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Why do Indian Founders in the Space Industry start their start-ups abroad?

R Sai Shiva Jayanth, Indian Institute of Management Kozhikode, India
Gopalakrishnan Narayanamurthy, University of Liverpool Management School, UK

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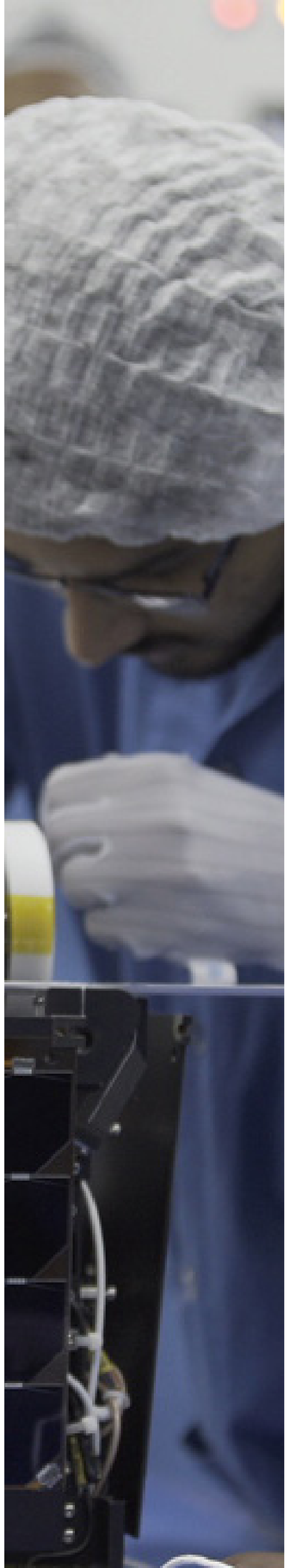

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This report is part of Spaceport SARABHAI's research programme that hopes to generate and grow the body of knowledge that can support research and evidence-based space law and policy making in India.

Written by R Sai Shiva Jayanth and Gopalakrishnan Narayanamurthy, it brings together the views of Indian space entrepreneurs who have incorporated their companies abroad.

Unless otherwise indicated, this report reflects the authors' understanding of the views expressed by the interviewees and participants of the survey. The author and the participants contributed in their personal capacities, and their views do not necessarily reflect those of the institutions they represent, or of Spaceport SARABHAI and its associates.

About Spaceport SARABHAI

Spaceport SARABHAI (S2) is India's 1st dedicated space think tank.

The think tank is based in Bangalore with satellite presence in New Delhi, Berlin, Sendai, and Boston. S2 aspires to be global, collaborative and inclusive.

S2 embraces the multi-dimensional nature of human space endeavours. The S2 lens includes, among others, the geopolitical, historical, scientific, economic, legal, safety, security and sustainability issues related to outer space activities.

S2 is a launch pad for ideas and future visions where thought leaders and practitioners gather for discussions, debates, critical thinking, opinion making and influencing policy for a sustainable shared future. S2 brings together an eclectic mix of people including entrepreneurs, government and industry representatives, investors, diplomats, journalists, historians, economists, social scientists and legal experts to craft progressive policy.

S2's aims to accelerate the transformation of India into a global space powerhouse by:

- Giving India an international voice,
- Transforming India into a developed space economy by 2030,
- Growing the body of knowledge that informs critical areas of space policy,
- Providing policy guidance to the government through research, stakeholder feedback, opinion pieces and private outreach,
- Building public perspective through writings, debates and conversations.

S2 curates space policy debates to discuss law and policy issues, both in the national and international context. S2 shares insights into the challenges and accomplishments of legacy companies and NewSpace entrepreneurs through a podcast series comprising candid conversations. S2 celebrates India's space history by broadcasting memory monologues of space pioneers.

S2 is an homage to the founder of India's space program Dr. Vikram Sarabhai, a physicist, a visionary, a renaissance man who believed that our cosmic commons can be used for the welfare of humankind.

AUTHOR BIOGRAPHY

R Sai Shiva Jayanth

R Sai Shiva Jayanth is currently pursuing his Ph.D. in Economics at the Indian Institute of Management Kozhikode, India. He was the JPAL Research for Impact Fellow 2020-21. His areas of research include agriculture economics, behavioural economics, experimental economics, and development economics among others. He extensively carries out field work for his research. His research has been published in Ecological Economics, Economic and Political Weekly, Asian Economic Letters and International Journal of Contemporary Hospitality Management among others. He has also published widely in nationally circulated newspapers and development blogs. He is a reviewer for South Asian Journal of Business Studies. Prior to joining PhD, he qualified as a Chartered Accountant and Company Secretary.

Gopalakrishnan Narayanamurthy

Gopalakrishnan Narayanamurthy is a Senior Lecturer in the Department of Operations and Supply Chain Management (OSCM) at the University of Liverpool Management School (ULMS), United Kingdom (UK). Prior to joining ULMS, he was a postdoctoral research fellow at the University of St. Gallen, Switzerland. He completed his doctoral studies from the Indian Institute of Management Kozhikode, India. During his doctoral studies, Gopal has been a Fulbright-Nehru Doctoral Research Fellow at Carlson School of Management, University of Minnesota. He researches in the area of healthcare operational excellence, transformative service research, satellite imagery analytics, digitization, and business model innovation. His research has been accepted for publication in Journal of Service Research, International Journal of Operations and Production Management, International Journal of Production Economics, Journal of Business Ethics, Technological Forecasting & Social Change, Computers & Operations Research, Production Planning & Control, and Computers in Industry, among others. He is currently serving as an associate editor for IIM Kozhikode Society & Management Review journal (ABS 2). He is an ad-hoc reviewer for Journal of Service Research, International Journal of Operations and Production Management, Decision Sciences Journal, Journal of Business Research, and International Journal of Production Economics, among others.

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FOREWORD

India has amazing entrepreneurial talent that is creating some of the world's largest unicorns by solving challenges faced by society, the economy and the environment. The space sector is yet another toolbox that entrepreneurs can leverage to solve challenges, both for people and businesses at scale.

India is witnessing a phenomenal rise of space start-ups. Today, we have over a hundred space start-ups, many of which were established in the past few years. Some of them are building space-related hardware and software, while others are using satellite-based services to improve lives and livelihoods here on Earth. However, simultaneously India is also witnessing an entrepreneurial brain drain with some of the space start-ups choosing to incorporate their companies in Europe, United States, Canada, Singapore and Australia given the start-up friendly ecosystems that these countries offer.

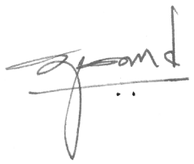
We, at Spaceport SARABHAI (S2), have created a Research Wing to engage researchers to generate and grow the critical body of knowledge that can inform and influence evidence-based policy making. S2's Research Wing's debut endeavour investigates the reasons why Indian space entrepreneurs are choosing to set up companies abroad. The goal of this study is to enable policymakers to identify what measures they need to take to retain space entrepreneurial talent in the country and create ventures and jobs locally.

This report presents the outcome of a study titled: Why do Indian Founders in the Space Industry incorporate their start-ups abroad? The research was conducted by Reddy Sai Shiva Jayanth, a final-year Doctoral Scholar in Economics at the Indian Institute of Management in Kozhikode, India. Prof. Gopalakrishnan Narayanamurthy from the University of Liverpool's Management School, United Kingdom served as the Research Advisor and Guide.

We hope that Indian policymakers at NITI Aayog – the apex public policy think tank of the Government of India, Department of Space (DOS), Ministry of Space and the Indian National Space Promotion and Authorisation Centre (IN-SPACe) will find this study useful and reflect on the research findings to create means and mechanisms to prevent entrepreneurial brain drain and enable Indian space entrepreneurs to realise the full potential of their enterprise without having to leave the country.

We, at Spaceport SARABHAI, are happy to discuss the findings of this report and assist in crafting research-based space policy that will propel the Indian space ecosystem to world standards.

Dr. Susmita Mohanty
Director General
Spaceport SARABHAI



Dr. Narayan Prasad
Director, Research & Operations
Spaceport SARABHAI

Why do Indian Founders in the Space Industry start their start-ups abroad?

ABSTRACT

The Indian space industry is at a crucial crossroads today. The Government of India launched Indian Space Association (ISA) to open up the space industry to private players and start-ups. The federal body, ISRO has taken positive efforts to facilitate improvements in this direction. The space start-ups are on an upward trajectory reflected by investments' inflow. In this backdrop, one of the key challenges faced by the Indian space industry is the choice of Indian founders to incorporate their start-ups abroad. To throw light on this phenomenon, this policy paper presents results of in-depth interviews with founders of space start-ups in India and abroad.

Results cover the advantages of incorporating abroad, the challenges of setting up in India and the suggestions to retain talent from going abroad. These findings are pivotal for policy makers and federal bodies in bolstering the Indian space start-up ecosystem and in reversing the space industry brain drain.

1.0 BACKGROUND

India, in the last decade, has turned into a global hub for start-ups. This is evident in the capital raised and number of start-ups incorporated in the country in the recent past. Total investment in the Indian start-ups in 2021 stood close to $38 billion compared to $11.1 billion in 2020 (Upadhyay & Pathak, 2022). One of the industries that has been of significant interest to entrepreneurs is the space industry. The space industry covers all activities providing goods and services for and from space. The firms operating in this industry can be categorised based on their focus and services offered. Downstream players focus on providing commercial space applications via products and services to final consumers while upstream players focus on production of launchers and satellites (PwC, 2020). Further, customers can be grouped under three main segments—institutional, like federal bodies and space agencies, commercial, like TV service providers, and mixed, that is public private partnerships (Pérez et al., 2017). In addition to customers and the corporates (both start-ups and multinational corporations) other major stakeholders of the space industry are policy makers, both central and federal governments, federal institutions like space agencies, and investors, including angel investors, venture capital firms, private equity firms, corporations, banks and public markets (Tkatchova, 2018).

The pace at which space start-ups have been growing in India is low compared to other countries. The total early-stage investment in space technologies in 2021 was $68 billion. Out of this, $28 billion alone was invested in 3086 companies in the United States. The second largest was China, where $4.8 billion was invested in 122 companies. In comparison, only $2 billion was invested in India among 110 firms (Chethan, 2021). In terms of space ecosystem, the US space ecosystem has progressed considerably by taking a big leap towards privatisation with around 85% of National Aeronautics and Space Administration's (NASA) budget going to private contractors—largely to design and manufacture rockets and spacecrafts (Andrew et al., 2021). Europe is a mix of public and private entities across the space value chain. Compared to the Indian scenario, the European space ecosystem is considerably privatised due to the strong encouragement of downstream and upstream activities (PwC, 2020).

So, when India as a country has so many entrepreneurs interested in the space industry, why does it have so few start-up registrations in the space industry? As a potential explanation to this contradictory observation, many entrepreneurs of Indian origin were found to register and operate their space start-ups outside India. The overarching research question is 'Why do entrepreneurs of Indian origin register and operate their space start-up outside India?'. The specific objectives of this research are listed below:

- Understand ecosystem advantages abroad that attracts Indian entrepreneurs to set up their start-ups abroad,
- Understand ecosystem drawbacks that hinder entrepreneurs to set up their space start-ups in India,
- Identify avenues of improvement in the Indian space industry ecosystem to retain space-entrepreneurs in the country.

2.0 DATA & METHODOLOGY

To achieve the research objectives, we performed in-depth key informant interviews. Data was collected from Indian origin entrepreneurs of space start-ups registered across the globe—a mix between those who incorporated space start-ups in India as well as abroad. The demographics of the interview respondents and their start-ups are presented in Table 1.

We conducted a total of ten interviews for this study. Six interviews were conducted in an exploratory manner while four were conducted to confirm the findings. The respondents' sample was obtained through two modes viz. references from field experts and snowball sampling. The interviews were conducted online through a video conferencing software using an inductive approach. We prepared a semi-structured question guide to aid us in the interview process. The questionnaire was divided into two parts. The first part consisted of demographic/background information about the respondent and their start up. We obtained information on the nature of operations, year and place of incorporation, revenue range, human and non-human resources and its stage of funding. In the second part, we asked questions targeting the research objectives. These included among others, questions related to barriers/challenges/benefits to start-ups in space ecosystem (in India vs abroad), idiosyncrasies of space start-ups, comparative analysis of setting up in India versus other countries, and role of different stakeholders in this whole process.

All the interviews were conducted in English language, each meeting lasted for an average of 56 minutes, and were conducted over a three weeks window starting from 29th November to 17th December 2021. All the interviews were recorded after seeking consent from the respondents and were later transcribed for analysis. The data obtained from interviews was analysed using grounded theory approach and Gioia methodology in accordance to Charmaz and Smith (2003) and Gioia et al. (2013) respectively. We formed first order, second order codes and finally the emergent themes. The answers to research objectives were extracted from this analysis.

Nature of Operations	Year Est.	Country	Revenue Range	People	Funding raised / Funding plans	Interview length
Consultancy services for space agencies, launching space missions	2017	Singapore (Subsidiary in France)	$ 2 million per annum	8 (full time)	Looking to raise funds next year	55:55
Satellite Imagery and solutions	2019	France	Not disclosed	2 founders (10 full time team)	Raised pre seed round 1 million € Looking forward to seed round in nex year	56:39
Small satellite systems, antennas and communication systems	2020	Germany	Not disclosed	2 founders (no employees)	Looking to raise seed funds	37:00
Manufacturing BUS for satellites	2020	Australia	$ 2-4 million per annum	4 founders	Plan to raise funds after completing a big project	64:27
Risk management solutions towards agriculture using satellite imagery	2019	Netherlands	$ 150000 per annum	1 founder 5 full time employees 2 part time employees	Received angel funding	65:37
3D Printing of metals and ceramics (with focus on aerospace industry)	2019	Germany	€ 100000	1 founder 3/4 full time employees	Received initial grant from ESA and R&D projects Looking forward to raise funds	29:52
Providing insights through satellite imagery to multiple institutions	2016	India	Not disclosed	3 founders 76 employees	Raised 5 million $ Looking forward to raise subsequent rounds	54:16
Providing insights through AI enabled real time data to food, energy and national security	2016	United States	Not disclosed	1 founder 5 full time employees	Not disclosed	48:27
3D Printing of metals and ceramics (with focus on space and defence)	2019	Netherlands	€ 100000	3 founders 3 interns	Obtained initial grants Looking to raise seed funding soon	47:12
Venture capitalists for space start-ups				5 founders	Invests in other space start-ups	57:01

Table 1: Demographics of the respondents' start-ups

3.0 FINDINGS

Table 2 summarizes the research findings categorized as input, process and output driven. These findings are described in subsequent sections. Section 3.1 and 3.2 summarize reasons why entrepreneurs of Indian origin incorporate and operate their start-up outside India and what restricts entrepreneurs of Indian origin to register and operate their space start-up in India, respectively. Section 3.3 presents avenues for improvement to retain talent in the country to foster the space industry ecosystem.

Category	Benefits of starting abroad	Challenges of starting in India	Avenues for improvement
Input driven	Better access to capital	Lack of access to capital	Access to grants/funding opportunities
	Better access to talent/ resources	Difficulty in accessing resources	Better procurement policy
Process driven	Clarity in space policy regime	Uncertain policy/ regulatory environment	Building a supportive ecosystem
	Conducive space start-up ecosystem	Bureaucracy/red tapism	
	Encouragement from space agencies	ISRO's rigid mentality	Undertaking structural changes
	Encouragement from government	Lack of government support	
Output driven	Better access to clientele	Outreach problem	Redefining the role of space agency

Table 2: Summary of findings addressing the research objectives

3.1 Why entrepreneurs of Indian origin incorporate and operate their space start-up outside India?

3.1.1 Input driven factors

(a) Better access to capital

One of the major reasons respondents chose to set up start-ups abroad is the availability of capital/ investment. Most of the time, the founders of start-up found better opportunities to raise funding from the host countries. Additionally, investors abroad favoured funding in start-ups incorporated in home country home-grown [RM28] [JSS29] start-ups as opposed to funding start-ups from other countries. One respondent reported that the start-ups were better valued in the US, providing them access to better quality and quantity of funding. Another respondent stated that, [RM30]

"We had to move to the Netherlands as that was one of the first conditions imposed by investors before providing any funding." – Respondent E

(b) Better access to talent/resources

Availability of talent was another key factor that pushed founders to move abroad. The access to experts on earth observation, business applications and remote sensing was thought to be better in countries such as the Netherlands, France, and the United States among others. This availability of talent was attributed to the space agencies' proactive measures in providing internships and opportunities to bachelors and masters students in honing their technological skills. In line with this, respondent E stated that,

"There is talent for remote sensing/ satellite related tech in India as well as the Netherlands, but attracting that kind of talent for start-up is easier in the Netherlands than in India." - Respondent E

In addition to such talent, the space agencies also provided advisors who were continually involved with start-up, providing constant validation, direction and feedback.

3.1.2 Process driven factors

(a) Conducive space start-up ecosystem

One of the most-often mentioned factors that encouraged entrepreneurs was the presence of a supportive space start-up ecosystem. The ecosystems were essentially formed by the respective countries' space agencies by establishing a collaboration between academics (i.e., universities), industry, and space experts. The outcome of such an ecosystem would be the provision of support and guidance in setting up start-ups, disbursing grants and subsidies, and providing access to key technical resources. Few space agencies also provided founders with access to talent, entry to conferences, seminars, fairs etc. Respondent B affirmed that,

"To build a product or develop something in the space sector, in Europe it's quite easy for people to get money and support your innovation." – Respondent B

(b) Clarity in space policy regime

Policies related to the space sector were found to be very transparent and encouraging in countries such as the United States, Singapore, Australia, Germany and France. Respondents highly appreciated the good regulatory framework, which directly helped in uncertainty reduction. This enabled the entrepreneurs to plan well in advance and give deeper commitments to its customers. As a result, the founders could focus more on the technical aspects of the business and less on the managerial and secretarial aspects.

(c) Encouragement from space agencies

Respondents were very vocal about the support obtained from space agencies. In addition to providing access to resources and funding, the European Space Agency (ESA) and NASA had established dedicated deep tech incubators. In short, the space agencies acted as a one-stop solution for all their challenges. This kind of support was unparalleled and supported the entrepreneurs immensely. Further, the founders could also reach out to multiple space agencies parallely using the network of their host country's space agency (especially in case of European countries). In support of this finding, respondent C mentioned that,

"The European Space Agency has a very wide network. They foster many research projects and centres. There is a great scope for funding and grants." – Respondent C

(d) Entrepreneurial support from government

In addition to the space agencies, the host governments had also provided a conducive environment by providing a good regulatory framework. In addition to the space sector, several ancillary industries were needed to support start-ups. For instance, Netherlands provided wide expertise in agriculture and allied activities, which enabled space-based start-ups providing services to the agriculture domain to thrive there. Respondent B stated that,

"In Europe, what I really like in terms of support is there are dedicated deep tech incubators and the government is very well connected with deep tech investors." - Respondent B

3.1.3 Output driven factors

(a) Better access to clientele

Majority of respondents reported that being in countries such as those mentioned above, gave rise to a signalling effect. It meant that mere setting up in another country brought them credibility. It also provided them better opportunities for collaboration and better networking opportunities. As a result, they were able to tap the global markets to sell their products. Acquiring demand/clients was one of the key challenges in the space industry and setting up a start-up abroad solved part of this trouble. Respondent B agreeing to the same mentioned,

"Among our clients, I see there is a more segregation towards western countries right now (bit more in Europe) because we are in Europe, and we have better network here" - Respondent B

(b) Economically viable alternative

Respondents reported that host countries offered lesser bureaucracy and ease of formalities. Few governments even subsidised multiple business expenditures, which made economic sense for start-ups. In addition, few countries such as Singapore charged very low taxes. All these points reduced the cost of operations and directly contributed to improving the bottom line of the start-ups. In line with this respondent A said,

"By setting up in Singapore we get two benefits. First, the tax rates are very low compared to India. Also, we get the credibility of being incorporated in Singapore" - Respondent A

3.2 What restricts entrepreneurs of Indian origin to register and operate their space start-up in India?

3.2.1 Input driven factors

(a) Lack of access to capital

Another major reason for not choosing India was the lower chances of raising capital in the Indian markets. Respondents agreed that Indian capital markets are huge, but explained that the VCs are generally not inclined towards investing in deep tech and rather choose to invest in FMCG, consumer, and IT among others. Investment in the space sector is very specialised and the knowledge/familiarity of such deep tech is necessary. The absence of the same has given rise to uncertainty in the financial investment environment. As quoted respondent D mentioned that,

"Unlike software companies, for space start-ups (especially upstream) it's an investment heavy market. So, obtaining need capital is a big challenge" – Respondent D

(b) Difficulty in accessing resources

India is home to a great number of engineers (both at masters and bachelors' level). However, the space industry is hardly able to attract and retain any of this talent. The entrepreneurs reported that the graduates of these courses do not find it interesting to join space start-ups. Further they also reported lack of expertise in core areas such as remote sensing and earth observation among others.

3.2.2 Process driven factors

(a) Uncertain policy/regulatory environment

One of the major factors that concern Indian space entrepreneurs is the presence of uncertain policy and regulatory environment in India. There are a handful of regulations in India regarding space start-ups and those regulations too aren't clear. More importantly, the Indian laws seem to lack the intent to support home-grown space start-ups. Laws in a few countries take up unlimited liability (ex: Australia, the US etc.) in cases of start-ups entering contracts with satellite providers. Indian space entrepreneurship laws currently do not provide that assurance. For instance, in case of Australia, respondent D stated-

"There are clauses related to unlimited liability in Australia which state that if a satellite fails, then the burden of contract would be mitigated. However, such options are absent in India" - Respondent D

(b) Bureaucracy/red-tapism

Another reason why entrepreneurs back out from India is due to the procedural delays, lack of ease of doing business, bureaucracy and red-tapism. Respondents reported that there wasn't a proper set up to define space start-ups in the first place and that the existing rules are very convoluted.

(c) ISRO's rigid mentality

Almost all the respondents also reported how the Indian Space Research Organisations' (ISRO) "rigid mentality" was adversely affecting the start-ups' establishment and growth. Majority of the respondents reported that it was very difficult to obtain already existing satellite data from ISRO. This added to the existing bureaucracy. There were no proper channels to automate and obtain satellite data which could be beneficial for operations. Unfortunately, as an alternative, data was being obtained from other space agencies such as NASA and ESA

(d) Lack of government support

The founders also repeatedly mentioned that the government support for space start-ups was very meagre. This was characterised by absence of concrete and non-discretionary policies. As a result, the founders feel that no one in India (including investors, government or space agencies) is willing to bet on their ideas. This attitude has let down multiple Indian entrepreneurs from setting up their start-ups in India. This problem is further aggravated due to the lack of coordination between government, the policy maker (ISRO) and the corporates. Respondent F mentioned that,

"I would say our government needs to push the space sector more towards privatisation. Even though there is no explicit support, there should at least be a mechanism that puts India in the world map of space"
- Respondent F

3.3.3 Output driven factors

(a) Outreach problem

Entrepreneurs who set start-ups abroad also repeatedly mentioned that there's a difference between being incorporated in India and selling outside India. There is a level of perception that is attached with the country where the start-up is set up. This is in spite of the fact that the work performed would be the same irrespective of the domicile. Respondent A also attested to this fact by mentioning that -

"They don't necessarily look down upon start-ups from India. However, it does take time to build credibility and gain foreign customers" -
Respondent A

(b) No spectrum for communication

For start-ups to communicate and interact with the machinery/products that are launched from the Indian space sector, there are no clear rules relating to the spectrum. The start-ups do not have clarity on how to obtain licences and communicate once their products are sent to space.

3.3 What are avenues for improvement that can retain talent and strengthen the space industry ecosystem?

3.3.1 Input driven suggestions

(a) Better procurement policy

As mentioned earlier, most of the respondents were apprehensive and confused about the current procurement policies in place in India. Therefore, there is an urgent need to establish clear, transparent and non-discretionary policies. More specifically, the respondents called for policies being stronger irrespective of whoever was in the helm of ISRO. For instance, respondent A mentioned that,

"I think the biggest support the federal bodies can extend is–rather than making everything on their own, they can outsource/assign tasks to start ups. In doing so, the procurement policy has to be revisited" – Respondent A

(b) Access to grants/funding opportunities

The space agencies also need to provide opportunities for funding and grants. In addition, they could create a system where VC and other investors look to invest in space-based start-ups. Few space agencies also provide support in the form of giving early commitment to start-ups. The commitment is usually conditional and for short periods. But within this period, the start-ups usually work hard and scale up. This could be a win-win for both space agencies as well as the entrepreneurs. Drawing a comparison from ESA, respondent A mentioned,

"In Europe (for instance) it's quite easy for start-ups to raise money for innovations. Even non space companies can get grants from the government to build technologies, which is not the case in India. We also were able to get some money from European Space Agency, without having any background or a credibility, so I think it was it was a good decision for us to come here" - Respondent A

3.3.2 Process driven suggestions

(a) Building a supportive ecosystem

The space agency should also take the onus of building a very supportive space start-up ecosystem. This could be done in multiple ways, based on learnings from other space agencies across the world. Firstly, ISRO needs to provide access to expertise and develop a framework for making technical support available to entrepreneurs. Second, the start-ups could be given access to events, competitions, conferences, seminars, and workshops. Third, the space agencies could provide projects to start-ups and enable healthy collaboration networks with universities within India and abroad. This enables simplification of pitching ideas and getting valuable feedback. This was supported by the statement made by respondent B.

"Ecosystem was a major plus point while working with ESA which even has business incubation centres. One of the first things we needed was incubation support because to be able to start working, one needs the start-up network" – Respondent B

(b) Undertaking structural changes

ISRO also needs to immediately revisit its policies related to basic infrastructure that includes images. Making them available and accessible to all the downstream players would immensely benefit start-ups by improving their operations and bringing down their costs. Further, the new age entrepreneurs thoroughly appreciated the presence of lesser paperwork/documentation and increased transparency in bidding processes. Although these might seem like small changes, they go a long way in providing strong signals about changes in space policy.

3.3.3 Other suggestions

(a) Redefining the role of space agency

One of the most important immediate requirements is to redefine the role of ISRO in India. The entrepreneurs need the space agency to take up an administrative/ gatekeeper role and not be overbearing. Parts of the ISRO's operations could be privatised in the lines of public private partnerships (PPP) to improve the efficiency of management. For instance, respondent C quoted that,

"There is scope for improvement for cooperation or coordination between the space agency in India, the industry and the universities. It is quite different in other countries" – Respondent C

4.0 CONCLUSION

The policy makers in India have recently made clear their intentions to bring radical changes to entrepreneurship in the space sector (ISRO, 2021). The union cabinet has approved reforms to boost private sector participation through the space value chain. Bodies such as the Indian National Space Promotion and Authorisation Centre (IN-SPACe) were established to guide space start-ups to establish themselves and work seamlessly. These, in addition to Satellite Communication Policy 1997, Remote Sensing Data Policy 2011 and the draft Spacecom Policy 2020, form the backbone of space policies in India. In addition to policy level actions, it is imperative to consider the viewpoints of start-up founders in helping this sector grow in India.

India undoubtedly is a talent powerhouse and has abundant manpower equipped with technical and managerial skills. At the same time, the space industry holds immense potential to explore the bounds of human capability, evolution of life and make things easier on earth. With this backdrop, it becomes very necessary for the policy makers and ISRO to leverage the in-house talent and reverse the space industry brain drain. At this juncture, our research offers key insights to the policy makers and federal bodies (ISRO) regarding steps that could be taken to attract, retain and encourage the home-grown entrepreneurs in the space industry.

TOPIC	STAKEHOLDER INPUT	S2 RECOMMENDATION	EXAMPLES FROM OTHER AGENCIES	INTENDED OUTCOME
ACCESS TO ISRO DEMAND	SMEs / start-ups can benefit from a special procurement process that will allow ISRO to procure products/services outside the existing tendering mechanism which is more favourable to older established companies.	ISRO / IN-SPACe should publish relevant product/ service problem statements to create demand for innovative new solutions by startups/SMEs.	Defense Research and Development Organisation's (DRDO) Defence Acquisition Council (DAC) cleared a debut procurement of 14 items worth Rs 380.43 crore from Innovations for Defence Excellence (iDEX) start-ups.	ISRO-need-driven problem statements can lead to Research and Development (R&D) of innovative products/ services not just for ISRO consumption, but also for commercial markets in and beyond India.
ACCESS TO ISRO EXPERTS AND FACILITIES	SMEs / start-ups cannot afford to invest in capital-intensive infrastructure that they need occassionally.	ISRO / IN-SPACe should decentralise facility access approvals, provide a direct Point-of-Contact for requisitioning and booking facilities at different ISRO Centres. Consumables may be charged on an actual cost basis and an insurance fee can be included to cover potential damage to the facilities.	Euroepean Space Agency (ESA) has grouped its facilities into Electrical, Mechanical, Software and Product Assurance Laboratories. Start-ups can contact the Lab Manager assigned to each laboratory when they need to access the lab facilities.	ISRO technical expertise and facilities can catalyse product/service R&D within SMEs / start-ups. It can also help lower start-up R&D costs and make their products/services globally competitive.
	SMEs / start-ups may not have all the expertise needed in-house to fully develop a product/service. Their access is limited to retired ISRO technical staff.	ISRO / IN-SPACe should facilitate access to currently employed ISRO technical staff to accelerate research and development of new products/services at SMEs / start-ups.	ESA provides upto 80 hours of technical support to start-ups from currently employed ESA technical experts to help start-ups develop products/services.	
INDUSTRY CONSULTATION	SMEs / start-ups need a periodic platform to provide feedback and suggestions to ISRO / IN-SPACe.	ISRO / IN-SPACe could host bi-annual open-house consultations for space businesses to attend, share candid feedback and propose ways to enable the private space ecosystem thrive.	Emerging space nations have created open-house consultation meetings where they invite space businesses to come and share their suggestions and feedback to policymakers.	Open, inclusive, pro-active ISRO / IN-SPACe platform for industry consultations can help capture inputs and insights from stakeholders across the value chain.
TRADE SUPPORT	Challenging to find a dedicated Point-of-Contact (POC) who can help young companies with any information and help they need.	DOS / IN-SPACe should create Business Incubation Centers across the country at major ISRO Centers, appoint a dedicated officer who can act as a single Point-of-Contact (POC) for SMEs / start-ups. The POC can be reached directly and easily during office hours via a mobile phone number and email.	ESA has 22 Business Incubation Centers (BICs) and logged a turnover of 96 Milion Euros from 450 space start-ups as of August 2018. European start-ups can easily reach out to the POCs in these BICs for broadbased support that includes legal, financial, technical and go-to market support. https://spacesolutions.esa.int/business-incubation	Dedicated POCs at multiple ISRO Centers who can be reached easily by phone and email and who will proactively help SMEs / start-ups with legal, financial, technical and go-to market support. Proactive and empowered POCs who can respond within 48 hours of receiving an email query or a call.
	Define and measure Key Performance Indicators (KPIs) of the 'NewSpace' economy. Based on KPI metrics, foster and fine-tune state, private and Foreign Direct Investment (FDI).	DOS / In-SPACe should engage a multi-disciplinary team comprising economists and space technology experts to measure the impact of space activities on the Indian economy on an annual basis.	The United Kingdom Space Agency (UKSA) holds annual 'State of the Industry' Reviews that is jointly conducted by by economists and space experts. They measure the impact of space on their overall economy, job creation, exports, etc.	Measuring and continuously monitoring KPIs will provide a scientific basis to provide evidence and data-based support for policy making, policy modifications and implementation to create a robust long-term impact on the Indian economy.
	Extremely challenging to take India-made space products and services to international markets without pro-active trade support mechanisms.	(1) Mandate Indian Trade Commissions abroad to actively promote and facilitate market access for Indian space companies. (2) Host an India Pavilion at all major space conferences and trade expos globally. e.g. International Astronautical Congress, Space Tech Expo Europe, Australian Space Forum. Invite space companies to set up their booths next to ISRO's free of charge, on a first come first serve basis.	Emerging space nations such as Australia, South Africa, Luxembourg, New Zealand have started creating Country Pavilions at major trade fairs, where they share the floor space with local space industries.	Country Pavilions and Trade Commission support at an interenational level will help showcase Indian space innovation and entrepreneurship to the world, while promoting the 'Made in India' Brand.

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ABBREVIATIONS

BIC	Business Incubation Centers
DAC	Defence Acquisition Council
DRDO	Defence Research and Development Organisation
ESA	European Space Agency
FDI	Foreign Direct Investment
FMCG	Fast Moving Consumer Goods
IN-SPACe	Indian National Space Promotion and Authorisation Centre ISA Indian Space Association
ISRO	Indian Space Research Organisation
IT	Information Technology
KPI	Key Performance Indicators
NASA	National Aeronautics and Space Administration
POC	Point of Contact
PPP	Public Private Partnership
R&D	Research & Development
SME	Small and Medium Enterprise
S2	Spaceport SARABHAI
TV	Television
UKSA	United Kingdom Space Agency
US	United States
VC	Venture Capitalis

contact@spaceportsarabhai.org