: ISRO, Arthur D. Little analysis

ISRO Players – Human Space Flight (Upstream)

Human Space Flight Centre (HSFC)

HSFC in Bengaluru formed in 2019, focuses on Gaganyaan mission for human lunar landing, apart from end-to-end mission planning, development of Orbital Module (OM),
development of life support systems, selection and training of astronauts. It undertakes multi-disciplinary R&D activities in new domains of human science and technology, while conforming to high standards of reliability and human safety

- G4 – Human transport spacecraft
- F1 – Spacecraft safety & efficiency
- H3 – Exploration sciences

Source: ISRO, Arthur D. Little analysis

ISRO Players – Control Services (Mid-stream)

Master Control Facility (MCF)

MCF in Hasan and Bhopal monitors and controls all the Geostationary /Geosynchronous satellites of ISRO, namely, INSAT, GSAT and IRNSS series of satellites. MCF is responsible for Orbit Raising of satellites, in-orbit payload testing, and On-orbit operations.

D5	Launch services	C4	GNSS augmentation infrastructure	H3	Exploration sciences
C5	GNSS operations	E1	Secure comm. (payloads & end user terminals)	E2	Early warning and signal intelligence remote sensing
A4	Satellite operations (satcom)	H2	Observational science		

IISRO Telemetry, Tracking and Command Network (ISTRAC)

ISTRAC is entrusted with the primary responsibility of providing TTC and mission control services to major Launch Vehicle and Spacecraft missions of ISRO. In order to realise these objectives, ISTRAC has established a network of ground stations at Bengaluru, Lucknow, Mauritius, Sriharikota, Port Blair, Thiruvananthapuram, Brunei, Biak, Indonesia and the Deep Space Network Stations at Byalalu

A4	Satellite operations (satcom)	C4	GNSS augmentation infrastructure	H3	Exploration sciences
C5	GNSS operations	E1	Secure comm. (payloads & end user terminals)	C2	Ground segment (GNSS)
E2	Early warning and signal intelligence remote sensing	H4	Spacecraft control and deep space network	I4	Space situational awareness and debris mitigation
A3	Ground segment (satcom)	C3	User segment (GNSS)	A7	Other fixed & mobile sat. services (FSS & MSS)

Source: ISRO, Arthur D. Little analysis

ISRO Players – Remote Sensing (Downstream)

National Remote Sensing Centre (NRSC)

NRSC, Hyderabadis responsible for Remote Sensing Satellite data acquisition, processing and dissemination, Applications, Aerial Services, Capacity Building and Outreach.

H1	Scientific data processing and distribution	C4	GNSS augmentation infrastructure	C6	Positioning / timing services for consumers
H2	Observational science	C7	Positioning / timing services for civil gov't & enterprises	B9	EO security & intelligence
E2	Early warning and signal intelligence remote sensing	B6	Meteorology and environmental monitoring	B8	EO civil government uses & sub-app.
B5	EO data collection and com.	C3	User segment (GNSS)	C8	Positioning / timing services for security

Source: ISRO, Arthur D. Little analysis

ISRO Players – Research Labs (Downstream)

Physical Research Laboratory (PRL)

PRL, Ahmedabad is engaged in basic research in the areas of astronomy and astrophysics, solar physics, planetary science and exploration, space and atmospheric sciences, geosciences, theoretical physics, atomic, molecular & optical physics and space chemistry and to develop appropriate instrumentation.

- F1 Spacecraft safety & efficiency
- H5 Scientific instruments
- I4 Space situational awareness and debris mitigation
- H3 Exploration sciences
- H2 Observational science

National Atmospheric Research Laboratory (NARL)

NARL, Tirupati is a centre for atmospheric research and carries out its research activities in radar application & development, ionospheric & space research, atmospheric structure & dynamics, cloud & convective systems, aerosols, radiation & trace gases, weather & climate research and computers & data management.

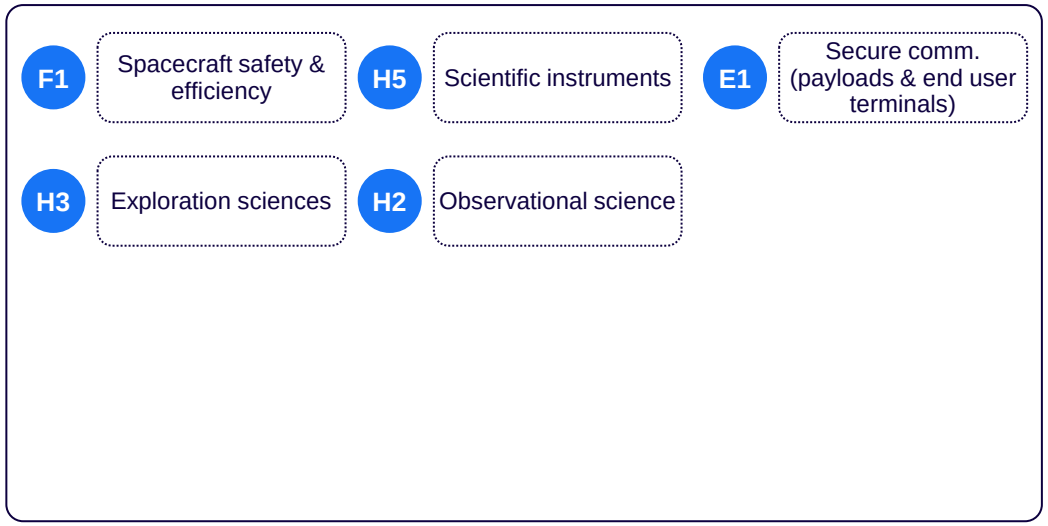
- F1 Spacecraft safety & efficiency
- H5 Scientific instruments
- I4 Scientific data processing and distribution
- B6 Meteorology and environmental monitoring
- H2 Observational science

Source: ISRO, Arthur D. Little analysis

ISRO Players – Research Labs (Downstream)

Semi-Conductor Laboratory (SCL)

SCL, Chandigarh is engaged in providing end-to-end solutions for development of application specific integrated circuits (ASICs), opto-electronics devices & micro-electromechanical system (MEMS) devices encompassing design, fabrication, assembly, packaging, testing and reliability assurance.



Source: ISRO, Arthur D. Little analysis

ISRO Players – Space Applications, Exploration and R&D (Downstream)

Space Applications Centre (SAC)

SAC, Ahmedabad is a major Research and Development Centre of ISRO. The core competence of the Centre lies in development of space borne and air borne instruments /payloads and their applications for national development and societal benefits. Besides these, the Centre also contributes significantly in scientific and planetary missions of ISRO.

H4	Spacecraft control and deep space network	H5	Scientific instruments	I4	Space situational awareness and debris mitigation
H3	Exploration sciences	H2	Observational science	H1	Scientific data processing and distribution
E1	Secure comm. (payloads & end user terminals)	B8	EO civil government uses & sub-app.	B5	EO data collection and com.
B9	EO security & intelligence	E2	Early warning and signal intelligence remote sensing	F1	Spacecraft safety & efficiency

North Eastern-Space Applications Centre (NE-SAC)

NE-SAC, Shillong provides developmental support to the North-East region using space science and technology and coordinates with the state remote sensing application centers for implementation of programs on natural resource management, infrastructure planning, emergency communication, early and atmospheric science research.

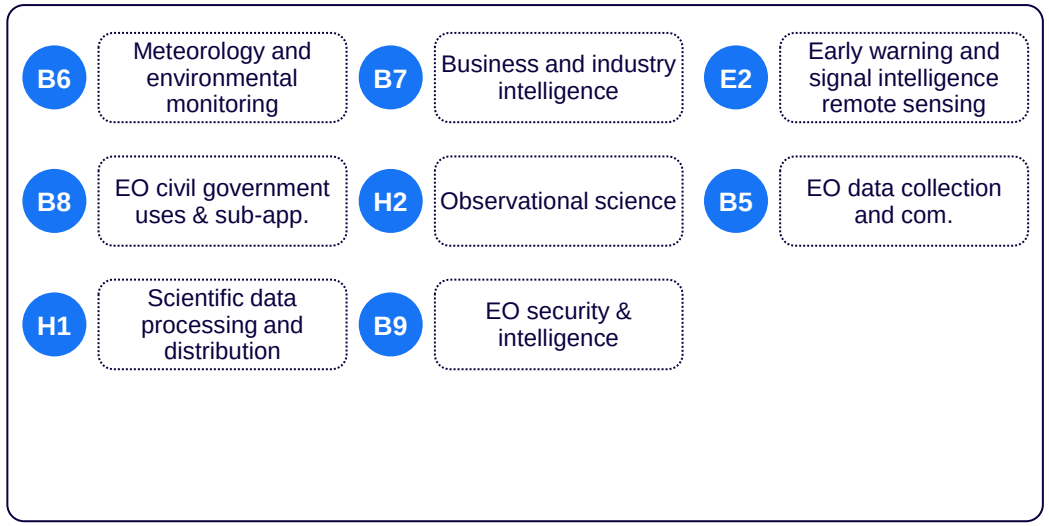
B6	Meteorology and environmental monitoring	B5	EO data collection and com.	E2	Early warning and signal intelligence remote sensing
B8	EO civil government uses & sub-app.	H5	Observational science	C6	Positioning / timing services for consumers
H1	Scientific data processing and distribution	B9	EO security & intelligence	C7	Positioning / timing services for civil gov't & enterprises
C8	Positioning / timing services for security				

Source: ISRO, Arthur D. Little analysis

ISRO Players – Space Applications, Exploration and R&D (Downstream)

Development and Educational Communication Unit (DECU)

DECU, Ahmedabad is dedicated for realizing satellite-based societal applications. DECU is involved in conceptualizing, designing, implementing, evaluating, invigorating, sustaining and upgrading SATCOM based societal applications



Source: ISRO, Arthur D. Little analysis

ISRO Players - Commercial Arms

Antrix Corporation Limited (ACL)

ACL, Bengaluru formed in 1992, is the commercial and marketing arm of ISRO, engaged in providing end-to end solution for many of the space products, ranging from supply of hardware and software including simple subsystems to a complex spacecraft, for varied applications covering communications, earth observation and scientific missions. SATCOM business segment continues to be a major revenue earner for the company amounting to approx. 60% of the operating revenue. Currently, ACL markets IRS data and services from satellites and archived imagery from past missions.

ACL is currently exploring new business opportunities under the space domain as ISRO's Transponder leasing, Launch services and Mission support, business segments which were handled by ACL, has been transferred to New Space India Limited (NSIL), since ACL was made bankrupt to minimize consequences of a serious lawsuit.

NewSpace India Limited (NSIL)

NSIL incorporated in 2019, is a public enterprise, to serve as DoS's commercial arm. NSIL's role includes facilitating business services for ISRO in areas like (i) Owning satellites for Earth Observation and Communication applications; (ii) Providing space-based Earth Observation and Communication services; (iii) Building satellites and launching them as per demand; (iv) Building launch vehicles through Indian Industry and launch as per requirements; (v) Providing launch services and (iv) Technology Transfer to Indian Industry.

A few of these services were previously marketed by ACL however, ACL now focuses on exploring new business opportunities for ISRO under space sector. Technology and space knowledge transfer to private entities in India was a new role assumed by NSIL.

Source: ISRO, Arthur D. Little analysis

Satellite based TV providers in India (DTH)

Company	Launch Date	Subscribers	Ownership	Satellite
DD Free Dish	Dec 2004	~40 mn	Prasar Bharti (Govt. of India)	GSAT-15 by ISRO launched in 2015 for 12 years
TATA Sky	Aug 2006	~23.5 mn	Tata Sons (60%), The Walt Disney Company (30%), Temasek (10%)	GSAT-10 by ISRO launched in 2012 for 15 years
Dish TV + Videocon d2h + Zing Digital	Oct 2003	~18.1 mn	Zee Group (55%), Videocon (45%)	NSS-6 by SES S.A. (2002 for 15 years), AsiaSat 5 by AsiaSat (2009 for 15 years), ST-2 by Singtel (2011 for 15 years)
Airtel Digital TV	Oct 2008	~17.9 mn	Bharti Airtel (80%), Warburg Pincus (20%)	SES-7 by SES S.A. launched in 2009 for 15 years
Sun Direct	Dec 2007	~11.6 mn	Sun Group (80%), Astro Group (20%)	MEASAT-3 by MEASAT (2006 for 15 years), GSAT-15 by ISRO (2015 for 12 years)

Source: TRAI, Arthur D. Little analysis
The Department of Space (DoS) requires all DTH operators in India to only use satellites commissioned by ISRO. DTH operators may use capacity leased by ISRO from foreign satellites only if sufficient capacity is not available on ISRO satellites

Top Suppliers of Satellite parts and services to ISRO in India

Alpha Design Technologies Pvt. Ltd.

Alpha Design, **Bengaluru,** now owned by Adani, was established in **2004**, specializes in R&D, manufacturing, AIT of defense, electronics, avionics, space satellite systems with focus on aerospace, communication, navigation and optronics technology

- Satellite, ground and navigation equipment like 1.2m C Band Fly Away VSAT, 8 channel Burst Demodulator, Antenna Control System, Distress Alert Transmitter, Dual Band Antenna, GPS/Navic Receiver, Vehicle Tracking Unit, Indian Rail Navigator, Power Module Unit, Rail MSS Terminal Locomotive
- Satellite Servicing like AIT, design and development, installation, commissioning, training and maintenance

Avasarala Technologies Limited

Avasarala Technologies in **Bengaluru** started in **1985** as a high technology engineering company in areas like nuclear power, factory automation, aerospace & defense, space products, medical equipment and R & D institutions

- Satellite Integration and Testing
- Thermal System Fabrication; Thermovac Chamber
- CNC Perforating and Ion Beam Polishing machine
- Conformal Coating Unit, Casting Facility, NDT
- Bowl Cleaning, Mixing Instrumentation
- Hardware and Surface Preparation System
- Heat pipes, wave guides, solar array development mechanism component, and other space products and equipment

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Bharat Electronics Limited (BEL)

BEL is a 1954 established public unit which manufactures electronic products for the Army, Navy, Air Force and others in homeland security solutions, smart cities, space electronics including satellite integration, energy storage products, transport solutions etc.

- It is a major supplier to ISRO and DRDO for SATCOM equipment and parts, radars, broadcasting systems, etc in their milestone missions and initiatives
- Some of its space related products include C band and Ku band receivers, Invar Filters, L band demodulators, ground terminal equipment for MSS, GSAT terminals, solar cells, NAVIC receivers, etc.

TATA Advanced Systems Limited (TASL)

TASL, is a 2007 formed aerospace and defense arm of TATA group in Hyderabad, with capabilities in missile, radar, command and control systems, aero structures, unmanned aerial systems, optronic and security solutions, etc.

- Mostly helps ISRO in satellite integration, and testing, manufacturing of aerospace and satellite structures especially for satellites used in defense

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Walchandnagar Industries Limited (WIL)

WIL, Pune's Technology Group has over 100 years of experience in engineering solutions for nuclear and thermal plants, oil and gas, defense, design engineering of complex projects, and special purpose machine and R & D projects

- WIL's association with ISRO started in 1973, with manufacturing of motor cases for SLV-3
- Manufactures booster motor casings and nozzles for the ISRO space programs commencing from SLV-3, ASLV to PSLV & GSLV Mk II and Mk III
- Equipment manufactured by WIL, have been used in the launching of 'ROHINI', 'SROSS', 'IRS', 'G-SAT' and other satellites and missions like Chandrayan-1 and Mangalyaan

MTAR Technologies Pvt. Ltd.

MTAR Hyderabad, established in 1970, is into manufacturing various machine equipment, assemblies, sub-assemblies, and spare parts for energy, nuclear, space, aerospace, defense and other engineering industries

- Supplier to ISRO for last 30 years, manufacturing liquid propulsion engines, cryogenic engines like boosters, gas generator, electro-pneumatic modules used in launch vehicles, LSRV for satellite precision ball screws and hydraulic actuator assemblies for PSLV, GSLV, other satellites of ISRO
- The engine for the PSLV-C25, which launched the Mars Orbiter Mission Spacecraft, as part of the Mangalyaan mission, was supplied to ISRO by MTAR

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Centum Electronics Limited

Centum Electronics Limited
TEAMWORK | TECHNOLOGY | TRUST

Centum, formed in 1994 in Bengaluru, offers design, development, manufacturing and turnkey solutions for space, aerospace, defense, communication, auto, transport, medical, industry and energy in NA, EMEA and Asia

- Satellite Bus Systems (subsystems for remote sensing, geo-stationary, navigation and scientific mission satellites, modules for control, sensors, telemetry, sensors)
- Design and Development of Test Tools
- Power Management, LRU, and Data Recorders (embedded power convertors especially for aerospace and defence, etc.)

Paras Defence & Space Technologies Ltd.

Paras Defence formed in 1972, is in design, development and testing of defense and space engineering products such as space optics, defense electronics, electro-magnetic pulse protection solution, and heavy engineering.

- Supplier to ISRO for Aditya L1, Chandrayaan-2, Mangalyaan, Resource SAT 3S ISRO, etc.
- Its space related products include diffractive gratings, multifold lenses, reflectors and costings, metal mirrors, IR lenses, gyro blocks, zerodur lenses, optical domes, lens barrel, ultra precision manufacturing, deployable space antenna, CFRP structures for space applications, etc.

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Godrej & Boyce

Godrej & Boyce, Mumbai founded in 1897, offers complex and custom engineering solutions for critical industries like aerospace, defense, clean energy, railways and automotive to manufacturing branded goods, etc.

- Tier 1 partner to ISRO for its various space missions and numerous satellite launches
- Develops liquid propulsions engines for launch vehicles, complex thrusters for satellites, high precision equipment, space engines and spacecraft components, complex assemblies for cryogenic and semi cryogenic engines for launch vehicles

Larsen & Toubro

Larsen & Toubro, Mumbai is an Indian multinational, founded in 1938, and engaged in engineering, construction, procurement projects, hi-tech manufacturing and services in across a diverse range of industries including financial and IT

- Associated wit India's space program since 1975, contributed to Chandrayaan-2, Mangalyaan, and single launch of 104 satellites in 2017 by ISRO, etc.
- S139 motor castings (middle segment), honeycomb deck panels was produced by L&T, used in PSLV-C37
- DSN antenna for tracking, Antenna mount structure, 13m diameter bull gear, C-band precision mono-pulse tracking radar, critical booster, heat shields, etc. was installed and commissioned by L&T

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Lakshmi Technology & Engineering Industries (LTE)

LTE incorporated in 1968, ventured into aerospace in 2004, engaged in the manufacture of high precision parts, realization of subassemblies, integrated production of subsystems, control valves, sensors, actuators for aerospace and other highly tech intensive sectors

- High precision parts & assemblies for Launch vehicle applications
- IPCS phase-2 components, sub-assemblies and module assemblies for PSLV
- Fabrication and supply of DC torque motors and DC Electrical actuators and fabricated parts for Various sub systems of launch vehicles

SASMOS HET Technologies Ltd.

SASMOS Bengaluru, since 2007 manufactures wiring harness and electric panels, electro-mechanical assemblies and unit integration products in the aerospace, defense, marine and nuclear industry

- SASMOS's clientele in space sector includes ISRO, it produces harnesses (satellite, battery, power module, solar panel, propulsion, umbilical), electro-mechanical parts (anti-backlash spur gear, precision ball screw mechanism, dual gyro assembly), electronics (isolated pressure signal condition module, embedded software, mission critical systems)

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Hindustan Aeronautics Limited (HAL)

HAL, Bengaluru is an Indian state-owned aerospace and defense company established in 1940, involved in designing and manufacturing of fighter jets, helicopters, jet engine and marine gas turbine engine, avionics, software development, spare supply, overhauling, etc.

- Some of the important structures manufactured are Heat Shield Assembly, Nose Cone Assembly and propellant Tank and Shrouds, aluminum alloy riveted structures used in Satellites like INSAT, IRS, etc.
- Full equipping & integration of the strap on L – 40 stage for GSLV MkII and manufacture of all riveted structures & welded tankages for a larger GSLV MK III vehicle with enhanced capabilities, etc.

Transpace Technologies Pvt. Ltd.

Transpace started in 2008 in Bengaluru, provides engineering solutions for medical electronics, aerospace, defense, and other industrial electronic applications

- Concept to proto design, satellite sub- systems, hi-Rel test equipment, avionics, embedded system solutions, EDA solutions, medical electronic equipment, devices and implants, on-board satellite sub-systems fabrication, testing, reliability analysis and PCB design

Source: Company Websites, Arthur D. Little analysis

Top Suppliers of Satellite parts and services to ISRO in India

Vajra Rubber Products Pvt. Ltd.

Vajra, Kerala established in 1989, is a fully integrated manufacturer of custom molded rubber, plastic and composite components for marine, railway, energy, defense, aerospace, auto, etc.

- Develops products ranging from small O-rings to sophisticated rocket seals
- Only manufacturer in India to have developed the directional control unit of a rocket called the 'FLEX SEAL'; supplied critical components for Chandrayaan & Mangalyaan
- Manufactured the ABLATIVE TILE for Gaganyaan mission

Mishra Dhatu Nigam Limited (MIDHANI)

Midhani is a public sector enterprise established in 1973, to produce super alloys, special steel, materials to defense, and other sectors such as space, aeronautics, and nuclear

- 70% of Midhani's products (value wise) cater to strategic customers like OFB, DRDO, ISRO,HAL, and DAE etc. In addition, it supplies special alloys and products to commercial sector including Larsen & Toubro, BHEL, Titanium equipment etc.
- It has a monopoly in supplying ultra-high-strength steel for rockets and satellites to ISRO and others

Source: Company Websites, Arthur D. Little analysis

The Indian Space-tech Start-up ecosystem is on the Rise

	Agnikul Cosmos	Skyroot Aerospace
	Founded in **2017**, in Chennai	Founded in **2017**, in Hyderabad
	Launch Vehicle segment - Small lift launch systems	**Launch Vehicle segment - Small lift launch systems**
	Flagship Product **– Agnibaan** (**Launch Vehicle**; max payload: 100 Kg to 700 Km LEO) Also has Agnilet (**single-piece, 3D printed**, semi-cryonic **engine successfully** tested in 2021) and Dhanush (**Launch pedestal**)	Flagship Series **– Vikram I, II, and III** (**Launch Vehicle**; max payloads: 225-580 Kg to 500 Km SSPO or 315-720 Kg to 45 degrees 500 Km LEO) All 3 have the **lowest costs** in payload segments and can be assembled and launched within **24-72 hours from any launch site.**
Partners:	इसरो isro; CIIE	**Partners:** इसरो isro; BELLATRIX AEROSPACE
	Total Funding - $14.2 mn Latest Funding - $11 mn; Series A; 2021	Total Funding - $12.5 mn Latest Funding - $11 mn; Series A; 2021

Source: Company Websites, Arthur D. Little analysis

The Indian Space-tech Start-up ecosystem is on the Rise

	Pixxel	Vesta Space Tech
	Founded in **2019**, in Bengaluru	Founded in **2018**, in Pune
	Earth Observation Segment – small/micro/nano **satellite manufacturing**, **EO data collection** for **Business and Industry Intelligence**	Launch Services, Building Platforms for Small and Nano Satellites, Ground Station services, Space Data, Mission planning and analysis
	Aiming to **launch satellite constellations** containing 36 satellites by end of 2023; Will use **data from hyperspectral imaging** to improve the **earth's health,** to **boost yields** across sectors, and to **map in-space resources**.	Helping **startups/mid-sized businesses** access benefits of **small satellites, SATCOM, sensors and connected** devices. **Space Data Gateway service** is set to revolutionize Ground Segment operations and Mission Control
	Partners: इसरो ISRO, MAXAR, NASA JPL Jet Propulsion Laboratory	**Partners:** इसरो ISRO
	Total Funding - $12.3 mn Latest Funding - $7.3 mn; Seed; 2021	Total Funding - $10 mn Latest Funding - $10 mn; 2020

Source: Company Websites, Arthur D. Little analysis

The Indian Space-tech Start-up ecosystem is on the Rise

	Bellatrix Aerospace	Dhruva Space
	Founded in **2015**, in Bangalore	Founded in **2012** , in Hyderabad
	Space Aeronautics – building advanced electric spacecraft propulsion systems, reusable Satellite Launch Vehicles, Orbital Transfer Vehicles (OTV)	**SATCOM (Ground Stations) and Launch segments –** satellite platforms, orbital deployers, hosted payloads, launch solutions
	Building a **Space Taxi for small satellites** through its OTV aboard Skyroot's Vikram rocket Microwave Plasma Thrusters offer the **highest thrust-to-power ratio** for heavier satellites	multiple technical proposals under review by ISRO by Dhruva Space for development of critical technologies for **Gangayaan (Human Space Flight Mission)**; also working on mission concepts for lunar and Mars communication networks
	Partners: SKYROOT AEROSPACE, SatSure, DHRUVA SPACE	**Partners:** इसरो isro, DRDO, SKYROOT AEROSPACE
	Total Funding - $3.01 mn Latest Funding - $3mn; Pre-Series A; 2019	Total Funding - $1.35 mn Latest Funding - $669,000; Seed; 2020

Source: Company Websites, Arthur D. Little analysis

The Indian Space-tech Start-up ecosystem is on the Rise

Other Rising Players

Azista-BST Aerospace

- Joint Venture between Azista Industries (Azista) and Berlin Space Technologies GmbH (BST)
- Bringing up a **single-roof satellite manufacturing** facility in Ahmedabad with high volume production capacity
- These satellites will be engineered in Germany
- Intends to harness opportunities in **low-earth orbit satellite** constellation applications especially in the **small-satellite segment**

Satellize (formerly Exseed Space)

- Builds customized nanosatellites and offers satellite solutions and services for Education & Research, Defence & Security, Agriculture, Oil & Gas and Logistics
- Has two satellites orbiting the earth currently
- Successfully launched on both SpaceX and ISRO rockets; space-qualified on both platforms
- Will be launching its own experimental satellite meant for High Frequency radio transmission

Source: Company Websites, Arthur D. Little analysis

Other Private Players in the Space-tech ecosystem

Manufacturers

SpanTrik

Develops new technology in **rocket launching** and **propulsion**; also builds on **Small Satellites**

TritonArc

Designs more affordable **Electric propulsion systems**

MeghVaahan

Designs, Develops and Manufactures unmanned air, vehicles, **Spacecraft Engines, Navigation systems, Space Optics, and Satellites** for various applications.

TritonArc

Manufactures **Space Engines** and **propulsion** systems; provides low-cost **satellite launch services** (launch from sea and land on port, **reusability** feature on heavier launch vehicles)

Velocity

Designs and **Builds environmentally conscious propulsion systems**; avionics engineering

SpaceCurve

Designs and manufactures **rocket engines** and **Launch Vehicles**

Source: Company Websites, Arthur D. Little analysis

Other Private Players in the Space-tech ecosystem

Manufacturers

Manastu Space

Provides engineering solutions in **Space Transportation**, including **green propulsion** systems; enables **30% savings** for satellite manufacturers and launchers per launch (I-booster); **S-booster award 2019 by JAXA**;

Abyom SpaceTech & Defence

Designs and builds **Reusable Launch Vehicles (RLV)** with different commercial projects related to Aeronautics and Defence; also involved in Space Education and Exploration

Satellite Technologies

Xovian

Provides **low-cost sustainable** solutions in **satellite technologies**. Has presence in Space Education, CANSAT, **Sounding Rockets, High Altitude balloons**, and Satellite components manufacturing

N Space Tech

Builds CubeSats and Femto Satellites for research and educational purposes; also provides the **required software services and ground stations** at affordable prices

Source: Company Websites, Arthur D. Little analysis

Other Private Players in the Space-tech ecosystem

SATCOM/ Earth Observation

Astrome

Its patented millimetre wave technology – **SpaceNet** – **reduces the cost of internet delivery by 2000 times** compared to the state-of-the-art terrestrial networks by packing more **data capacity in every micro-satellite**

Sumeru Microwave Communications Ltd

Designs, builds and supplies **VSAT antennae** across C/KU Band Antenna, KA Band antenna, and Drive away Antenna

Astrogate Labs

Enables **high-speed communications for small-satellites** with laser communication solutions; solutions are SWaP (size, weight and power) compatible for cube/nanosats

SatSure

Set to **launch its own EO satellite fleet** with **Bellatrix Aerospace**; Innovative **decision analytics** using **satellites remote sensing** (along with ML and Big Data Analytics) to answer questions **across industries**

Source: Company Websites, Arthur D. Little analysis

Other Private Players in the Space-tech ecosystem

Research & Development

- Entropy R&D
- Space Zone India
- Antriksh Labs
- ARDL, IISc

Space Mission Planning/ Space Education

- SatMaks Kerala
- Team Indus
- Aniara Spacecom LLC
- Earth2Orbit (E2O)

Source: Company Websites, Arthur D. Little analysis

Other Private Players in the Space-tech ecosystem

Private Space Data Analytics and GIS Intelligence Players

Speck Systems Ltd.	Pixxel
SatSure	Geospoc
Earth Analytics India	SpaceGeo
Kawa Space	ASL Advanced Systems
Cyient	Esri India
Marvel Geospatial	Global Climate Risk Solutions

Source: Company Websites, Arthur D. Little analysis