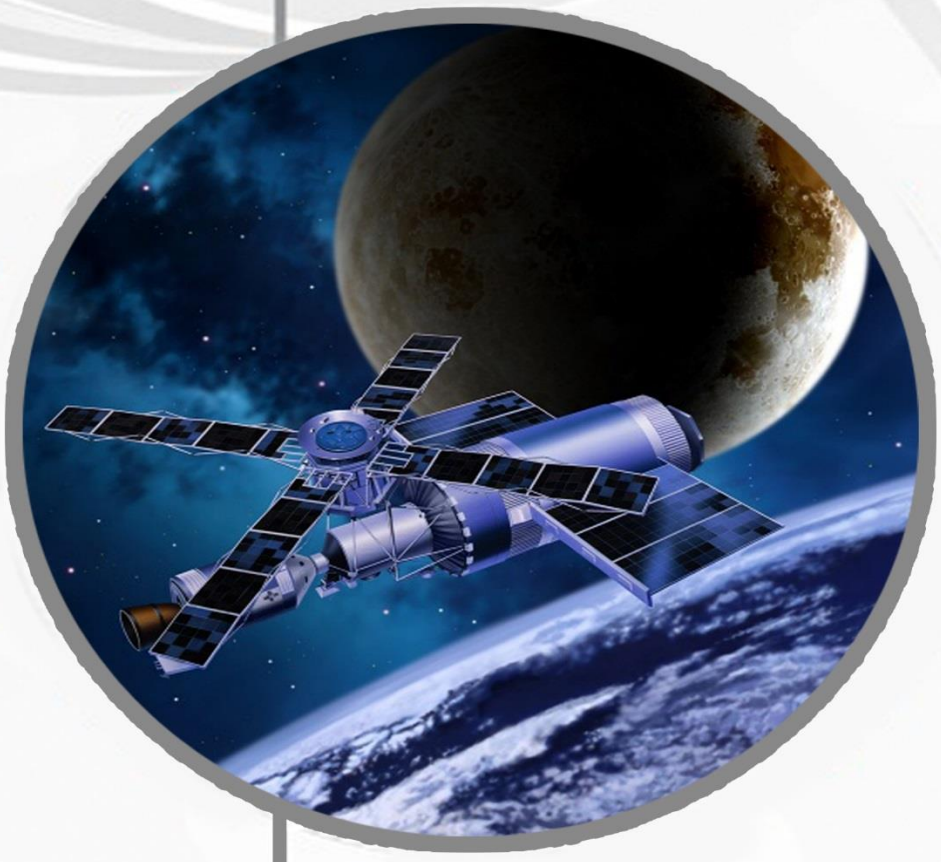
Pakistan's Space Program



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Abstract

Pakistan hopes to become a front running country in terms of development in coming years, but our policymakers have limited their scope to a few fields while completely ignoring the others. Space exploration is a field that Pakistan has extreme potential for but due to the poor policymaking, the country has been left behind by competing nations that established space programs decades after SUPARCO came into existence. Countries such as India, Kazakhstan and South Korea have achieved great amounts of success in this field simply because it is a priority for these nations to progress. If Pakistan truly wishes to become a world leading country, we will have to give each and every aspect of nation building equal amounts of importance.

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Introduction

Space exploration has been one of the main focuses of the developed and developing countries since after World War II. Countries including USA, China, India and Russia have dominated this sector with Japan and Kazakhstan and many others following close behind. The discoveries these countries have made and the developments taking place are mind boggling as they have come close to answering questions which remained impossible to be addressed few decades ago.

Space exploration is not just about finding answers to cosmic questions, although this should be a matter of importance. In fact space exploration and successful space programs can be helpful strategically as in the case of North and South Korea where each uses its space expertise in their attempts to attain a clearer idea about each other's military intentions, and plan their respective future strategy accordingly.

From the investment point of view, space exploration can be extremely vital as in the case of Kazakhstan and Russia wherein Russia is able to fund Kazakhstan through the renting of its spaceport.

One thing is clear that unless a country is focused on space exploration and willing to provide healthy funding to the cause, it will be left behind in this race which is the present and the future benchmark of success. Other countries will take over the industry while the receding ones will only be left to stand and watch. Progression in space technology is another criteria through which countries are being categorized as developed or under-developed.

Pakistan's space program "Space and Upper Atmosphere Research Commission (SUPARCO)" was established in 1961 by Dr. Abdus Salam. Upon inception it was set to be quite successful as it was the first of its kind in the subcontinent. In the first few initial years, Pakistan launched a few satellites successfully and was leading the subcontinent in space related activity. However, when Pakistan started to work on the development of its nuclear weapons; space exploration took the backseat priority wise.

Since then, Pakistan has fallen far behind the countries that started the development of their space programs many years later and we have slowly become one of the wait and watch countries.

This research paper is comparative in nature, taking into account the development of space programs of India, South Korea and Kazakhstan vis-à-vis that of Pakistan. It further discusses some of the reasons behind the downfall of Pakistan's space exploration, the Government's policy on the matter and what Pakistan has in store for space exploration in vision 2025.

Pakistan vis-à-vis Other Countries:

Pakistan:

Pakistan's national space agency "SUPARCO" was created in 1961 by Dr. Abdus Salam. It was the first space program of the subcontinent.

Pakistan launched its first rocket in 1962 called "Rehbar-1" with the help of NASA and later that same year "Rehbar-2" was launched.[1] After this launch the organization underwent many administrative changes and for a long time the space exploration remained stagnant, until 1990, when "Badr-1" was launched as Pakistan's first satellite with the help of China. Our last satellite operation happened in 2001 and was called "Badr-B", but very little has happened since then including the launch of Paksat-1R which is Pakistan's only fully functional Communications Satellite.

In 1970, Pakistan shifted its entire attention towards the development of its nuclear program and space exploration took a back seat indefinitely. We achieved excellence in the field of nuclear development with the help of Dr. Abdul Qadir Khan, but in lieu space exploration took a massive setback.

Nuclear development was, however, not the only issue faced by Pakistan. We have been in a constant state of turmoil since the 1990s which includes issues such as natural disasters, ambiguous state of politics, terrorism, lack of funds and lower focus on education in this field; another major reason for our shift in priorities was our involvement in "War on Terror" which not only depleted our resources but also placed us in an awkward position with our neighbors, which is why we started incurring massive counter terrorism budget. All of these issues led to underwhelming aims and lack of a futuristic approach of the Pakistan's space program towards further development of their work.

[1]Official website of SUPARCO.

Pakistan, currently, has one institute of repute that focuses on space education that being the "Institute of Space Technology" located in the capital city of Islamabad. The institute hires top ranking lecturers and professors that are fluent in their understanding of space technology but the students that graduate from the institute find no solid place to develop their careers in the country and look towards foreign institutes for career development. This is why space exploration and technology is one of the biggest sources of "brain drain" in Pakistan and it is the responsibility of the state to ensure that these Pakistani students find a suitable platform within the country so that they can contribute to the future of Pakistan's space programs and can attain work in in the country rather than having to look abroad.

According to the official website of SUPARCO and on the very first page the three main programs undertaken by the SUPARCO currently are mentioned, all three of which are related to either crop or weather conditions. This can be used as an active description of what our space program has been reduced to today.

India:

"Indian space Research Organization" or ISRO was established in 1960 and since then the following operations have been undertaken by the organization:

According to the official website of ISRO, it was established as the "Indian National Committee for space Research (INCOSPAR)" by their department of Atomic energy.

Their first operation was a rocket launched on November 21st, 1963; a whole year after Pakistan's "Rehbar".

They had set up their first Satellite Communication Earth Station in 1967 and developed an Air-Bourne Remote sensing from 1972-1976 as the ISRO (1969), both of these were successful operations. In 1975-76, India conducted its first Satellite Instructional Television Experiment (SITE).

First satellite launch took place on April 19th, 1975 called Aryabhata, whereas Pakistan did this in late 1990s. The second satellite launch took place in 1979 named "Bahskara-1", still two whole years before Pakistan launched its first.

In 1981, India has successfully placed RS-D1 in the earth's orbit and started receiving signals which is something Pakistan still has not managed successfully. It also launched "Bhaskara-2" in the same year.

In the same year, India launched APPLE, which was its first successful Geo-stationary Communication Satellite. This gave India a massive head start in their attempts to build a small scale space station.

India successfully launched "RS-D2" in 1983 and managed to place another satellite in Orbit. Furthermore, in 1984 the first India-Soviet manned space mission took place, which was successful.

Launch of first operational Remote Sensing Satellite took place in 1988 called the "IRS-1A". While the second IRS launch took place in August, 1991.

In 1994, India managed to successfully place a satellite in the Sun-synchronous Orbit called "IRS-P2".

In the 2000s, India had become so successful at launching satellites successfully into the orbit that it began to undertake missions to place satellites of other countries into the orbit and has since then placed close to 175 foreign satellites in the Orbit successfully.

The ISRO did not however stop work on their own space programs and it proved its worth by landing on the moon in 2008. India has planned its second expedition in 2018 and work for that is underway.

ISRO holds many prestigious records in the field of space technology, and in a few instances India has broken its own records.

Firstly, ISRO held the record of launching 20 satellites simultaneously in 2016, which the ISRO itself broke in the year 2017 by launching 104 satellites at the same time.

India also hold the record of 35 successful missions in a row, which no other country in the world has even come close to.

ISRO's Remote Sensing Satellite system is now the largest in the world.

One of its most recent accomplishments is the Mars expedition in 2013, termed the "Mars Orbiter Mission (MOM)" in their first attempt which was completed in the record budget of $75 million. This was the first successful Mars expedition in Asia and the 4th worldwide.

This list of achievements by the ISRO is still incomplete as only major satellite and expedition missions have been mentioned here, India in fact has many success stories

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in the field of space technology. ISRO plans to perform a human spaceflight in 2017 as well.

The ISRO shows no signs of culminating this pace of operations as can be seen from their Vision 2040 wherein they wish to visit Venus and perform a manned expedition to Mars. This shows the futuristic approach of the Indians and their focus on the development of their space program.[2]

South Korea:

The "Korean Aerospace Research Institute (KARI)" is the national space program of South Korea. It was established in 1989 and the reason of comparison with Pakistan is that the basic purpose of Korea's space explorations was to protect itself from North Korea and keep an eye on their activities. Pakistan faces a similar threat from India but our expeditions have been nowhere near as successful; even though KARI was established almost 20 years after SUPARCO.

Korea launched its first Rocket in 1993, decades after Pakistan's first launch, the expedition was successful. The second Rocket launched by Korea was in the year 1998 called "KSR-2".

Korea launched its first satellite in 1999, called the "KOMPSAT-1" this is termed as a "multipurpose satellite".

[2]Official Website of ISRO.

In 2002, Korea launched its first Liquid Propellant Rocket called the "KSR-3" following which came the launch of STSAT-1; both missions were successful. An interesting development that took place was that Korea broke ground on the development of Naro space Center in 2003, which was completed in the year 2009. During its development while the Government was spending vast amounts of money on the Space Center, it managed to launch "KOMPSAT-2" after which the public started to question the spending of the Government and demanded that the Government either shows results of all these expeditions or cut down their spending on this field. The Government's response to this was that South Korea would not cut down its spending as it would become vulnerable to attack from North Korea; furthermore it would continue to explore newer technologies until it no longer needed assistance from the United States in the field.

In 2008, the first Korean astronaut went into space, and the people began to back the Governments expenditures and decision.

In 2010, Korea launched COMS, which was a dedicated "Communication, Ocean and Meteorological Satellite", this was a Geo-stationary satellite.

In 2012, Korea launched "KOMPSAT-3" and in 2013 "Korea's first space Launch Vehicle (KSLV-1)" was launched. In the year 2013, "KOMPSAT-5" and "STSAT-3" were launched.

The most recent launch by KARI was in 2015 termed "KOMPSAT-3A".

The future of KARI's development is in the fields of space Launch Vehicles, Satellites, Lunar exploration, Satellite Navigation and Cryogenics.

KARI is miles ahead of SUPARCO even though it started operations almost two decades later. This is also troubling since Pakistan requires a similar space program in order to be able to cut down their defense budget while ensuring no vulnerability from its hostile neighbors. [3]

Kazakhstan:

Kazakhstan's National space program is named "Aerospace Committee of the Ministry of Defense and the Aerospace Industry of the Republic Of Kazakhstan. (KAZKOSMOS)". It has the first and largest spaceport in the world called "Baikonur Cosmo drome" which was developed in 1955. KAZKOSMOS is also the only space program from the ones selected for comparison that is a member of the "UN Committee on the Peaceful Uses of Outer space for Peaceful Purposes (COPUOS)".

The timeline of KAZKOSMOS starts from 11th September, 1991 when it was initiated. Its first "Cosmonaut" T. Aubakirova took flight in 1991.

In July, 1994 a Cosmonaut of the Independent Republic of Kazakhstan took a 126-day flight and successfully completed the second Research and Experiment Program. In 1994, they also signed a lease for "Baikonur" complex with the Russian Federation

"Peace" the second 208-day flight in TA Musabaeva astronaut space as Commander of the International Crew of the 25th main Expedition to the Orbital Complex took place

[3]Official Website of KARI.

in 1998. Kazakhs made the third program of space research and experiments of the Republic Kazakhstan in the same year.

The third flight of T. Musabaeva astronaut to the International Space Station as Commander of the International Crew of the world's first space tourist D.Tito occurred in 2001, along with Kazakhstan's fourth space program of scientific research and experimentation.

Agreement between the Government of the Republic of Kazakhstan and the Government of the Russian Federation on creation at the Cosmo drome "Baikonur" space rocket complex "Baiterek" signed in 2004

The first Kazakh communications satellite and "Kazsat" broadcast from the Cosmo drome "Baikonur" in 2006

Second Kazakhstan geostationary spacecraft communication and broadcasting "KazSat-2" also happened in 2006 with Russia's Federal State Unitary Enterprise "State Research and Production Space Center of MV Khrunichev", and Kazakhstan extended their lease of the Cosmo drome to Russia until 2050, in 2010.

Launch of the second Kazakh Communications and Broadcasting Satellite "KazSat-2" from the Cosmo drome "Baikonur", happened in 2011, also, the third "KazSat-3" from the Cosmo drome "Baikonur" space vehicle communications and broadcasting was released in 2014.

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The first Kazakh satellite remote sensing high resolution "KazEOSat-1" from Kourou (French Guiana) was launched in 2014 along with the launch of the second ERS satellite medium resolution "KazEOSat-2" from the Russian launch base "Clear" (Orenburg region).

This shows that the investment done by Russia in KAZKOSMOS has been put to good use as the Kazakhs ensure that they pay the Russians back in the form of a useful space port, whereas Pakistan due to lack of good governance, personal interest and the menace of corruption, focuses on getting more and more and putting it to no good use.[4]

Comparative Analysis of Space Programs:

Year	SUPARCO	KAZKOSMOS	ISRO	KARI
1961	Established	-	Established	-
1962	"Rehbar-1" and "Rehbar-2"	-	-	-
1963	-	-	First operational rocket launched	-

[4]Official Website of KAZKOSMOS.

1967	-	-	Satellite Communication Earth Station	-
1972-1976	-	-	Air Bourne Remote Sensing, First Satellite Instructional Television Experiment and First Satellite.	-
1979	-	-	Second Satellite operation.	-
1981	-	-	Placed a Satellite in Earth's Orbit and launched APPLE, the first Geo-stationary Satellite.	-

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1983	-	-	Placed another Satellite in Earth's Orbit	-
1984	-	-	First Manned space expedition.	-
1988	-	-	Launch of first Remote Sensing Satellite	-
1989	-	-	-	Established
1990	First Satellite Launch	-	-	-
1991	-	Established and first manned expedition.	Second Remote Sensing Satellite.	-
1993	-	-	-	First Rocket launched.
1994	-	126-day flight and signed a lease with	Placed a Satellite in the Sun-	-

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		Russia for the Spaceport.	Synchronous Orbit.	
1998	-	208-day fight called "Peace"	-	Second Rocket Launch.
1999	-	-	-	Launched its first Satellite
2000	-	-	Began undertaking Satellite launches for other countries.	-
2001	Launch Badr-B	First successful mission to the International Space Station.	-	-
2002	-	-	-	First Liquid Propellant Rocket and STAT-1
2003	-	-	-	Broke Ground on first Space

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				Center called Naro
2006	-	First Kazakh Satellite from Cosmo drome, first Geo-stationary Satellite and extended lease of Spaceport with Russia	-	-
2008	-	-	Landed on the moon.	First Astronaut to space
2009	-	-	-	Finished Naro Space Center.
2010	-	Extended lease of Spaceport until 2050	-	Launch of Geo-stationary Satellite called COMS

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2011	First Geo-Stationary Satellite	Second Kazakh Communication and Broadcasting Satellite	-	-
2012	-	-	-	Launched KOMPSAT-3
2013	-	-	Successful Mission to Mars.	First space vehicle, STSAT-3 and KOMPSAT-5
2014	-	First Kazakh High Resolution Remote Sensing Satellite.	-	-
2015	-	-	-	KOMPSAT-3A
2016	-	-	Lunched 20 Satellites simultaneously	-
2017	-	-	Broke its own record by	-

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			launching 107 Satellites at the same time.	

Pakistan Government's Policy:

The Government of Pakistan has still to give a comprehensive policy regarding the development of SUPARCO. In fact, the only thing that we can look forward to in terms of space development is the program called "SUPARCO 2040", which is the state of operations SUPARCO wishes to achieve by the year 2014. It was pinned in the year 2012 while some of the salient features of SUPARCO 2040 are:

1. National demands will dictate the number of satellites the country needs.
2. At least 3 Remote Sensing Satellites launched every three years.
3. Focus on different types of RSS in the next 7-8 years.[5]
4. Addition of 5 Geo-Satellites and 6 LEOs to replace the existing ones.[6]
5. Paksat MM1, Paksat MM2 and Paksat-2 to be launched.
6. 5 Remote Sensing Satellites to be launched.
7. Launch of First Optical Satellite.

[5]Salman Siddique (2012) "Lagging Behind:2040-Pakistan's Space Od[d]yssey" The Express Tribune.

[6]Suddle, D.Sc., Mohmmad Riaz (19 December 2009). "Pakistan's Space Programme". SUPARCO Media Research Directorate. Dr. Mohmmad Riaz Suddle, Director of the Paksat-IR Programme and current executive member of the Suparco's plan and research division. Archived from the original on 10 January 2011.

Although the agenda of the Vision includes prospects of expeditions in space, the work done so far is limited to observation. In the issue released in 2012 by SUPARCO, most of the work done was about the study of transit of different celestials and tracking Meteoroids within Pakistan. [7]

Our central Vision of the future is limited and SUPARCO is already confirming a lag in the activities; any major changes in Pakistan's space program cannot be seen. The program seems to be an underwhelming attempt to make it seem like the policy makers have made a heavy hearted attempt in eradicating the problem.

Noticeable here is the fact that is all the postulates of Vision 2040, Pakistan only discusses the possibility of actual space expeditions yet draws no real map towards that. Countries that prioritize space programs such as India and China are already in the process of expeditions towards Venus and farther, whereas Pakistan has just made it to the earth's orbit. The Cosmos is far more than theory and if Pakistan is to get back in the race, it has to focus its efforts on taking calculated risks in space exploration or get left behind.

Vision 2025:

Vision 2025 is the report developed by the Planning Commission of Pakistan that discusses the proposed state of Pakistan by the year 2025 and the road map for the achievement of those visions.

[7]SUPARCO Astronomy and Astrophysics Bulletin; June 2012, Vol 1 Issue 6

Vision 2025 of Pakistan has 7 pillars and 7 Development Programs in place, we will discuss each of these and try to find what the Government has in store for Space Development in Pakistan.

The 7 Pillars:

1. **Development of Human and Social Capital:** This pillar focuses on developing the quality of life for each and every citizen of Pakistan. This will be done by capitalizing and solidification of the existing capital, improving people skills and ensuring equal opportunities for everyone.
2. **Achieving Sustained, Indigenous and Inclusive Growth:** Maintain the current level of growth keeping in mind equity and environment.
3. **Governance, Institutional Reform and Modernization of the Public Sector:** Good Governance, Development of institutions and devolution of power to provinces.
4. **Energy, Water and Food Security:** Producing sufficient, reliable and cost effective energy, water and food sources.
5. **Private Sector and Entrepreneurship Led Growth:** Make Pakistan attractive for foreign investment and focus on the growth of private sector.
6. **Developing a Competitive Knowledge Economy through Value Addition:** Developing National Competitiveness in the International Market through effective understanding and utilization of resources.

7. **Modernizing Transportation Infrastructure and Greater Regional Connectivity:** Effective and Integrated systems of communication.[8]

The thing to notice here is that none of the pillars of our vision 2025 have any inclination towards space exploration and the focus seems to be heavily tilted on economy and infrastructure development. The conclusion we can draw from briefly looking over these pillars is that the policymakers of the country do not even see the limited space exploration as an issue and is therefore putting minimal thought into its development. Unless the government is made aware of the serious lag Pakistan faces in this field, we will eventually face a time when our space program might even be abolished, given that its current state is of no use anyway.

In the Vision 2025, there is a portion explaining that "Pakistan is situated at the nexus of the 4 most dynamic regions of the world" and this is used as an explanation of the growing amounts of focus on infrastructure development in the country; whereas if you focus on the statement its regard is in no way limited to infrastructure, in fact Pakistan being in the nexus of dynamic regions means that it faces the pressure to build on each and every element of its economy equally, which includes space programs.

Now we take a look at the seven Projects that Pakistan is undertaking in vision 2025;

1. **China Pakistan Economic Corridor:** The heavy Chinese investment in various departments of Pakistani Economy. It includes various departments of the

[8] Planning, Development and Reforms Commission Pakistan, Vision 2025.

economy such as Energy, Infrastructure, Sea Port, Railways, Job Creation etc, but fails to mention space collaborations

2. **Development Communication:** Public and Private Non-profit Development initiatives. Providing creative solutions through socio-technological innovations. In this day and age communication is heavily reliant on space technology, The satellites and wireless technology are dominating this industry. Without prioritizing space technology, we cannot improve or excel in communications.
3. **Peace and Development Unit:** To facilitate an enabling environment for building social capital for poverty reduction by mobilizing the communities towards sustainable development
4. **URAAN:** A project for the development of people under the poverty line who need assistance to fulfill their needs, categorized as a relief fund and will also include affectees of natural disasters.
5. **PSDP:** Public Sector Development Program channels domestic and foreign resources to implement the development programs and projects prepared by the federal, provincial and local agencies.
6. **Establishment of Center for Social Entrepreneurship:** Initiatives in Governance, Maternal Health, Education, Microfinance and Women's Entrepreneurship etc. All of these initiatives are aimed to make the future prospects of social development bright.

Although all of these projects are aimed at increasing the social and individual standards of living for the people of Pakistan and should therefore be completed, regarding the topic at hand these projects are a massive let down and not a single one of them even discusses our space programs or mentions what Pakistan's stance on space exploration should be in 2025.

After the brief understanding of Pakistan's Vision 2025, we can observe that till date we do not have any relevant policy, the situation of SUPARCO until at least 2025 does not seem to be any different.

Conclusion/ Recommendation:

Pakistan was once the country recognized as having the first space program in the Subcontinent and we enjoyed a special position given that we had started the testing of our rockets way before India or South Korea. However, as time has progressed the basic priorities of our governing forces shifted and Pakistan has become stranded in a circle of natural disasters, terrorism, corruption and poor governance which has led to underwhelming goals for the future of our space program. Pakistan is on an ideal Geo-Strategic location and we need to effectively utilize it, space programs such as satellite imaging can help us in strengthening our defenses against hostile countries that surround us. We can use these programs to bring better change in our strategies and therefore, make better decisions.

Currently, Pakistan has only one space studies related institute in Islamabad but the graduates of that university do not find a proper platform to put their knowledge to

use and end up looking at foreign institutes to solve their career development problems. This is why lack of space programs has become one of the biggest sources of brain drain in Pakistan and unless we come up with more sources of development for these graduates we will never be able to get back in the race with countries such as China and India. We have to find a way to make our space program attractive for both these graduates and the foreign investors as well so that they may wish to invest in the betterment of SUPARCO as that is the only way we will get out of this rut we are in.

As we discussed the current situation of Pakistan, we discussed the trajectories of space programs of India, South Korea and Kazakhstan and we compared it to that of Pakistan and it is actually visible how easily these countries took the lead and left us in the state where we are today. Pakistan's role in space technology has been reduced to a curious onlooker and we have conducted least amounts of successful operations in space in the list of countries that have national space programs.

The list of activities that SUPARCO wishes to achieve until the year 2040 regarding space science was extremely underwhelming as most of the activities stated were theoretical or observatory in nature and has no real road map to its completion. More over the agency itself does not even propose a manned or unmanned expedition to any celestial body which is something that almost all the leading space programs already have underway. India for example has planned a mission to Venus and re-visit Mars by the year 2040.

The last ray of hope we assessed was the Vision 2025 put forth by the Ministry of Planning, Development and Reforms of Pakistan. This Vision had 7 pillars and 7 programs in place and we looked at the description and purpose of each of them individually and tried to look for what the Government has in store for space programs until 2025 and as it was suspected, nothing. The programs underway were excellent initiatives but none of them answered any space related issues that Pakistan faces.

Conclusion from this assessment is that the reason SUPARCO does not foresee any development is because the Government or the Planning Commission does not even regard the underdevelopment as a problem. The Government needs to be made aware of the country's lag in space development so that it can work towards a sustainable solution. The planning commission must evaluate that infrastructure development does not solve all our problems, which we are facing in this day and age where technology and communications mastered by space technology are taking the lead.

The recommendations for the advancement of Pakistan's space program are as follows:

- Create awareness about the importance of studying and implementing space information for the betterment of the country.
- Creation of institutes related to space development and hiring certified faculty.
- Revamping of SUPARCO and allocation of funds.
- Inclusion of space exploration as a priority in the Vision 2040.
- All existing loopholes in the policymaking must be highlighted and a way forward must be devised.