POSITION PAPER

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India's Emerging NewSpace Ecosystem

A Gain for the Country, with many lessons-learned, but a Talent Challenge for ISRO

Key Takeaways

India's NewSpace sector is transitioning from early-stage emergence to a structurally significant component of the national space economy. This shift is creating both opportunity and tension within the broader ecosystem.

- India's private space sector is expanding rapidly across launch systems, satellites, propulsion, and downstream services, with **over 150 space startups registered in India as of 2024**, signaling a maturing industrial base built on Indian Space Research Organization 's (ISRO) foundational capabilities.
- ISRO remains the core enabler of India's space ecosystem, having executed **more than 430 spacecraft missions and 100+ launch missions**, while also developing the engineering culture, product development tools, a PLM ecosystem, and talent pipeline that underpin current private-sector growth.
- The rise of NewSpace companies is strengthening India's global competitiveness, with the sector attracting **US$1.5–2 billion in cumulative private investment in the last decade**, but it is also increasing the risk of migration of experienced talent from ISRO.
- The most critical challenge is not talent mobility itself, but the absence of structured mechanisms to ensure knowledge circulation among public institutions and private firms.
- A sustainable model requires a distributed ecosystem in which ISRO, industry, academia, and government each play clearly defined and complementary roles.

Introduction: A Structural Shift in India's Space Sector

India's NewSpace ecosystem is moving beyond experimentation into early operational maturity. Startups are no longer limited to subsystem development or conceptual innovation; several are now demonstrating integrated capabilities in launch systems, satellite manufacturing, propulsion technologies, and space-based services.

This transition has been enabled by policy and institutional reforms, including the establishment of Indian National Space Promotion and Authorization Centre (IN-SPACe) in 2020, the expanded commercial mandate of NewSpace India Limited (NSIL), the Indian Space Policy 2023, and liberalized foreign direct investment (FDI) rules allowing up to **100% FDI in selected space segments**.

At the same time, this structural shift raises an important strategic question: whether the growth of private space companies strengthens national capability or whether it inadvertently weakens ISRO by drawing away critical human capital.

ISRO as the Foundational Capability Builder

ISRO remains the central pillar of India's space capability. Over more than five decades, it has developed a comprehensive portfolio of launch vehicles, satellite systems, and interplanetary missions, including:

- PSLV (Polar Satellite Launch Vehicle)
- GSLV and LVM3 heavy-lift systems
- Chandrayaan lunar missions
- Mangalyaan Mars Orbiter Mission
- Aditya-L1 solar mission
- Gaganyaan human spaceflight program (ongoing)

ISRO has conducted **100+ launch missions and deployed 430+ spacecraft**, establishing India as one of the few nations with end-to-end space capability. However, ISRO's contribution extends beyond missions. It has built systems engineering framework for complex space mission, mission assurance and reliability processes, supplier ecosystem involving hundreds of small and medium industrial partners and national launch and tracking infrastructure across multiple sites.

Most importantly, ISRO has developed a highly skilled workforce of several thousand engineers and scientists, many of whom have decades of mission experience along with expertise in CAD, CAM, PDM and CAE. This talent base is now the primary source of expertise for India's NewSpace companies.

Emergence of the Private Space Ecosystem

India's NewSpace companies are increasingly focusing on specialized, modular, and commercially scalable segments of the space value chain. Key areas include small satellite launch services (payloads under 500 kg), earth observation constellations (optical, Synthetic Aperture Radar, hyperspectral), electric propulsion systems and green propulsion technologies, standardized satellite buses and modular platforms (possibly managed by PLM), space situational awareness (SSA) and debris tracking, in-orbit servicing and inspection systems, and downstream geospatial analytics and AI-driven applications.

Globally, the small satellite market alone is expected to grow at a **CAGR of 15–18% through 2030**, driven by demand for real-time Earth observation and connectivity services.

Unlike ISRO, which must balance scientific, strategic, and national objectives, private companies can focus on narrower commercial segments. This enables faster iteration cycles, venture capital funding, and product-driven development models. India is therefore transitioning from a single-institution model to a distributed innovation ecosystem involving multiple specialized actors.

Economic and Employment Implications

The global space economy is projected to exceed **US$1 trillion by 2040**, driven by satellite communications, Earth observation, navigation, defense applications, and downstream digital services. For India, this represents a major opportunity for industrial expansion and high-skilled employment. The sector will require multidisciplinary talent across aerospace and mechanical engineering, electronics and

embedded systems, software engineering and AI/ML, materials science and propulsion, geospatial analytics and remote sensing, systems engineering and integration, PLM-based information and process management, and regulatory, legal, and financial services.

Downstream applications are expected to dominate employment growth, particularly in agriculture through precision farming using satellite data, insurance through risk modelling and crop assessment, infrastructure through urban planning and monitoring, logistics through route optimization and fleet tracking, and climate services through disaster prediction and environmental monitoring.

Industry estimates suggest that downstream services could account for **60–70% of total space-sector employment growth in India by 2035**. India produces over **1.5 million engineering graduates annually**, but only a small fraction currently receive exposure to space systems engineering or remote sensing applications.

Talent Migration and Institutional Risk for ISRO

A key structural implication of NewSpace growth is the increasing mobility of experienced ISRO personnel into private companies. ISRO engineers possess tacit knowledge developed through launch campaigns and countdown operations, systems integration and testing cycles, failure analysis and anomaly resolution, and long-duration mission operations.

This knowledge typically takes **10–15 years of experience** to develop at a mission-critical level. Private companies attract this talent through:

- Compensation packages often 2x–5x higher than public-sector pay scales
- Equity participation and wealth creation opportunities
- Faster decision cycles and technical autonomy
- Direct product ownership and entrepreneurial roles

ISRO, constrained by public-sector pay structures, cannot directly compete on financial terms. The risk is therefore not mobility itself, but asymmetric flow—where ISRO becomes a net exporter of experienced talent without structured mechanisms for knowledge retention or reintegration.

International Benchmark: NASA and the Commercial Space Model

The NASA–commercial space model, particularly the Commercial Orbital Transportation Services (COTS) and Commercial Crew Program, provides a relevant reference. Key features include NASA's investment of over US$8 billion in commercial crew development, long-term contracts of 10–15 years that provided demand stability, milestone-based funding that reduced technical risk for private firms, and NASA's continued role as the anchor customer for ISS logistics and crew transport.

Companies such as SpaceX and Northrop Grumman emerged within this structured demand environment. The key lesson is that private space ecosystems require:

- Anchor customers
- Long-term procurement commitments
- Clear certification and safety frameworks
- Shared risk mechanisms

For India, this implies a stronger procurement role for ISRO and NSIL in creating sustained demand for private-sector capabilities.

Toward a Distributed National Space Ecosystem

A sustainable model requires clear functional distribution:

- **ISRO:** strategic missions, human spaceflight, deep space exploration, and frontier R&D
- **Private sector:** commercial launch services, satellite manufacturing, and scalable data services
- **Academia:** fundamental research and talent development
- **Government agencies:** regulation, standards, and demand creation

This structure reduces duplication while increasing system-wide efficiency.

Managing Talent Flow: From Drain to Circulation

The central policy challenge is to transform talent movement from a one-directional flow into a circular ecosystem in which knowledge is continuously shared and reintegrated. This requires structured mechanisms such as joint ISRO–industry appointments, sabbatical and rotation programs, shared R&D initiatives, startup participation in ISRO-led missions, and formal re-entry pathways for professionals returning from industry to public service. Equally important is the development of common engineering standards, certification frameworks, and knowledge-sharing platforms that ensure continuity of expertise across institutional boundaries. Investment in Product Innovation Platforms (a key segment of the PLM market as defined by CIMdata) is critical for the knowledge to remain within the organization in spite of the movement of talent to private companies.

Conclusion

India's emerging NewSpace ecosystem represents a fundamental structural shift in national space capability. The rise of private space companies is not a replacement for ISRO, but an extension of the capability base that ISRO has built over decades.

The central challenge is whether India can manage this transition in a way that strengthens both commercial competitiveness and institutional resilience. If managed effectively, ISRO and the private sector can form a mutually reinforcing system that enhances national capability and global competitiveness.

About CIMdata

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