As public and private investors look for new sources of economic growth and innovation, the space sector has opened up several avenues. From satellite manufacturing, launch services, and ground stations to commercial space products and services such as satellite broadcasting, Earth observation, geo-location, and global navigation equipment and services, the space industry is growing at a fast pace.
Until recently all investments in space technologies and the output from the missions have principally being used by governments. The utilization involves R&D, defence and telecommunication services, weather forecasts, etc., the benefits being harnessed entirely for technological growth, military applications and prestige of a nation.

However, the trend is now changing in many countries worldwide. The prospect of privatization of space missions is taking shape at a fast rate with many business moguls venturing into investing their fortunes in space. Some prominent names in this sector: Elon Musk co-founder of PayPal, invested nearly $100 million from his personal fortune in the company Space Exploration Technologies, popularly known as SpaceX; Jeff Bezos of Amazon.com investing his gains in the company Blue Origin which manufactures a spaceship called New Shepard; Britain’s billionaire Sir Richard Branson’s Virgin group investing in Virgin Galactic. In addition, despite dipping economies globally, most countries’ space budgets have not been reduced drastically. The current trend is that many countries are vying to involve in space explorations, manned missions, research and also sharing of services. What could be the reason? The answer: Space is a booming business prospect.

We are familiar with telecommunication satellites being a major source of economy for countries that launch them. The information beamed across the corners of the world are leased and bought by other countries for their communication purposes. Some examples of the areas of current interest being weather forecasting, Direct to Home (DTH) television services, Fixed Satellite Services (FSS) for receivers stationed on the ground, Mobile Satellite Services (MSS) for satellite phones and in-flight communications; the imaging services of earth and natural resources departments benefits from the satellite services along with the defence and intelligence departments.

Satellite services are also used in navigation systems, communications, and meteorology and earth observations. Satellite communications also find extensive use in urban planning, traffic control, medicine, disaster management, and transportation. All this justifies the commercial aspect of the revenue from space technology.

The global space industry has grown steadily in the past decade; the majority of the revenue generated by the space missions is of commercial nature, with global space activities amounting to nearly $315 billion in the year 2013 and reporting a rise to $323 billion in 2015. This amounts to a major chunk of the space related activity coming from commercial use.

Amidst all this, where does the common man benefit? The role played by these explorations has so far been in the betterment and developed functioning of human societies. One obvious advantage for us from space technologies and satellite missions is the geo-spatial positioning system that allows for accurate reading of the latitude, longitude and altitude of small receivers independently – a feature which we are familiar with by using the GPS and maps facility. This has helped in better and safer prospects of navigation, not only for commercial purpose but for maritime and aviation navigation as well.

Stretching this utility further, these companies plan to expand the resources and make them available to the common masses in such a way that anyone can play a role in the utilization of the outcome from these missions. The goal is to benefit from the studies conducted in space technologies such
that it becomes beneficial for the common people in some way. In other words, space is not a reserved territory for specially trained people, but can be approached by any person willing to involve.

Already advanced countries are immersed in such projects and are bringing out prospective missions to explore the outer space. The current regulations are being modified such that private companies are permitted to invest in these missions and benefit from the sale of resources.

Space Economy
This brings us to the interesting aspect of space economy. For example, all deep space missions customarily log on to the International Space Station (ISS) – a facility up in space shared by all countries exploring space and contributing to its upkeep. It is by way of refuelling or withdrawing resources from ISS, the probes are able to catapult into further deep space.

The ISS in turn also depends on further missions to furnish its supplies regularly. All these eat away into the economy of the mission, costing not only huge amounts running into billions but also depleting earth sources.

Another difficulty faced by missions now is that they are launched with a specific time frame – till the on-board resources of the ship are exhausted or the radiation shielding expires, or for manned missions, the available resources are exhausted and the team has to return.

However, if resources can be extracted and utilised from space itself, then the burden on earth as well as the
economy comes down. Moreover there is a promising factor of establishments being able to sell resources from space to improve their economy. This is similar to an outsourcing facility in space available to anybody entering into space for various reasons.

Hence, space is able to build an economy providing immense returns in the coming days for prospective investors.

**The Demarcation**

So who can actually involve in this? One mandatory requirement is that it is a combined investment of Government agencies and the private sector. This ensures the missions use cutting-edge technologies from the latest research, are safe under various calculated risks and the blanket of regulations are met through. Hence this entire procedure is divided into two main categories – the Primary and the Secondary providers.

Primary manufacturers take care of the deep space technological concepts, missions, R&D etc. The Secondary manufacturers utilize the services of the Primary producers to convert them into commercially viable services. For example, a satellite owning company involves in manufacturing and maintaining a satellite service playing the role of a Primary, whereas remote sensing services, sat-TV services, weather forecasting services, etc. are taken care of by the Secondary providers.

So with this type of involvement from different sectors, space mission expenditures become more lucrative and there is a wider utilization of the huge investments. As private sectors have scope for wider economic growth with innovative approach, it attracts a bigger investor cluster.

The pioneering manufacturer in this sector is SpaceX which has successfully designed and launched payloads to ISS. It has made several trips to refurbish supplies to ISS.

As with any venture, calculated risk plays a major role in success of these ventures. Amidst all the activity, there have been breakthroughs, delays and disasters. However, the steely determination by these companies to forge ahead despite setbacks and unforeseen events remains in the forefront.

Rigorous tests, experiments and a number of unmanned missions are carried out before actually achieving the manned missions. Intense research involved is bringing out new technologies to re-use the spacecrafts. Better designing and safety measures are being tested for manned missions.

The forefront companies venturing into space have even been backed abundantly by NASA, US Air Force and other governments interested in investing.

**The Space Foundation**

Keeping an eye on the various developments and progresses of the global space industry, a non-profit organisation The Space Foundation was started in 1983. This not only provides services in terms of space awareness activities, educational programmes and major industry events related to space, but also provides an annual report called The Space Report. With a subscription fee, any country can access and benefit from these reports, which often serve as guidelines for the latest activities.

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**ASTOUNDING FIGURES**

- Between 1996 and 2002, 245 launches were made for commercial ventures while government (non-classified) launches were only 167 for the same period.
- In 1994, DirecTV debuted direct broadcast satellite by introducing a signal receiving dish 18 inches in diameter. By the end of 2000, DTH subscriptions totalled over 67 million.
- As per OECD’s (Organisation for Economic Co-operation and Development) report of Space Budget of 2013, USA tops the list with a budget of 39332.2 million USD. Followed by China (10774.6 million USD), Russia (8691.6 million USD) and India (4267.7 million USD).
- According to The Space Report 2016, in 2015, the global space economy totalled $323 billion worldwide. With a total of $246 billion, commercial space activities made up 76 per cent of the global space economy.
Space Mining
What other prospects could space missions hold? The year 2017 will see another probe from NASA approaching a near-earth asteroid. One interesting aspect of this mission is the samples collected from the asteroids. Asteroids as we know are smaller space objects with earth-like orbits and abundant resources. They have been found to contain water, precious minerals and un-diffused solar energy. So is it possible to utilise this rich repository for the economic benefit of mankind?

Yes, say scientists and establishments involved in deep space missions. They opine that for one, any current space mission requires enormous resources in terms of fuels, water and energy to complete its mission. While all these are being sourced from earth, it is evident it is a depleting resource. The idea of extracting resources from space is to fill these gaps and make the required materials available from space itself. By utilizing these resources, the earth’s depletions can be filled up. Also provisions can be made to mine and utilize the resources in space itself.

For example, some minerals that are extracted from space objects can be used as propellants and fuels. It is being visualised to develop technology milestones…

• In 2012, Falcon rendezvous with ISS made SpaceX the first commercial company to make it to space.
• Dragon spacecraft is the first reusable craft that has made successful trips to ISS and back. Since then Falcon has made 29 trips and delivered essential cargo to ISS, making it a leader in private space missions.
• Lockheed Martin and Boeing’s Alliance Company proposes to launch Vulcan as a competition to Falcon in 2019.
• Some unique features of Falcon include its nine-stage initial engine facility that ensures that a mission is completed even in the event of an engine shutdown.
• Boeing is also developing the CST-100 spaceship with a capacity of seven astronauts. In addition it proposes to send them to ISS by 2017.
• Lockheed Martin has Orion being designed for deep space explorations.
• Very soon manned missions called the Dragon crew are to be tested. This will make its maiden flight with features fitted to accommodate passenger travel but is initially being tested by experienced astronauts.

…AND SOME MAJOR DISASTERS
• 2003: Brazil’s VLS small launch vehicle burst into flames causing damage to the infrastructure and killing 21 people. This was a pre-launch test procedure that failed.
• 2010: Our own GSLV-D3 plunged into the sea minutes after launch.
• 2013: Proton lifted off but crashed sideways immediately.
• October 2014: Orbital ATK’s Antares rocket carrying the Cygnus payload to ISS blasted into flames soon after its launch. A retooled rocket is being designed to launch in 2017.
• 28 June 2015: Falcon lifted off from Cape Canaveral station only to burst into flames minutes later.
• 1 September 2016: SpaceX Falcon 9 pre-launch static-fire test witnessed an explosion leading to a huge loss – the rocket as well as the payload of Amos 6 communication sat which was leased out by Facebook – and infrastructural damages to the launch pad. No loss of life was reported as the staff was cleared well in advance of the pre-test – a mandatory procedure of SpaceX. The attributed reason was an unexpected glitch in one of its helium systems that cover the liquid oxygen tank.
such that the facility is available in-situ – that is mining, processing and providing all in space itself!

Some of the minerals of interest are gold, silver, iridium, and rhodium which can be brought back to earth for utilisation here. Aluminium, copper and iron find use in construction. Water and oxygen sources from space can directly be used to sustain astronauts in space; hydrogen, oxygen and water can be used to derive propellants for rockets – a kind of fuel filling stations in space!

Some of the organisations working in this sector are Deep Space Industries and Planetary Resources.

**Space Travel**

Manned missions are just over four decades old. Old enough for rapid developments and progress in this arena. Many countries including India have sent their astronauts into space and conducted researches. Now, as a common man one is tempted to ask: “Is it possible for you and me to travel into space?” Very much Yes, say these organisations involved in space economy.

As we know flight travel by itself contributes to a major chunk of a country’s economy even giving birth to indirect revenue in the form of cargo, tourism, hospitality industry, etc. Similarly, space travel in the future too holds a lot of promise as a commercial business prospect.

Technically, a distance of 50 km upward comes under space. Currently, commercial space travel is aimed at providing five minutes of the weightlessness experience to the participant in this region which is also the near-earth orbit only. Then the craft glides back to the base.
As of now it occupies the status of adventure travel, reserved for a few rich people and can cost a whopping $200,000 or more per person. But analysts predict that this is definitely not a niche market as the major chunk of revenue comes from the middle class travellers. So very soon there will be change in this scenario and prices will come down.

Not far off is the prospect of hospitality industry in this belt! Mushrooming from these prospects are subsidiary economy generators like tourism, hospitality and various branches. It is projected to create many more jobs too.

Rigorous experiments and test flights are underway to tap into this market. SpaceX again claims to be able to ferry passengers in small modules by 2020 at least. Their further vision as declared on their webpage is to make travelling to Mars a possibility for human habitat.

Deep Space Scavenging
Some other possible services that are of economic value are deep space scavenging. This involves the collection and disposal of space debris left by defunct, malfunctioning spacecrafts. They can include parts or entire probes lost in space until now. The vision is to collect such objects, route them to a facility in space for destroying or recycling as required.

Regulations
With such lucrative prospects waiting to be exploited, it is obvious that investors would make a beeline to grab them. There have been many back and forth arguments regarding ownership rights of space objects for mining or inhabiting purposes. In 2012, by signing The Outer Space Treaty it was unanimously agreed by many countries that no individual or country has ownership rights on space objects. However they are free to utilise the resources available and claim an ownership on the resource.

On 25 November 2015, President Obama signed the U.S. Commercial Space Launch Competitiveness Act (H.R. 2262) into a law. The law recognizes the right of U.S. citizens to own space resources they obtain and encourages the commercial exploration and utilization of resources from asteroids.

Even as we read this, buzzing activity is taking place; scientists and engineers work round the clock in this sector to unfold many imaginative prospects into reality. The coming years wait to witness their efforts.

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