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Not Beyond Reach – Access an Equity to
Aerospace Transportation: India
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India's background to space activities

- India has seen tremendous growth in space research and activities since 1960.
- Indian Space Research Organization (ISRO) was established in 1969 for development of space programme as a tool for economic and social development.
- Use of satellite apps as a development tool has made a major dent in the early years. India developed its launch capability and has sent many satellites from its own launch pads and also launched commercially for other countries.
- In 2008-09, India sent an unmanned mission to Moon called Chandrayan I and in 2014, sent a Mars Orbital Mission (MOM) successfully (on its first attempt).
- The cost of Mars Orbital Mission was \$75 million, which was less than making of the film Gravity (\$100 million). Another similar mission to Mars by NASA around the same time cost many times more.

Commercialization of Space Apps in India: Antrix Corporation (1992)

- In order to leverage the gains made by ISRO, a commercial arm called Antrix Corporation was set up in 1992.
- Antrix Corporation was able to access ISRO staff of 16000 scientists and engineers.
- Antrix Corporation has launched through ISRO many successful satellites for other countries and has business agreements with many governments and corporations.

Indian Commercial Space Industry: Need for Private Sector Initiative

- India's commercial space industry is worth just over \$1 billion when global space industry is worth \$314 billion in 2013. India needs to encourage private sector in space industry.
- Antrix Corporation has a large vendor base but there is no major independent private sector space industry.

India's Human Space Flight Programme

- India has the technical expertise for developing a Commercial Space Transport Industry.
- While Human Space Flights have been carried out by USA, Russia and China, India also has a Human Space Flight Programme.
- Although ISRO has no launch vehicle capable of carrying humans as yet, it is developing an orbital vehicle with two member crew for Low Earth Orbit (LEO) to be ready little after 2017.
- ISRO has also proposed a training centre for Astronauts on 140 acres site outside Bangalore.

India's Launch Capability

- India is one of the eleven countries having indigenously built and reliable launch capability for satellites.
- India has two launch vehicle: Polar Satellite Launch Vehicle (PSLV) and Geo-Synchronous Launch Vehicle (GSLV)
- PSLV is India's workhorse and has no weight limitations. India's Chandrayan (Moon) and Mangalyan (Mars) has been sent from this launch pad at $1/3^{\text{rd}}$ the international cost.
- GSLV launch vehicle for Geo-Synchronous orbits has however weight limitations of about two tonnes. However, with India's indigenously developed and successful cryogenic engines this will soon be overcome.

Re-Usable Launch Vehicle (RLV) by India

- ISRO proposes to design a Re-Usable Launch Vehicle (RLV) as a technology demonstration.
- This will be first step towards developing a full fledged vehicle that will go into for manned space missions.
- RLV will also reduce cost of satellite launches by ten times. A more developed version could be used for manned mission.
- Therefore, India will be capable of entering Space Tourism Market on its own.

- A series of experiments on RLV including Hypersonic Flight Experiment (HEX), Landing Flight Experiments (LEX), Return Flight Experiments (REX) and Scram Jet Propulsion Experiment (SPEX) are likely to be carried out.

- These multiple demonstrations of RLV will confirm the feasibility and preparations of India Manned Space Mission.
- Cost of RLV will come down furthermore. Putting one KG object in space costs about \$5000. This will come down substantially.
- RLV will also help India enter Space Tourism market in a cost effective manner.

- India has successfully used an indigenously developed cryogenic engine. From two tonnes of payload, India hopes to carry much larger payload in GSLV. This full cryogenic engine (GSLV Mark III) should be ready by 2016.
- A satellite using this new engine is proposed to be launched in 2017.
- In a recent seminar in Delhi, Mr. Frank Rose, US Assistant Secretary of State for Arms Control has stated that US was working with India on a comprehensive strategy on new space capabilities. He also mentioned that India could be invited to work with US on International Space Station (ISS). This will be a great opportunity for India if it takes place. India will also be able to learn docking techniques with India's RLV, it will be a great experience for India.

Would India Develop an Aerospace Transportation Industry?

- Yes, India is already well on its way towards it for both sub-orbital flights and space trips.
- India already has a working space port called Satish Dhawan Space Port at Sriharikota.
- While India has a much better and advanced capability for starting Aerospace Transportation, India is yet to make an announcement on the subject.
- India is currently in the process of bringing about a Space Legislation so that private sector can also be involved.

- According to NASSCOM – India's IT enabled Industry Association in its Start-Up Report 2014 has stated that India is the fastest growing and third largest eco-system globally driven by young and diverse entrepreneurs.

Private Sector in Space in India

- Indian Start-Ups in Space business are coming up. Aerospace Start-Ups Axion Research Labs Team India has just won a \$1 million prize out of a \$30 million Google Lunar Xprize Competition in the Landing Milestone Category.
- After competing with 17 teams around the world the prize has been awarded to 'Team India' to land a rover on the moon by December, 2016.
- Dhruva Space, another start-up are collaborating with Berlin Space Technologies to establish India's first factory for small satellites.
- Further NASSCOM predicts by 2020, 11500 start-ups will start and will employ 250,000 professionals.

Conclusion

- In conclusion, India is technologically well on its way in participating in Aerospace transportation in the world it can also claim a major cost advantage is, therefore, favourably positioned for the same.

Thank you