Space Programs in Latin America: History, Current Operations, and Future Cooperation

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Introduction

Space programs in Latin America have not been able to develop as fast as other programs around the world. To understand why, it is important to summarize the region's history for the last 64 years. Space travel and exploration, as known today, started with the launch of the first objects into space in 1957. Since then, many nations have pursued the creation and operation of agencies to accomplish what once seemed impossible. Despite the enthusiasm for space exploration in the early 1960s, not many nations have been able to fully advance their goals, mainly due to the high cost of space technology development. The United States and then the Soviet Union were the two main powerhouses during the early stages of space travel, in what was known as the space race during the Cold War period. Since then, many other nations have formed space programs, operating satellites, launch facilities, and sending people outside Earth's atmosphere. Today, countries like China, Japan, India, Pakistan, Iran, and the European Space Agency (ESA) have space programs with vast capabilities and resources.

However, most countries in Latin America have encountered many challenges in their quest for space technology, as they have been, historically, nascent nations that for the last 100 years have confronted multiple economic, social, and political issues. Not surprisingly, most of their governments have sidestepped technology development in favor of investing resources into more pressing matters. That said, since the beginning of space exploration with the launch of the Sputnik satellite by the Soviet Union, countries in Latin America have, indeed, created space programs. The first space programs in Latin America were established in 1960 by the Argentine and Brazilian governments, followed by Mexico which established an agency in 1962. However, despite their longevity, these programs have not attained worldwide recognition in the space community. While most of the countries in the region have seen exponential growth in technology and space development in the last two decades, no single country has built orbital launch vehicles nor achieved full operational capabilities.

Currently, the only countries in the region that have a space program and have launched satellites into space are Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and Venezuela. At this time, there are around 3,000 satellites orbiting Earth, but only 85 of them belong or are operated by countries in Latin America. In perspective, the United States government alone allocates USD$22,700 million for its space programs, not including private sector investment. In second place is China, followed by the ESA, Germany, France, and Russia. Out of all the countries in Latin America, in 25th place in the world, Brazil spends the most on space programs, USD$47 million annually, followed by Argentina with USD$45 million, and Mexico with USD$8.34 million. The following is a summary of the major space powerhouses in Latin America.

Argentina

Argentina was the first Latin American country to create an organization for space flight and exploration in 1952; and throughout the years, the Argentinian government has created diverse research and exploratory projects in this field. In the 1960s, it established the National Commission for Space Research, followed by the Condor Program in the 1980s. This culminated in the establishment of the National Space Activities Commission (CONAE) in 1991. CONAE, similar to the National Aeronautics and Space Administration (NASA) in the United States, oversees all space-related matters in Argentina. According to their official website, CONAE develops all satellite missions conforming to the needs of the country. They oversee the design, construction, calibration, integration, and testing of space technology. In addition, the agency oversees launching operations using third parties.

CONAE has developed two of the main projects for Argentina, the "Satélite de Aplicaciones Científico" (SAC - the Scientific Application Satellite), and the "Satélite Argentino de Observación Con Microondas" (SAOCOM - the Argentine Microwaves Observation Satellite). The SAC project was a joint effort with NASA that consisted of four platforms with optical instruments. SAC-A was a technical mission, SAC-B was an astrophysical mission, and the SAC-C and SAC-D missions were dedicated to earth observation.[1] Currently, the SAOCOM venture is Argentina's biggest project to date, and poses a challenge because it will be the first of its kind meant to provide information transmission regardless of weather conditions, day or night, using the L band frequency. The project is a combination of two identical satellites applying technology developed in Japan with the capability to provide soil humidity measurements and information to prevent, monitor, and avoid natural disasters.[2]

The first SAOCOM satellite was launched from Vandenberg, California in 2018 and was carried by a SpaceX shuttle. The second SAOCOM satellite was launched in August 2020 from Cape Canaveral, Florida—a rare launch because it was its first polar launch since 1969. This satellite was launched aboard a Falcon 9 rocket operated by SpaceX and was successfully deployed from the upper stage around 14 minutes after liftoff. This cost of both satellites under the SAOCOM program was USD$600 million, including launches; and both satellites are in an orbit trajectory which allows them to fly over the poles.[3] Argentina partnered with Italy to create the first European and American space satellite constellation for emergency management, and will share images obtained by the two SAOCOM satellites with the Italian government, while Italy will provide information gathered by its four COSMO-SkyMed satellites. The combined six-satellite constellation was named SIASGE (Italian-Argentine Satellite System for Emergency Management)—able to cover a massive width of the Earth that allows for images to be repeated in just 12 hours.[4]

Bolivia

The Bolivian Space Agency officially started in February 2010. The agency's objectives included the deployment of the first Bolivian satellite, the development of new space projects, the training and education of human resources in space technology, and the implementation of satellite applications for social development, military defense, and the environment, among others. In the same year, the Bolivian and the Chinese government signed a contract for the construction of the Tupac Katari satellite. The contract included a USD$251 million loan with China Development Bank.[5]

The first satellite launched by the Bolivian government took place outside the city of Xichang, China on December 20, 2013. The satellite was built by a Chinese company in collaboration with the Chinese and Bolivian governments, measuring 2 meters by 2 meters and weighing 5.3 tons. The total cost of the project was USD$300 million, its main mission to ensure internet coverage to Bolivia's national territory, allowing for schools and hospitals in remote areas to communicate with bigger cities,[6] especially the poor and those living in remote rural areas who did not have access to telephone, television, radio, or internet, and providing communications services to 3.3 million Bolivians living in places where fiber optic had not reached. The platform had four transponders for television broadcast, and 26 transponders for transmission and reception. The project went beyond just providing access to communications, as it also sought to boost the economy by providing opportunities such as virtual-education, work, and health. The program was intended to create qualified personnel and quality jobs, in addition to advance other industries like software, hardware, and information and communication technology in general.[7] Bolivia has been an example for many developing countries around the world, given that it is one of the smallest nations in the region, with a rather small Gross Domestic Product (GDP) of USD$40.9 billion in 2019. The Bolivian Space Agency has been able, in the last ten years, to not just launch a satellite to provide communication capabilities to its population, but to create ground stations that monitor and manage satellite operations. Furthermore, Bolivia has expressed interest into acquiring remote sensing satellites. To further develop aerospace technology in the country, the Aerospace Bolivian Conference was the first organized congress with the objective to boost advanced education and technology to students, professionals, and the general public. The conference took place in 2014 and was supported by public institutions. private companies, and international universities.[8]

Brazil

Brazil is a powerhouse in Latin America with regards to space programs. Since the early 1960s, the Brazilian government has been interested in space travel and technology. The origins of its space program as it is currently known, started with earth observation, meteorology, telecommunications, rockets, infrastructure, and ground support. Currently, the Brazilian space program includes the development of its indigenous Sonda rockets, launch vehicles, medium and heavy lift vehicles, space probes, satellites, and multi-mission platforms. A few of the applications of the Brazilian space program are being used for science, communication, earth observation, and military. Some of the ultimate goals of the Brazilian space program include access to space, application satellites, and the development of more advanced multi-mission platforms.[9] According to the National Institute for Space Research for the Brazilian government, the Sino-Brazilian Earth Resources Satellite (CBERS) is currently one of the main projects of the country's space program. This partnership between China and Brazil started in 1988 with an investment of more than USD$300 million and the system, developed to implement first-class remote sensing systems, represented a breakthrough in transfer of technology within international agreements. To date, CBERS has built and launched six satellites. Out of the six satellites, two are operational, two are retired, one suffered a failed launch, one experienced a loss, and one satellite is on order.[10] According to the Brazilian Space Agency's official website, not only is Brazil actively and currently leading the region in space missions, but it is also looking to expand future operations.

Brazil, having the biggest space program in Latin America, is looking into the future of space missions by preparing, training, and collaborating with other countries for a future Mars mission. The Brazilian Space Agency is supporting a training project that uses the semi-arid region of Brazil to simulate the environment of Mars. By 2017, the project had recorded 65 missions with 30 more being scheduled. To date, 213 people from 29 different countries have contributed to this project.[11] With a mission to Mars currently being one of the largest projects for different space programs like the United States and China—Latin American countries' involvement in this program demonstrates their willingness to participate and collaborate in future endeavors.

Additionally, Brazil is taking significant steps to be the first country in the region to successfully complete an orbital launch from its territory. The Brazilian Space Agency and the Brazilian Air Force are partnering with Virgin Orbit to use its Alcantara Launch Center to bring such capabilities to fruition. Because of the uniqueness of the Virgin Orbit's launch vehicles and the Center's optimal site location near the Equator, this partnership seems very promising for both the Brazil space program and the Long Beach, California based company. The Alcantara Launch Center is located on Brazil's northern coast just a couple of degrees South of the Equator—this excellent location allows the launch site to be the only one in the world capable of achieving any orbital inclination. Construction of the Alcantara Launch Center started in 1982, and since then multiple suborbital rocket launches have been performed. Virgin Orbit's launch vehicle, LauncherOne, once successfully launched, will transform the Alcantara Launch Center into the second orbital-class site in all South America, and the fifth one in the entire southern hemisphere.[12]

Chile

The Satellite of the University of Chile for Aerospace Investigation (SUCHAI) is a great example of how new technologies have allowed for emergent space programs to enter the space race. This project is based on the deployment of CubeSats, also known as nanosatellites—these small platforms measure around ten centimeters on each side. The small size combined with the latest technology has made this satellite very affordable and relatively easy to develop. The program started in 2011 with a USD$200,000 budget. This small satellite only has a simple probe, one camera, an electronics experiment, and a battery health management experiment. Due to their small size and small weight, nanosatellites are a great opportunity for emergent space programs to develop and launch their own platforms as nowadays even the cost of space deliveries has declined, especially for small platforms such as these.[13]

According to the official Chilean government website, Chile is currently working on new projects and initiatives. In 2020, the president of Chile announced a new satellite system that will promote scientific, technological, military defense, and civilian applications. Like other projects, this satellite system will consist of multiple platforms that will work in coordination with each other, the Ministry of Defense, and the Chilean Air Force—and will be an upgrade and replacement of the current FASat-Charlie. A total of three satellites will be developed, and they will serve as a constellation for earth observation. Additionally, three interconnected ground control stations will be built to provide satellite access, with an eye for future international cooperation. Moreover, in a joint effort by the military, industrial, and educational sectors, seven microsatellites will be built focused on search and rescue and ocean surveillance.[14]

Chile is also developing and building a new class of extremely large telescopes. The Giant Magellan Telescope (GMT) is currently under construction and is a joint venture between Chile, the United States, Australia, Brazil, and South Korea. This new type of telescope will revolutionize how space and the universe is viewed and understood. The telescope will be constructed in the Las Campanas Observatory and is expected to be fully operational by 2029. Once completed, the GMT will be ten times more powerful than the Hubble Space Telescope. The project location was determined based on the many advantages that the Chilean region offers for space observation, namely Las Campanas Peak. One of the highest and driest places on Earth, the telescope will reside at an altitude of 8,500 feet—with over 300 nights of clear conditions perfect to observe the universe.[15]

Colombia

The Colombian Space Program is relatively young. Colombia's first attempt to create a space agency started in 2006, when the president created the Colombian Space Commission to oversee research, coordination, guidance, and planning of the development and application of space technologies in the country. The Commission is headed by the vice president of the country and is formed by different national departments and agencies.[16]

According to authors Urbina Carrero and Jonathan Camilo, in their article, "El Espacio, Futuro de la Fuerza Aérea Colombiana" (Space, the Future of the Colombian Air Force), the first satellite that Colombia launched to space was the "Libertad 1" in 2007. This was a CubeSat developed at the University of Stanford in partnership with the Boing company. Financed by the Sergio Arboleda University with a weight of less than one kilogram, the only function of the first satellite was to report back information about its status. The satellite was operational for about 30 days, the length of its battery's lifetime.[17] Some of the objectives of this first satellite included testing of very precise electronic designs, collection of information about the satellite such as temperature, battery status, and basic communications from the satellite to earth stations. The project was first funded by Colombian citizens from several private companies, and further sustained and brought to fruition through resources provided by the Sergio Arboleda University. The project was developed in two years, to include planning, design, engineering, construction, and launch. The satellite was launched by the Russian Space Agency and was able to orbit around Earth from pole to pole at 800 kilometers/hour, crossing the Colombian territory at least twice a day for about 12 minutes each time.[18]

There currently is an agreement between Colombia and Ecuador on future Moon missions. The Ecuadorian Space Agency and the Colombian Space Agency agreed to work together with Astrobotic to begin a Moon exploration program; and Astrobotic will be launching the peregrine lunar Lander in 2021.[19] Other partnerships include a 2022 project with SpaceX to launch its first two non--experimental satellites. This project is expected to cost USD$8 million. In addition to the two satellites, Colombia is looking to develop personnel expertise in technical and academic areas. According to country statistics, in 2018 Colombia spent USD$282 million in satellite services, 55 percent of it allocated to communications, 44 percent to navigation and Global Positioning Systems, and 1 percent for imagery.[20]

Currently, the Colombian Air Force (FAC for its acronym in Spanish), manages the FACSAT project. FACSAT-1, a CubeSat powered by solar cells and batteries, was launched in November 2018. It is an earth observation and technology platform that provides daily coverage of Colombia, providing imagery can be used for urban development, land restoration, illegal crop management, natural disasters, and fire response. FACSAT-2 is scheduled to be launched into orbit in December 2021.[21]

According to the office of the vice president of the Colombian government, emphasis is being placed on the future of space policy for the country due to its worldwide importance—as with an approx. USD$348 billion economic impact, the potential of the space industry to generate employment, commercial growth, and new technologies is great. Some of the future initiatives of the Colombian government include acquiring a constellation of satellites for earth observation and the development of new technologies to save costs in the long run. In addition, a constellation of satellites will aid the government prevent natural disasters, search for cocaine fields, provide weather forecast, border defense, and identify migration movements, among others.[22]

Ecuador

According to the Ecuadorian Civilian Space Agency website, the history of the agency goes back to 2007. In 2007, the first Ecuadorian astronaut successfully graduated from the Russian Federation program, and in November of the same year, the Ecuadorian Civilian Space Agency was officially created. The first satellite sponsored by the Ecuadorian government was the NEE-01 PEGASO. This nanosatellite only weighed 1.2 Kg and was launched from China to a height of 650 Km, costing the Ecuadorian government at least USD$700,000. The satellite was placed into orbit on April 25, 2013. The first video feedback from the satellite was obtained on 16 May of the same year. However, just one week later the satellite encountered some debris and was thrown off its orbit. In November 2013, a second satellite was put into orbit aboard a Russian shuttle, the NEE-02 KRYSAOR.[23]

The NEE-02 KRYSAOR was very similar to the PEGASO, but with different solar arrays. Also a CubeSat with a mass of 1 Kg, the satellite's main objectives were technology development, education, video transmittal, and thermal/radiation shield testing. Moreover, the satellite provided coastal imagery of Colombia, Ecuador, and Peru.[24]

The Ecuadorian Civilian Space Agency was the first Latin American country to have a microgravity airplane. The project was a collaboration with the Ecuadorian Air Force and was designed to create a zero-gravity training environment. Such training is beneficial and required, as astronauts will encounter these conditions during space travel, such as in the International Space Station, Moon, and Mars. For example, while humans on Earth are subjected to gravity measured at 1.0, the gravity on the Moon is 0.16, and the gravity on Mars is 0.33. The T-39 microgravity airplane starts its flight at 6,000 meters above sea level and can achieve microgravity for about 20 seconds/8,500 meters. The plane can carry eight passengers and can repeat the flight maneuver over 30 times for a total of 10 minutes of microgravity experience.[25]

Furthermore, the Ecuadorian Civilian Space Agency has partnered with the International Astronautical Federation, Blue Origin, Astrobotic, RBC Signals, and the Colombian Space Agency to develop LATCOSMOS, a Space Development Plan for Latin America and the Caribbean. This project consists of a four--stage plan created to overcome the historical lack of space education in the region; as space programs in the region, except for Brazil, Argentina, and Mexico, have not historically received a lot of interest. This is directly reflected in the lack of resources, poor research, and lack of technological improvement in the region, and a direct result of most of countries in Latin America choosing to buy space technology from developed nations—which has not only exported funds to other countries but has hindered national development and education.[26]

Mexico

Mexico started to develop early stages of its space program in the 1960s. In 1962, the "Comisión Nacional del Espacio Exterior" (CONEE - Outer Space National Commission) was created with the intent of boosting investigation and space research for peaceful objectives. Additionally, the same year, the Geophysics Institute Department of Outer Space was established under the "Universidad Nacional Autónoma de México" (UNAM), known today as the Department of Special Sciences. The CONEE built some rockets (Mitl) and successfully accomplished high atmospheric research; but nonetheless was decommissioned in 1977.[27]

The first big project for the Mexican government was the deployment of the Morelos satellites. In 1982, Mexico tried to provide communications for its rural and urban areas through an agreement with Hughes Aircraft Company. Each communications satellite, powered by body-mounted solar cells, had a life span of nine years, a mass of 1,140 Kg, and were located on a geosynchronous (GEO) Orbit. The Morelos-1 was launch onto space on June 17, 1985, aboard NASA's space shuttle Discovery, and the Morelos-2 on 27 November of the same year, aboard the Atlantis.[28]

During the 1990s and 2000s other space projects included the UNAMSAT B, a microsatellite developed by UNAM students—the first Mexico-built satellite in orbit. The "Solidaridad I – II" (Solidarity I and II), launched in 1993 and 1994, respectively, replaced the Morelos satellites.[29] After the launch of both Solidaridad satellites from French Guiana, in 1995 the Fixed Satellite Services sector of telecom was privatized. In 1997, Hughes was asked to make the Morelos 3, which later became the SATMEX 5 and renamed as EUTELSAT 115 West A. SATMEX 5 was launched in 1998 and was the first satellite over the Americas able to provide continental coverage on C and Ku bands.[30]

Not until 2010 was the Mexican Space Agency officially established; after more than six years waiting for congressional approval. The agency was created as a public organization run by the federal government, under the Department of Communications and Transportation. Its mission was to utilize science and technology for the benefit of the Mexican population, to boost innovation and development, and to position Mexico as part of the international space community. The Mexican Space Agency is working in five specific fields; the formation of human capital, scientific investigation and technological development, industrial development, space competitivity, international relations and financing, and Space Affairs.[31]

The Mexican nanosatellite D2/AtlaCom-1 was launched by SpaceX from Cape Canaveral in June 2021. This latest project was announced by the Mexican Space Agency and the Department for Communications and Transportation; and was a collaboration with Dragonfly Aerospace, Space JLTZ, and NanoAvionics. This new satellite launch opened a door of possibilities for many young people in Mexico, as multiple students from various universities were involved and able to work on the project.[32] According to Duarte Muñoz, Mexico is still actively involved in the development of its space program. A newer nanosatellite will be launched by the Mexican government, developed by experts and students from the UNAM, and with the collaboration of other countries, to include India and Brazil. This small satellite called, NanoConnect-2, will be one of a series of satellites that would allow Mexico to be positioned as a main actor in the development of space instruments and applications for Lower Earth Orbit (LEO).[33]

Peru

According to Robert Harding, in his book "Space Policy in Developing Countries: The Search for Security and Development on the Final Frontier," Peru occupies a special place among Latin America's emerging space actors, as one of Peru's own, Pedro Paulet, invented the world's first liquid-fuel rocket engine in 1895, and the first modern rocket system in 1900. Paulet also established the first national pro aviation league, which later became the Peruvian Air Force. In 2009, Peru created the first national space policy for the country.[34]

Despite Peru's basic space program, it has achieved some important milestones. The first Peruvian space probe was launched in December 2006, the mission lasted two years and has been helpful for the development of platforms and software that can measure temperature, humidity, and pressure in the upper layers of the atmosphere. The first domestic satellite that Peru attempted to launch was an imagery nanosatellite developed at Stanford University and launched by Russia; taking images from an altitude of 600 kilometers. In 2014, the first Peruvian nanosatellite, CHASQUI I, weighing 1Kg, was launched by hand during an International Space Station spacewalk. It was designed by students of the "Universidad Nacional de Ingenieria" and equipped with two cameras that transmitted Earth imagery. A second satellite was a project of the same university and the Russian university in Kursk. The CHASQUI II was a microsatellite, weighing about 30 Kg, built to monitor deforestation and natural disasters.[35]

Peru's Space program is led by the National Commission of Investigation and Aerospace Development (CONIDA for its acronym in Spanish.) In 2016, CONIDA and Airbus worked together to create the National Satellite Image Operations Center. The new center focused on obtaining technological independence with oversight of PeruSAT-1—currently one of the main space projects for the country. PeruSAT-1 is an earth observation satellite with a very-high-resolution New AstroSat Optical Modular Instrument (NAOMI) imager. The satellite, with a 10-year life span, was produced in record-time using a new Airbus manufacturing system which reduced development and construction lead times for satellites up to 500 Kg. It was launched by Arianaespace on a Vega launcher from French Guiana, and was placed in a sun-synchronous polar orbit at 700 Km. This satellite is considered a primary data source for Peru and provides high-quality imagery used for civil and military applications such as homeland security, border control, coastal surveillance, monitoring of illegal trafficking to mining, geology, hydrology, natural disaster management, and environmental protection.[36]

Uruguay

While Uruguay is the smallest country in South America, its Aeronautics and Space Research and Dissemination Center (CIDA-E) has created partnerships with other countries within the region and outside the continent; and is working on projects mainly aimed at earth observation, with applications for the environment, natural resources, crop monitoring, and water quality surveillance.[37] CIDA-E was created in 1975 with the mission to study and promote aeronautics and space; it works with and provides guidance to the Uruguayan Air Force (FAU for its acronym in Spanish), the aeronautical civil agency, and other organizations that work with aviation or space. Furthermore, CIDA-E organizes educational courses, maintains communications and working relations with foreign space agencies and is responsible for laws and regulations. CIDA-E is a voting member of the International Astronautical Federation and the International Institute of Space Law.[38]

AnteltSat is a CubeSat developed by the "Universidad de la República" of Uruguay and the national telecom service provider. This was the first country's satellite; with the purpose of developing skills in radio and aerospace engineering, mainly to promote Science, Technology, Engineering and Math (STEM) educational projects. The satellite was classified as experimental and launched in June 2014 from Russia, transmitting color and infrared images in addition to providing radio services; all with the objective to take agricultural measurements, the country's main industry.[39] Equipped with two photographic cameras, one for color imagery and the other for infrared; it made possible to measure earth and water temperature, in addition to cloud systems' altitude. Furthermore, it allowed for finding and tracking weather storms, tropical cyclones, and measuring chlorophyll levels in crops. The satellite was a collaboration with telecommunications Antel, which funded the project with USD$695,000. AntelSat weighs 2 Kg and was built by a team of 60 people, mostly Antel engineers, teachers, and students from the "Universidad de la República" engineering department.[40]

Leading the way for the establishment of a dedicated space agency in Uruguay is FAU, which is advocating for the establishment of a National Space Agency.

According to a FAU representative, a well-formed agency not only brings together different sectors and organizations from the country, but is vital to create partnerships and treaties with other regional space agencies.[41]

Venezuela

The Bolivarian Agency for Space Activities (ABAE for its acronym in Spanish) was created in Venezuela in 2008 under the Department of Science and Technology. The objective of ABAE is to manage and develop space policies. The two main projects that the agency administers are the VENESAT-1, also known as the "Simon Bolivar," a telecommunications satellite; and the VRSS-1 and VRSS-2 earth observation satellites.[42]

The VENESAT-1 was the first satellite owned by Venezuela and was a collaboration with China to provide television and connectivity services. The satellite was based on the Chinese designed DFH-4 platform, cost more than USD$400 million, and weighed 5,100 kilograms. It was launched in 2008 to provide cellular phone service, educational services for remote communities, and internet access. In 2020, VENESAT-1 suffered solar array problems, which put the satellite out of commission three years earlier than planned—it was retired and relocated to a graveyard orbit away from operating satellites.[43]

While Venezuela lost the Simon Bolivar satellite, it still has two more satellites in partnership with China.[44] The second satellite launched by Venezuela, the VRSS-1, also known as the "Miranda," is one of two satellites built by China for remote earth observation. The satellite, a CAST-2000 platform with reduced weight, was launched in September 2012 to provide data and imagery collection, natural disaster prevention, and space, research, and education promotion. The VRSS-1 provides environmental, agricultural, health services in remote areas, and planning, emergency management, and defense applications.[45] The second satellite developed under the VRSS program was named "Antonio Jose de Sucre" (just like its predecessors, it was named after a South American independence leader). This was also a remote sensing satellite developed and launched by China. The platform was launched aboard a CZ-2D Chinese Long March rocket into a 645 Km sub-synchronous orbit in October 2017.[46]

Findings

Historical Background

Space programs in Latin America go back to the early 1960s, with many of them attaining recognition in the early stages of space exploration. Nonetheless, most space programs in the region never fully developed their programs in comparison with others around the world—most countries attached their space programs to other government functions, such as transportation, education, or military. To this day, not all countries in the region have an independent space agency. This organizational limiting factor is perhaps a contributor to many of the issues that regional space programs encounter presently: By being part of another agency or another department, resources and personnel had to shared, which shortchanged space technology development. For many nations, especially during the first decades of space exploration, the benefits of satellites and space development were not a priority and they contracted with other countries to use their technology. However, in the last 20 to 30 years, satellites and their applications went from being a luxury to a necessity. Countries around the world are realizing that having their own platforms orbiting the Earth may require a large investment in the front end, but is an investment that can be recovered within a few years.

Historically, Argentina, Brazil, and Mexico have been the pioneers and leaders in technological development. The number of satellites they've launched reflect how important they are for the region. Between all three space programs, they have a combined 71 satellites, representing 83 percent of total Latin American satellites.

Brazil is perhaps the dynamo in the region, as it has achieved a positive and relatively steady space program. Brazil has successfully conducted rocket launches, parabolic flight experiments, satellite design and development, and satellite operations. They have effectively partnered with different sectors within the country to include the Brazilian Air Force, universities, and private companies, and with different space powers like the United States and China.

Current Challenges

One of the most significant challenges for Latin American countries is the lack of qualified people to work in their space programs. There are not many recognized and certified educational facilities and curriculums, and relatively very few people from Latin American countries have achieved successful space careers. Some of the few that have achieved space travel include the first Latin American astronaut, Arnaldo Tamayo Mendez, from Cuba, who took part in the Soyuz 38 Soviet mission in 1980; Rodolfo Neri Vela, from Mexico, who was part of the US STS-61-B mission in 1985; and Franklin Chang-Diaz, from Costa Rica, a physicist professor and director of NASA's Advanced Space Propulsion Laboratory, who took part in seven US space missions conducted. Additionally, Ellen Ochoa was the first Hispanic woman from the US to take part in an expedition in 1993 and was also the first Hispanic director at the Johnson Space Center.[47] Other people from Latin America have worked and have been successful in different space agencies as well. Nonetheless, most of them had to go to other countries to get educated and trained.

Space programs in Latin America have faced and continue to encounter multiple challenges. The lack of resources is probably the main challenge that many of the space programs in the region confront as most of the time, science and technology are not a high national interest priority. However, over the last few decades, many Latin American countries have started to understand that technological advancements can help support their national interests; as space and space services are used by everyone.[48]

In 2020, the world's total space budget was USD$71.75 billion, a decrease of 0.81 percent from 2019. Countries in Latin America and the Caribbean only contributed 0.22 percent of world resources allocated for space exploration (USD$157.6 million); lagging all regions in the world except Oceania. North America, including Canada and the US, has the highest budget allocated to Space, mainly due to the US, which has the largest space industry in the world. In 2020, North America allocated USD$38.54 billion to space, 53.71 percent of the world's budget.[49]

Future Cooperation

Regional cooperation, especially in South America, in terms of the creation of a Space Agency, has been proposed multiple times. However, none of them have been successful.

More than ten years ago, Argentina was the first to propose regional, military oriented, collaboration. Throughout the years, the proposal evolved and Brazil, as one of the powerhouses of the region, was suggested as headquarters. The last big step started in 2015 during the South American Space Generation Workshops held in support of the United Nations' Space Generation Advisory Council. During the first workshop, hosted in Argentina, in addition to education, outreach, technology, research, and Mars's mission simulation, the creation of a South America Space agency was discussed as well. However, during the second workshop in Peru in 2016, astrobiology studies, space research, emerging space nations, nanosatellites, and CubeSats were at the center of the debate.

Many countries in South America that intend to continue with their space programs understand that the best method to share costs is to combine efforts. A joint effort could be modeled after ESA, a collaboration based on the GDP of each nation. This approach would benefit all nations as it would allow the planning and development of missions that no country can currently do on its own. While the idea and concept of the creation of a South American Space Agency or a Latin America Space Agency is great, the actual implementation faces multiple challenges. Governments' instability can affect the participation, commitment, and funding of the agency. The legal framework of creating such an agency is a big challenge as well, together with trying to find conditions where all involved parties can attain their desired outcomes. Furthermore, the legal implications of sharing technology and information must be agreed beforehand within their countries and according to international law. Political differences are also a limiting factor, as regional cooperation has historically been marked by political differences. Financial sustainability or longtime commitment to the agency could pose problems in the future as well, as some countries may want to change terms and conditions over time. Lastly, cultural differences could hinder the performance and establishment of an agency as many Latin American countries have very distinct cultural backgrounds, and a joint mission will require people from different professions and organizations to work together.[50]

Nonetheless, 2020 marked a milestone on the creation of a regional space agency. In October, Argentina and Mexico agreed to the creation of the Latin America and Caribbean Space Agency (ALCE for its acronym in Spanish). This initiative resulted from the efforts of another organization, the Community of Latin American and Caribbean States, which strives to create alliances and share resources among multiple countries. Bolivia, Ecuador, El Salvador, and Paraguay will be actively involved in this joint project, which seeks to launch its first satellite by the end of 2021 or 2022. While launching satellites may seem insignificant compared to other space programs sending people into space, or missions to the Moon and Mars, countries in Latin America rely on satellites for communications, weather monitoring, navigation systems, scientific development, national defense, among many other applications. The creation of ALCE is a regional opportunity for technological freedom. The agency seeks to invest in satellite development and future major space missions.[51]

Recommendations

To properly establish ALCE, it will be important to understand the history of the countries in the region, the current Space environment, and what each nation is looking for in the future. Bringing together a significant number of countries with the same goals will require a theoretical, legal, and operational framework to serve as the backbone of the agency, just like a constitution that holds together a republic.[52]

One potential approach to gathering more regional interest is to implement a policy that provides a return for invested resources, like the Geo-Return model applied by ESA, which allows equitable collaboration by each member, based on each stakeholder's investment. Sharing costs will be particularly important since many of Latin America's emergent economies have relatively very little to invest in technology and development. Hence, ALCE projects should consider the reality of its members and create objectives that are within reach and attainable. Distributing tasks and sharing other resources could also provide a lot of benefits—scholarship opportunities, training programs, technology, and shared use of lab facilities are some of the resources that could be distributed among members to minimize the burden of a robust space program.[53]

For example, ESA's operational budget is split in two categories, mandatory and optional. The mandatory category includes agency essential activities, like future projects, research in technology, technical investments, information systems, and training programs. All members of ESA must contribute to these programs based on their GDP. The optional category includes earth observation, telecommunications, satellite navigation, and space transportation programs. Optional programs are voluntary for members to participate in and allocate resources. Countries that participate in the ESA contribute from 0.01 percent to 0.05 percent of their GDP.[54]

ALCE must understand that to become a relevant, independent, space agency will take years and plenty of resources; and will require, at least in the beginning, working together with advanced countries that have already achieved the knowledge and the technology necessary for space exploration. Furthermore, each ALCE member country should strive for public support from its citizens, as many regional pundits still consider space programs in Latin America as unnecessary expenditures, and instead advocate for resources to be invested to combat poverty and inequality in the region.

The way forward is not easy, and the next 10 to 20 years will bring many challenges, due to the different cultural backgrounds, multiple languages, and diverse economic and political visions in the region. The next two to three years will be crucial in consolidating a regional space agency. Most countries in Latin America are facing social and economic struggles, and investment in space for many will be put aside to tackle more pressing earthly issues. Successful Latin American cooperation in space technology will represent more than satellites and/or missions to the Moon or Mars; it will represent a clear statement to the world that the region has achieved a scientific and cultural identity.

Taking into consideration ESA's model, ALCE should create an executive board to prioritize space activities to tailor the needs of the region, oversee and assess resource allocation, and provide basic operational budget proposals. While ALCE cannot fully adopt ESA's model, it can use it as a guide to form an agency with its own identity. Based on the GDP of Latin American and Caribbean nations, if all members contribute 0.03 percent of their 2020 total GDP, they can pool USD$2.003 billion. This would represent a 92 percent increase of the

USD$0.1576 billion currently allocated in the region in 2020. For many years, Latin America has concentrated in solving immediate problems—however, a push for technology could bring long-term solutions for many issues. Space development is an investment in the future that could provide better technology, help education in rural areas, create diverse jobs, attract civilian and international capital, and bring public support. The space programs of today will define the outcomes of tomorrow. ❑

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