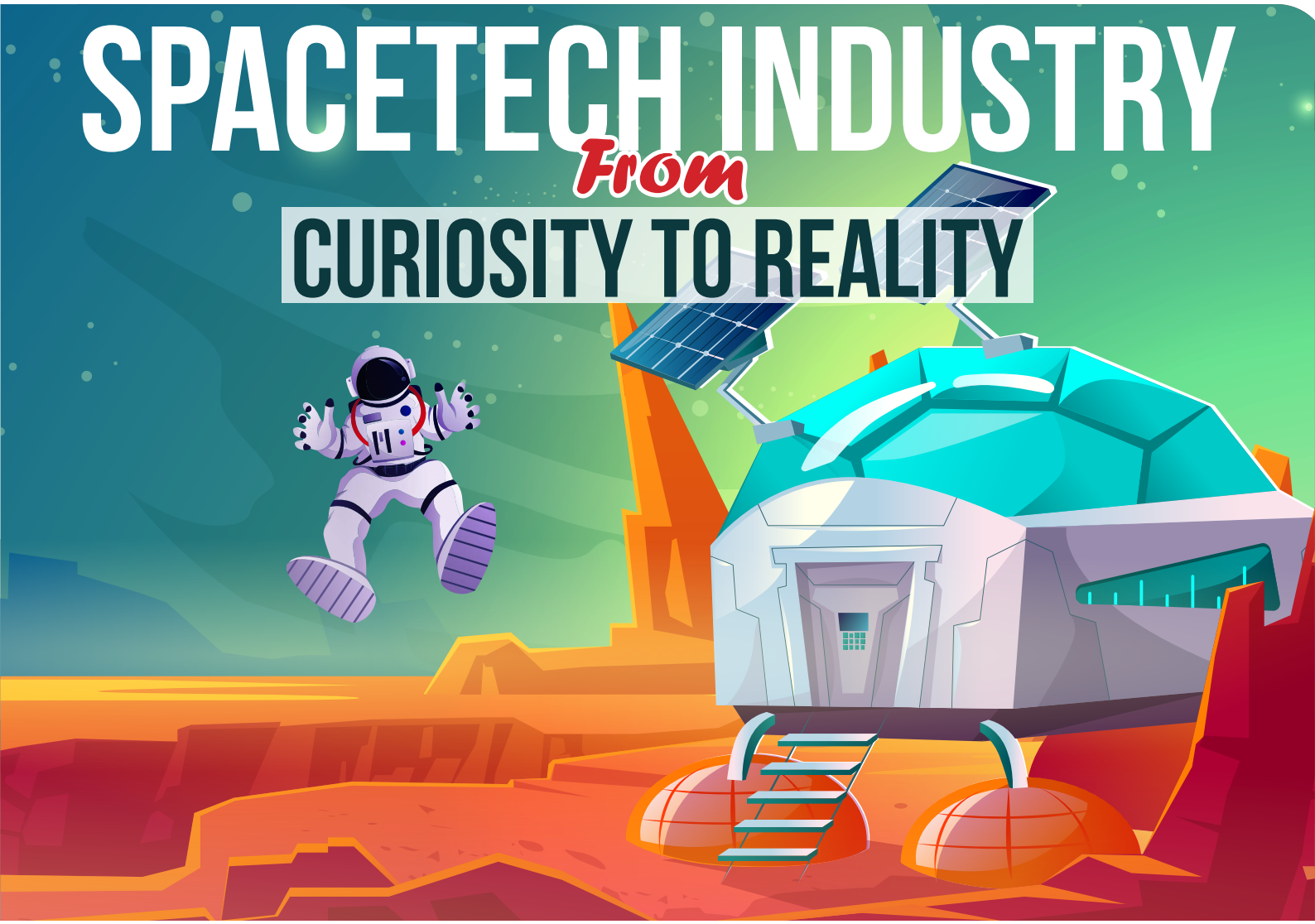
SPACETECH INDUSTRY From CURIOSITY TO REALITY



In the vast expanse of space, **humanity has expanded its imagination and intellect** to develop **tools, vehicles, and systems that push the boundaries of what is possible.** From the launch vehicles that breach Earth's atmosphere to the sophisticated satellites that orbit our planet, **space technology is a testament to human ingenuity and our innate curiosity about the cosmos.**

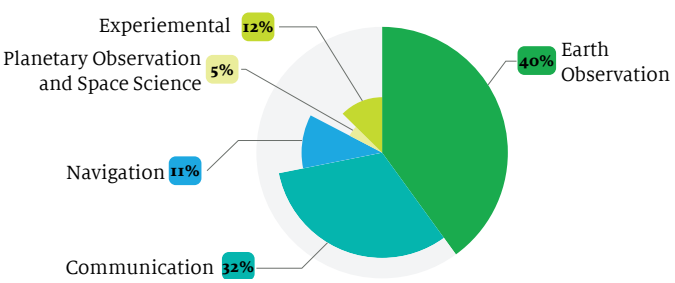
IN THIS DOCUMENT

1. What is Space technology?

Space tech industry involves the **development and application of technology** for activities related to outer space, **including satellite communication, exploration, and space travel**. It encompasses **design, manufacturing, and operation of spacecraft, satellites**, and other equipment used in space missions and applications.

Figure 1.1. Snapshot of SpaceTech Industry

The **global space industry was valued at USD** 386Bn **in 2021** and is expected to grow to about USD 1 Trillion by 2040.

India occupies a meagre **2% of global market value**	India has potential to **capture 9% of global market share by 2030**	India boasts **world's 8th largest fleet of operational satellites**	From 1999 to 2022, **381 satellites from 34 different countries have been launched from India.**	**Application-wise Split of Indian Spacecrafts Launched by ISRO** 

Broad classification of the space technology sector

Upstream Segment	Downstream Segment	Auxiliary Segment
This segment refers to all activities, products and infrastructure ensuring the **development, testing, launching, operations and monitoring (including space situational awareness)** of space assets. It includes emerging areas of leveraging in situ usage of space viz, **space tourism, space-based manufacturing, space mining,** etc.	Primarily sub-segmented into **Earth Observation (EO), Satellite Communication (SATCOM), Positioning, Navigation & timing (PNT),** this segment refers to all applications, services and devices relying on **satellites to create business value.** This includes dual-purpose services and applications that cater to strategic requirements.	Primarily refering to activities, **products and services derived from space technology in other sectors,** such as manufacturing and health. It includes additional space-related activities such **as space insurance and awareness, education and training.**

2. What does SpaceTech offer?

SpaceTech offers **new means to address global challenges** encompassing satellites, space stations, ground stations, monitoring and tracking centres etc. Over the past six decades, this purpose has created an ecosystem that continues to generate solutions **critical socio-economic and strategic sectors:**

Table 2.1. Applications of SpaceTech

End users	Applications
Broadcasting	➢ **Drivers:** Today, there are 898 satellite TV channels, 7 DTH catering to ~101 Mn households. ▷ **Increasing adoption of entertainment services** in rural India. ▷ **Extending satellite bandwidth to OTT players** has the potential to increase the market size ➢ **Emerging Use-Cases :** Ultra-High-Definition Broadcasting, Video on Demand Services, Integration with smart appliances, Personalized content streaming etc.

Disaster Management	➢ **Disaster Response Management:** In the event of floods, earthquakes, landslides, forest fires, droughts or cyclones & tsunamis satellite imagery has been used **to coordinate relief efforts and assess damages to property and lives.** ➢ **Emerging Use-Cases:** Predicting forest fires, Snow cap/glaciers melting rate, Riverbank monitoring for flood predictions etc.
Infrastructure	➢ **Terrain Mapping, Topographic Surveys and Planning:** driving initiatives such as **Gati Shakti** can boost the effectiveness of the capital expenditure. ▷ This can aid in **the better planning of roads, ports, industrial zones, power grids etc.** ➢ **Emerging Use-Cases:** Asset Utilization monitoring, Satellite image based Building Construction Information Model etc.
Maritime	➢ **Cargo:** With ~95% of India's merchandise trade being conducted through its ports; cargo emerges as an important & significant use case within the maritime sector in India. ➢ **Emerging Use-Cases :** Remote ship diagnostics, Integrated fleet management, Autonomous ship navigation etc.
Agriculture	➢ **Focus Area:** Earth observation for crop insurance and monitoring for horticulture have a **market potential of ~USD 1.35 billion** over the next 5 years. ▷ **With PM-Fasal Bima Yojana,** Government of India aims to increase the insurance penetration. ➢ **Other areas:** Integrated watershed management, Irrigation Management, Soil Mapping etc.

Box 2.1. In conversation: SpaceTech Industry and Defence

Vinay

Hey Vinay. Yesterday I was reading about the Space Technology industry. It's amazing how it is used for so many things like exploring planets and studying the universe.

Absolutely! But did you know it's also crucial in defence as well?

Really? How so?

Satellites help in monitoring borders and tracking enemy movements.

That's interesting. And they're important for GPS too, right?

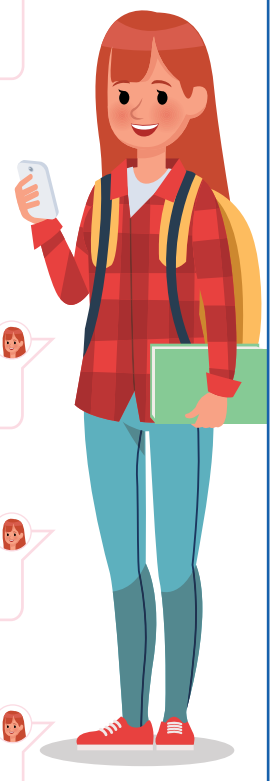
Exactly! Plus, there are anti-satellite weapons to protect or disable satellites.

I heard about that. But doesn't destroying satellites create space debris?

Yes, it's a big concern. Space debris could potentially destroy satellites.

So, Space Technology in defence is not just about power. It's about smart strategies and at the same time understanding your responsibility.

True. If done right, it's a growing field with a lot of potential.



Vini

3. Key milestones: How has SpaceTech evolved in India?

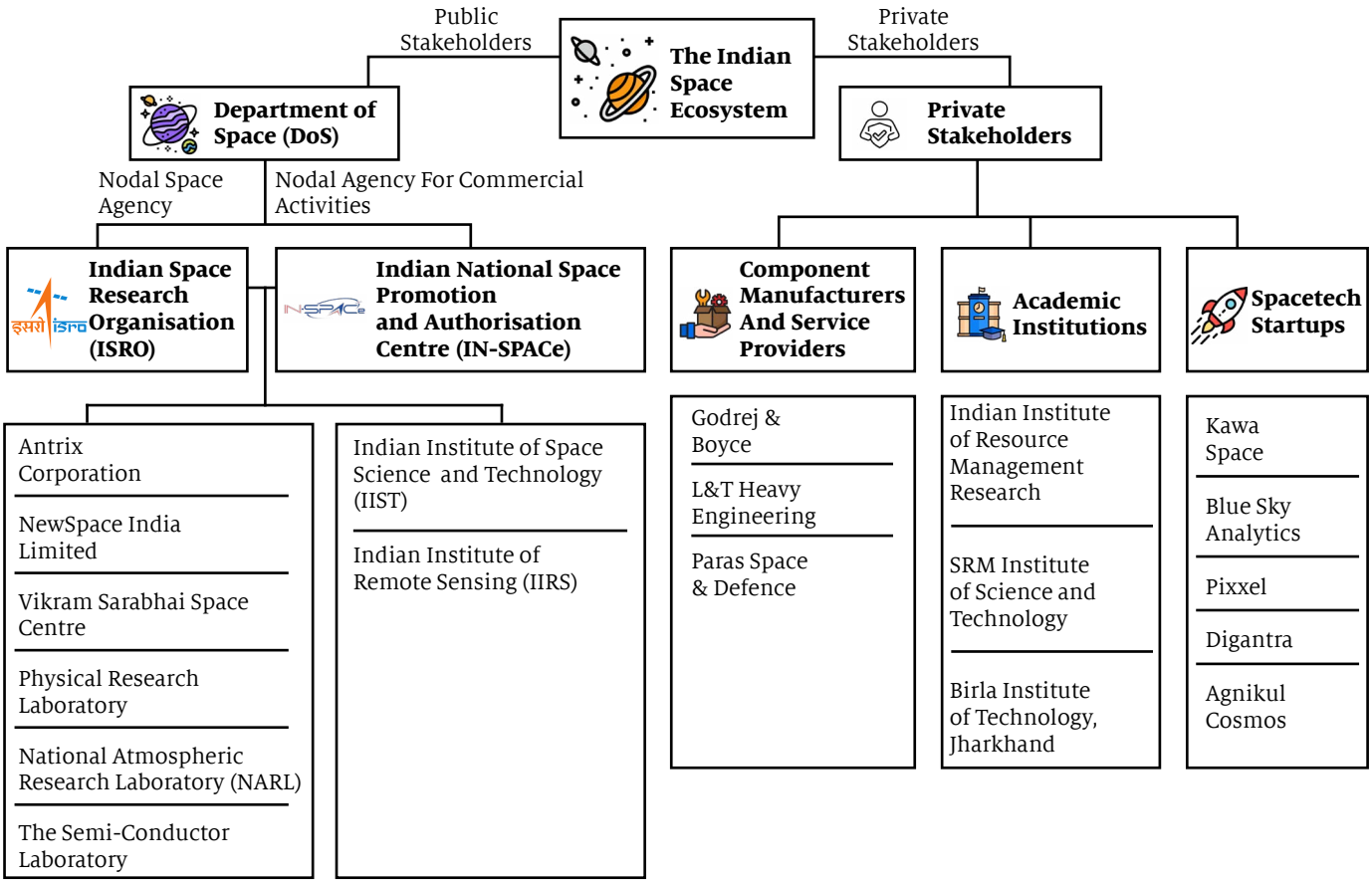
India's journey in space technology has been marked by **significant progress and achievements**, evolving from **humble beginnings** to becoming **a notable player** in the global space community.

- **Formative Phase (1960's to 1980's) :**
  - **1962: Establishment of INCOSPAR** to formulate and execute India's space program.
  - **1972: ISRO was established** superseding INCOSPAR to leverage space technology.
  - **1975:** India with help of Soviet Union launched its 1st satellite Aryabhatta.
  - **1980:** ISRO developed its 1st Satellite Launch Vehicle -3 (SLV-3). Placing Rohini satellite (RS-1) in orbit.
  - **1988: ISRO started remote sensing programme** with **objective** to apply space technology for **socio economic development.**
- **Conservative Phase (1990-2019):**
  - **1992: Antrix Corporation established** to explore commercial aspects of Satcom & launch services.
  - **1994: India successfully launched its first PSLV.** It enabled ISRO to launch LEO & GTO satellites plus facilitate the launch of foreign satellites.

Between 1990 to 2019, India experienced numerous advancements in space technologies and international partnerships. However, **the space sector remained heavily protected & privatisation** was discouraged due to national security concerns.

- **Progressive Phase (2019 onwards)**
  - The **NewSpace India Limited (NSIL),** the commercial arm of ISRO was founded to enable Indian industries **to take up high-technology space-related activities.**
  - **Government announced the privatisation of the space sector** and released the **Spacecom 2020 Policy** to facilitate public-private cooperation.
    - » **IN-SPACe (Indian National Space Promotion and Authorisation Centre) was also introduced** to act as an interface between **ISRO and private parties.**
  - **Up to 100% FDI is allowed** for satellite establishments and operations, subject to sectoral guidelines under the government route.
  - **ISRO will shift focus towards R&D**, moving away from manufacturing of operational space system.

Figure 3.1. Key custodians of the Indian SpaceTech Industry



4. What are the key challenges faced by SpaceTech In India?

While India has made significant strides in the field of space technology, there are several key challenges that the country faces in this domain:

- **Technology Gaps:** Bridging technology gaps and achieving self-sufficiency in critical areas remains a challenge as India relies on imports for certain advanced space technologies. E.g., high strength carbon-carbon fibres, space qualified Solar Cells etc.
- **Infrastructure Constraints:** Indian SpaceTech startups face infrastructure gaps that hinders quick prototyping and experimentation. This is due in part to the absence of advanced testing and launch facilities accessible to private companies.
- **Workforce Shortage:** There has been a constant dearth for trained scientists, engineers, and technicians to meet the demands of an expanding space program.
- **Increasing Commercial Competition:** The global space industry is becoming increasingly commercialized, with private companies entering the sector.
  - India needs to compete with these entities while fostering collaboration for mutual benefit.
- **Hurdles for private sector participation:**
  - **Absence of a clear national space legislation,** which leads to a lack of clarity on planning and conducting space-related business activities in the country
  - **Lack of awareness** about the dynamics and demands of the global space industry, as the Indian Private Space sector is very nascent.
  - **Investor reluctance to back early-stage startups** has led to a diminished number of new ventures in the sector.
  - **High-risk nature of SpaceTech projects** tends to make investors cautious, posing an obstacle for startups seeking funding.

Box 4.1. Development vs. Space conundrum

Why are we building satellites for space when there are so many basic problems to fix in the country?

Sustainable Development Goals (SDGs, or Global Goals) unanimously adopted at the **United Nations in 2015, are a great summary of the world's current challenges.** Space is one of many important tools that can be used to help us address them. Following examples illustrate this idea:

Earth imaging satellites

- **Goal 2: Ending Hunger** - Satellite imagery can estimate crop yield on a pixel-by-pixel basis – enabling farmers to better decide when to add water or fertilizer and when to harvest.
- **Goal 6: Clean Water** - Satellite images enable broad and efficient monitoring of reservoir water levels, providing early warning of shortages thus enabling optimal usage.
- **Goal 13: Climate Action**- Often the earliest and clearest indications of climate change can be observed in very remote regions of the world.
- **Goal 14: Life Below Water - Satellites can help track and stop illegal fishing** by pairing vessel Automatic Identification System (AIS) transponders.

Communication satellites

- **Goals 3 and 4: Good Health and Well-being; and Quality Education - Just 50% of Earth's 7.5 billion people have access to the internet.** A global network of **communications satellites could enable internet connectivity** to a clear majority of people.
  - **With access to the internet** comes increased knowledge sharing, the benefits of the best **doctors and teachers via tele-medicine and digital and online education** among others.

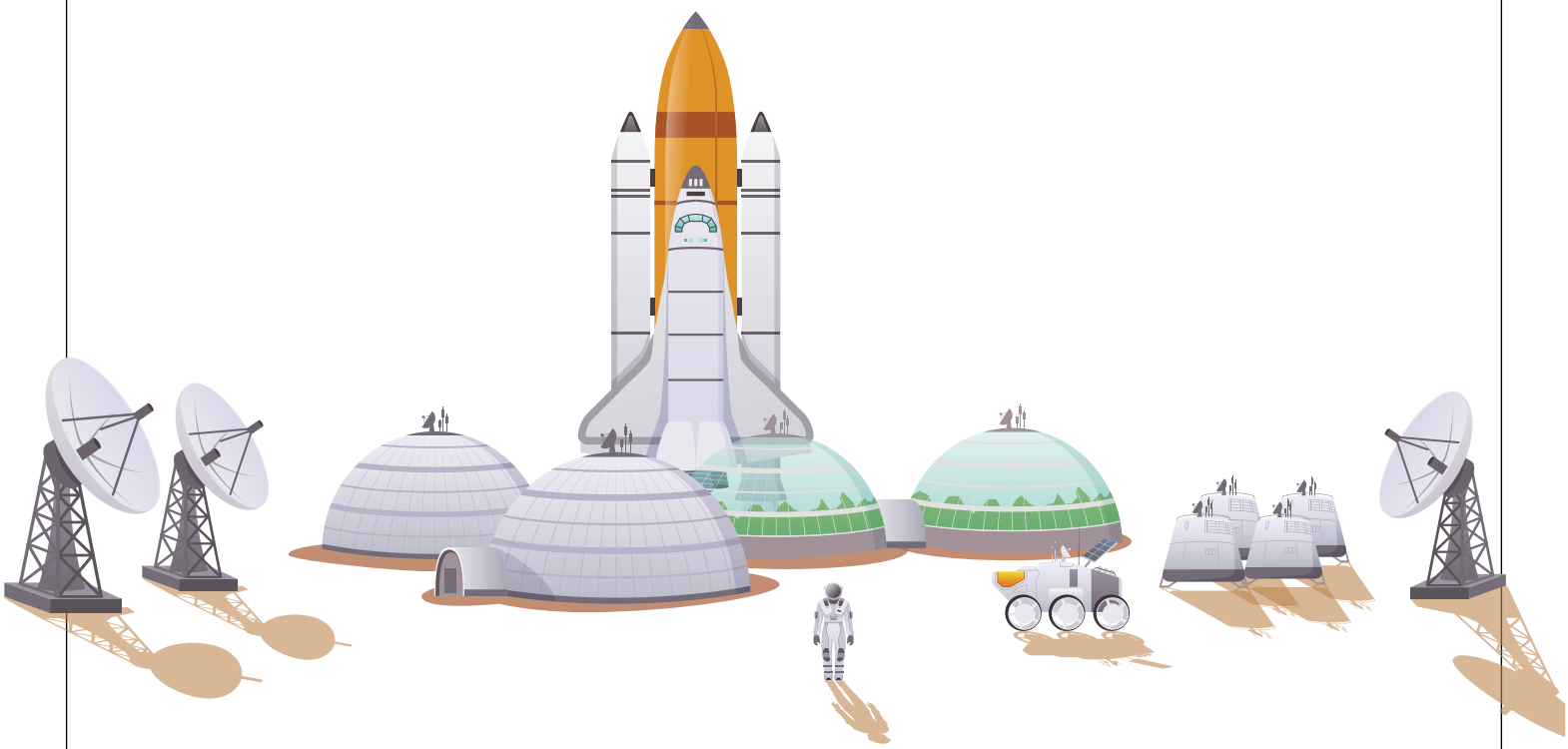
5. Road ahead

India possesses **the core capabilities** to become a major player in the **global commercial space market**. But realizing it would require a **multi-faceted approach involving strategic planning, investment, innovation, and collaboration-**

- **Regulation/policy:** Under the current framework, regulatory approvals are required from multiple agencies such as DoS, DoT and/or MoIB for the establishment of upstream/downstream space activities.
  - **A single window approval process** through a nodal body focused on the space economy would aid and ease the process that shall further help ease of doing business.
- **Improve access to technology** for the Industrial sector which will indirectly improve cost competitiveness and improve innovation potential.
  - **ISRO can act as an enabler for boosting R&D** by way of technology transfer, collaborations, and sharing of infrastructure that shall help achieve wider participation from the industry.
  - **Collaboration between the ISRO-academia-industry** on satellite technology can be envisioned.
- **Skills development:** Develop competency in systems engineering for the space segment, conducting training on how to operate satellites skilfully.
- **International Collaboration:** International collaborations can provide access to new technologies, shared resources, and diversified expertise.
- **Public-Private Partnerships:** Foster collaboration between government space agencies and the private sector.
  - **Encourage private investment in space ventures, satellite manufacturing, launch services, and other space-related activities.**
- **Giving a larger role to the private sector:** The private industry is well placed to take up a leading role in meeting security, R&D, and innovation needs **as ISRO shifts its focus towards pursuing research, development** and innovation.
  - **Privatisation of manufacturing in the space sector** will also help India capture a larger share of the global market.

Conclusion

As **India's space technology** sector continues to evolve, it holds the promise of not only contributing significantly to the **country's socio-economic development** but also playing a pivotal role in **global space exploration and cooperation**. With a strategic and holistic approach, the Indian SpaceTech industry can overcome challenges and chart a course towards new frontiers of innovation and discovery.



TOPIC AT A GLANCE

SpaceTech Industry: From Curiosity to Reality

Space tech industry involves the **development and application of technology** for activities related to outer space, **including satellite communication, exploration, and space travel.** It encompasses **design, manufacturing, and operation of spacecraft, satellites**, and other equipment used in space missions and applications.

Applications of SpaceTech

- **Disaster Response Management** in the event of floods, earthquakes, landslides, forest fires etc.
- **Terrain Mapping, Topographic Surveys and Planning** for **better planning of infrastructure.**
- **Earth observation** for **crop insurance**, integrated watershed management, Irrigation Management, Soil Mapping etc.
- **Remote ship diagnostics,** Integrated fleet management, Autonomous ship navigation etc.

Key challenges

- Bridging **technology gaps and achieving self-sufficiency** in critical areas remains a challenge.
- **Infrastructure gaps** that hinders quick prototyping and experimentation.
- A **constant dearth of trained scientists, engineers, and technicians** to meet the demands of an expanding space program.
- **Increasing Commercial Competition** as the Global space industry is becoming increasingly commercialized.
- **Hurdles for private sector participation** like Investor reluctance to back early-stage startups, lack of awareness etc.

Way Forward

- **A single window approval process** through a nodal body focused on the space economy would aid and ease the process that shall further **help ease of doing business.**
- **Improve access to technology** for the Industrial sector which will indirectly improve cost competitiveness and improve innovation potential.
- **International collaborations** can provide access to new technologies, shared resources, and diversified expertise.
- Foster collaboration between **government, space agencies and the private sector.**
- **Privatisation of manufacturing in the space sector** will also help India capture a larger share of the global market.

Figures, Tables and Boxes