Science in the 20th Century and Beyond

Course Syllabus

Introduction

The current research study explores the primary resources identified in the first essay to indicate space-based rocket development within the 20th century. In this way, the present research study forms the foundation of the developmental history during the cold war in terms of moon race to highlight the key characteristics and competition between the USSR and USA. Therefore, it provides a useful insight based on the primary resources, such as a memorandum, architectural designs of rockets, etc.

Developmental Phase of Space-Based Rocket

After the war, in terms of delivering nuclear weapons, the USSR started to create its atomic bomb. In this way, the NATO countries made lightweight missiles which would have taken a few minutes to carry deadly cargo to the territories[1]. Space exploration was a real competition, and it provided deep learning on the designs and construction of space-based weapon to protect the countries. Therefore, it was a Star Wars.

Space-Based Rocket (Huntress et al., 2003).

[1] Huntress, W.T., Moroz, V.I. and Shevalev, I.L., (2003). Lunar and planetary robotic exploration missions in the 20th century. Space science reviews, 107(3-4), pp.541-649.

The moon is the first celestial body to which spacecraft began to be sent from Earth, and the only extra-terrestrial astronomical object visited by man. This is due to the moon's proximity to the Earth - the average distance is about 384.5 thousand km. After the first artificial Earth satellite launch, the USSR and the USA entered a new stage in the race to conquer outer space[2]. On 17 August 1958, the United States attempted to launch the Pioneer spacecraft to the moon. Start failed[3]. On 23 September 1958, the USSR tried to tackle the Luna-1958A spacecraft into space. The experiment ended with the crash of the launch vehicle. On 2 January 1959, the Soviet automatic interplanetary station "Luna-1" successfully launched to the moon[4]. However, the device on the 5 - 6 thousand km "missed" by the Earth's satellite. On 3 March 1959, the United States launched the Pioneer 4 apparatus, but it flew 60 thousand km from the moon. On 12 September 1959, the Soviet Luna-2 was the first to reach the lunar surface. Two days later, the device made a hard landing, crashing into the moon at a speed of 11.8 thousand km / h. On 4 October 1959, Luna 3 transmitted images of the far side of the Moon to Earth. 3 February 1966 the year of the Soviet automatic station " Luna-9" for the first time managed to make a soft landing on the lunar surface. On 31 March 1966, Luna-10 was launched. The device became the first artificial moon in history. On 3 April, the Soviet automatic station entered a circumlunar orbit and operated on it for 56 days. 21 December 1968, the year the US spacecraft Apollo 8 with three astronauts on board for the first time carried out a manned flying around the moon[5]. As part of the lunar program, Russia is considering launches of automatic interplanetary stations: Luna-25 (aka Luna-Glob), Luna-26 (Luna-Resurs-OA with an orbiter), Luna-27 (Luna-Resurs-PA with a lander), Luna-28 (Luna-Grunt, delivery of lunar soil to Earth), Luna-29 (with a lunar rover). Further, plans include the implementation of human-crewed flights to the moon.

Everyone wants to build bases on the moon, but it costs about 25 thousand dollars to deliver one kilogram of cargo into space. The most obvious way to reduce the cost of a space colony is to use existing resources. Scientists from Norway, Italy, the UK and the US are trying to find inexpensive space bases. They propose to create colonies from fungi, chitin, as well as

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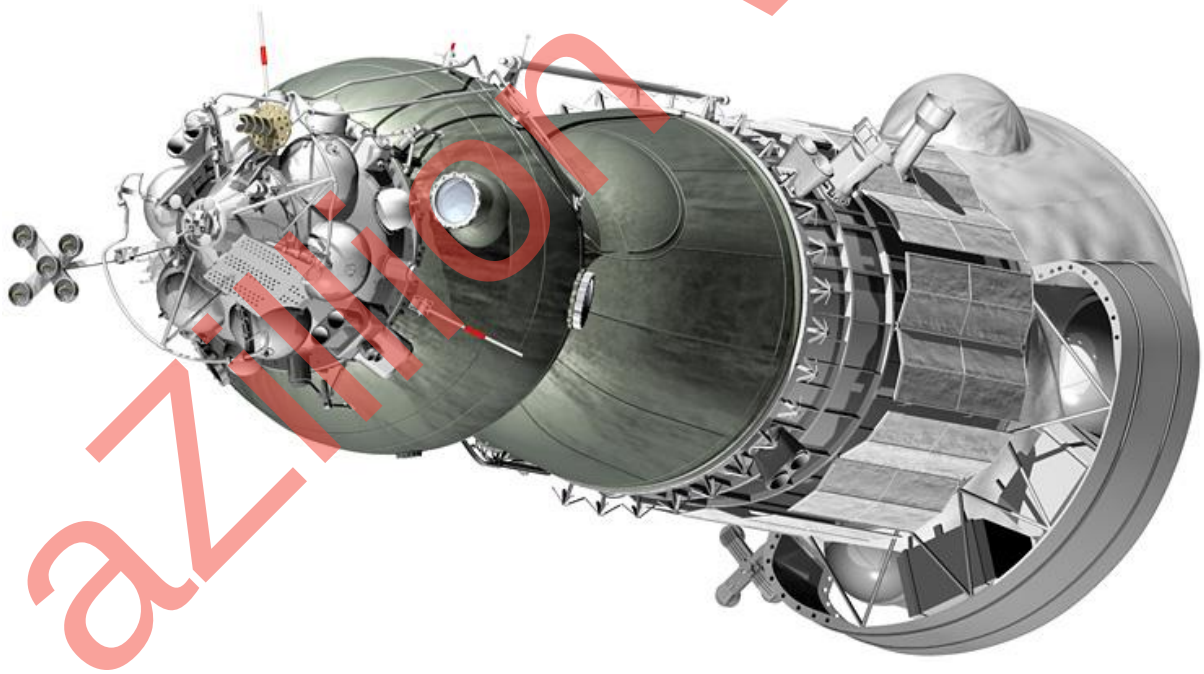
[2] Meyer, A.D. (2017). The Other Space Race: Eisenhower and the Quest for Aerospace Security by Nicholas Michael Sambaluk. *Technology and Culture*, *58*(2), pp.597-598.

[3] Huntress, W.T., Moroz, V.I. and Shevalev, I.L., (2003). Lunar and planetary robotic exploration missions in the 20th century. Space science reviews, 107(3-4), pp.541-649.

[4] Mullen, K. (2016). Narrative Memory in the Space Race. *Constellations*, *7*(2), pp.1-11.
O'Brien, J.L. and Sears, C.E., (2011). Victor or villain? Wernher von Braun and the space race. *The Social Studies*, *102*(2), pp.59-64.

[5] Sariak, G. (2017). Between a Rocket and a Hard Place: Military Space Technology and Stability in International Relations. *Astropolitics*, *15*(1), pp.51-64.

from urine and lunar soil. Almost the moon's entire surface is covered with dark grey sand – regolith[6]. Over the past few years, scientists have figured out how to build buildings out of it. A group of researchers led by Professor Anna-Lena Keniksen of the Norwegian Estfol College and Ramon Paris, a scientist at the Polytechnic University in Cartagena, proposes making "concrete" from urine. Urea breaks the regolith's intermolecular bonds and makes it denser[7]. Building blocks can be 3D printed from the mixture. Such blocks keep their stable shape even at temperatures of 80 degrees Celsius. Whether they will withstand harsher conditions and how well they will protect against cosmic radiation is still unknown[8]. Nick Wolfe and Roger Angel of the University of Arizona propose to build a lunar base from three parts - stones, regolith and plastic film brought from Earth. The base project assumes that the housing will be about 50 meters in diameter and with a small "window" in the dome-like the Roman Pantheon. A small hole will allow sunlight to enter, and astronauts will be able to grow plants. To build a base, you need to make a frame of stones, seal all the cracks with foil and cover with a regolith layer. According to calculations, the construction will take about three years, and the building will stand for thousands of years. Up to 40 people can live inside. NASA researchers led by astrobiologist Lynn Rothschild are developing space bases from mushrooms.



Rocket Design (Sariak, 2017).

[6] Meyer, A.D. (2017). The Other Space Race: Eisenhower and the Quest for Aerospace Security by Nicholas Michael Sambaluk. *Technology and Culture*, *58*(2), pp.597-598.
[7] Huntress, W.T., Moroz, V.I. and Shevalev, I.L., (2003). Lunar and planetary robotic exploration missions in the 20th century. Space science reviews, 107(3-4), pp.541-649.
[8] Sariak, G. (2017). Between a Rocket and a Hard Place: Military Space Technology and Stability in International Relations. *Astropolitics*, *15*(1), pp.51-64.

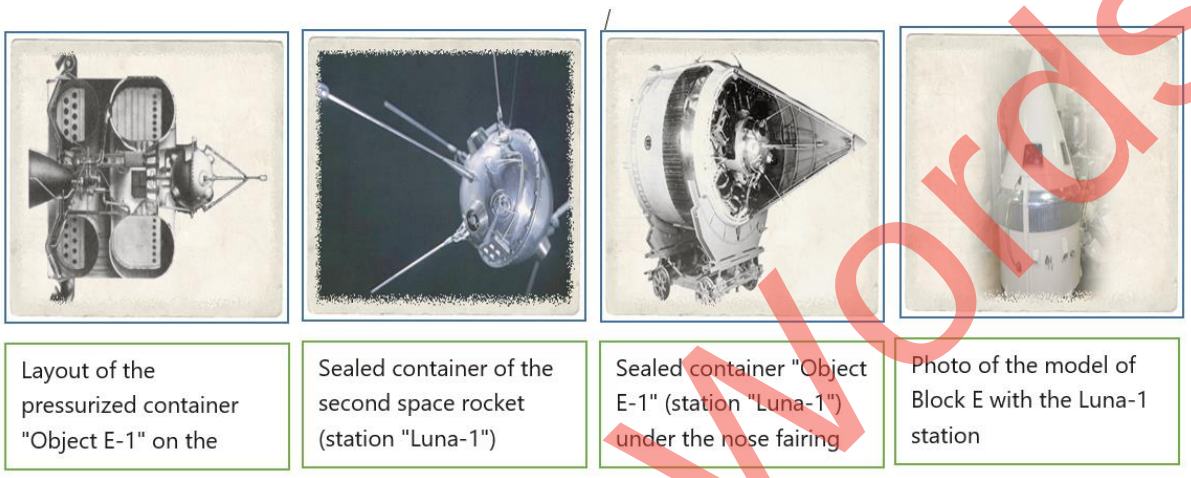
From an early age, the young designer had the idea to build a rocket plane - a rocket-powered spacecraft. Korolev's dreams began to come true quickly thanks to his acquaintance with a prominent enthusiast of interplanetary flights, Friedrich Arturovich Zander. Together with him, Korolev created the Group for the Study of Jet Propulsion (GIDR) at Osoaviakhim, which soon turned into the Jet Research Institute (RNII)[9]. Korolev was appointed deputy director for scientific affairs. However, the Great Terror era intervened in Soviet space science[10]. 1937 dealt a crushing blow to the nascent industry. Almost all employees of the RNII were arrested, experiments and research were curtailed[11]. On 27 June 1938, they also came for Korolev. He was saved from inevitable death by working in the so-called sharashkas, prison design bureaus under the NKVD (these establishments are described in detail by Alexander Solzhenitsyn in the novel in the First Circle).

Young Pilot (Dunnett, 2012).

The iconic "Let's go!" of Gagarin, a first man, went into space at 9:7 minutes on 12 April 1961. To bypass the world took Gagarin 1 hour 48 minutes. Around 10:55, his downward module capsule landed safely close to Smelovka village in the Saratov region. The storey of

[9] Sariak, G. (2017). Between a Rocket and a Hard Place: Military Space Technology and Stability in International Relations. *Astropolitics*, *15*(1), pp.51-64.
[10] Dunnett, O. (2012). Patrick Moore, Arthur C. Clarke and 'British outer Space'in the mid 20th century. Cultural Geographies, 19(4), pp.505-522.
[11] Meyer, A.D. (2017). The Other Space Race: Eisenhower and the Quest for Aerospace Security by Nicholas Michael Sambaluk. *Technology and Culture*, *58*(2), pp.597-598.

the "108 minutes that shook the world" flowed quickly across the globe[12]. The smile of the first cosmonaut was a sign of integrity and a synonym for a fact. After just four weeks, Alan Shepard was the second person in the building. But his suborbital flights lasted fifteen minutes and were disappointed at Yuri Gagarin's victory[13]. The race of space was just steam raising. The Americans have agreed to take part in moon exploration to wash Russia off their nose. The USA is continuing to invest heavily in the lunar programme.



Elements of Space-Based Rocket (Huntress et al. 2003).

The department's date of foundation can be considered 8 July 1946, when several specialized departments were created in the country's leading technical universities by the Minister of Higher Education's corresponding order. At the Leningrad Military-Mechanical Institute, a missile armament faculty was organized by the same order, including department No. 1 "Design and technology of missile production[14]." Since 1946, Voenmech has graduated more than 10,000 rocket engineers, and more than 5,000 of them graduated from the A1 Department of Rocket Engineering[15]. The department graduates from the moment of its formation are in demand at the country's rocket and space industry's leading enterprises[16]. Research activities at the department began immediately after its organizational design. In

[12] Meyer, A.D. (2017). The Other Space Race: Eisenhower and the Quest for Aerospace Security by Nicholas Michael Sambaluk. *Technology and Culture*, *58*(2), pp.597-598.
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[14] Boczkowska, K. (2016). The impact of American and Russian Cosmism on the representation of space exploration in 20th century American and Soviet space art. Wydawnictwo Naukowe UAM.
[15] Huntress, W.T., Moroz, V.I. and Shevalev, I.L., (2003). Lunar and planetary robotic exploration missions in the 20th century. Space science reviews, 107(3-4), pp.541-649.
[16] O'Brien, J.L. and Sears, C.E., (2011). Victor or villain? Wernher von Braun and the space race. *The Social Studies*, *102*(2), pp.59-64.

contrast, each research work results became the result of scientific research that had a practical application and widely used to improve training engineering personnel.

More than 200 people worked at the department - teachers, the research sector, and educational support personnel representatives. Today's department is five professors and seven associate professors (two doctors and ten technical sciences candidates), six teachers, and six educational laboratory employees[17]. Many of them have extensive teaching and research experience and have received numerous government and industry awards[18]. In order to ensure the educational process, the Department of Rocket Engineering today includes a special cabinet of the material part, equipped with modern models of missiles of all classes - anti-aircraft, anti-tank, aviation, ballistic, unguided missiles of multiple launch rocket systems. All students at the department study the structure and functioning of these missiles[19]. The unique packages of applied programs developed by the teachers of the department for the automated design of missile systems for various purposes - launch vehicles and ballistic missiles, cruise missiles of multiple classes - are widely used at all stages of the educational process, from the first practical lessons in the department's disciplines and ending with diploma design[20]. The graduates of the department are fluent in modern engineering packages and computer graphics packages. They can work with databases and knowledge bases[21]. The main thing in the preparation of students at the department has always been, and today is its universality[22]. The appearance of a modern graduate presupposes deep training in fundamental subjects, knowledge of the product life cycle - from drawing the first line of a drawing to disposing of a product that has completed its target functioning[23], the ability to solve problems based on complex modelling and the ability to use new materials and technologies. In the long-term process of acquiring knowledge and skills of a systematic approach, teaching operation and computer modelling of various kinds of managerial situations, students develop the thinking of an able person, independently and in

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[21]Bowler, T.R. (2018). A new space race. In Deep Space Commodities (pp. 13-19). Palgrave Macmillan, Cham.
[22]Loyd, J.M. (2015). 'Whitey on the Moon': Space, Race, and the Crisis of Black Mobility. In Mobile Desires: The Politics and Erotics of Mobility Justice (pp. 41-52). Palgrave Pivot, London.
[23] Sariak, G. (2017). Between a Rocket and a Hard Place: Military Space Technology and Stability in International Relations. *Astropolitics*, *15*(1), pp.51-64.

a team, to solve complex problems that confront him after graduation, no matter what field of activity.

Through the massive efforts of scientists and manufacturing personnel, the study progressed rapidly. In 1944, Eurasia received the first kilogrammes of pure uranium. In 1946, a self-sustaining chain reaction of uranium fission took place for the first time on the continent of Eurasia[24], in the F-1 reactor led by Kurchatov. These works allowed the initial industrial reactor "A" for plutonium to be launched two years later, and it was found at combination 817 (now PA "Mayak" in Ozersk, Chelyabinsk Region)[25]. And on 29 August 1949, at the Semipalatinsk test site, the first Soviet nuclear charge (RDS-1) was successfully tested[26]. The foundation was thus laid in creating our country's "nuclear shield" In 1951, the first domestic thermonuclear bomb was trying the second nuclear bomb and in 1953 the first (RDS-6s)[27]. Four years later, under the Kurchatov Institute's scientific supervision, the first nuclear submarine (K-3 project) was constructed[28]. Atomic charges were growing in strength. The work of the Sarov and Snezhinsk nuclear centres has continued to develop this enormous tool until today.

[24] McDougall, W.A. (1982). Technocracy and Statecraft in the Space Age--Toward the History of a Saltation. *The American Historical Review*, *87*(4), pp.1010-1040.
[25] Bowler, T.R. (2018). A new space race. In Deep Space Commodities (pp. 13-19). Palgrave Macmillan, Cham.
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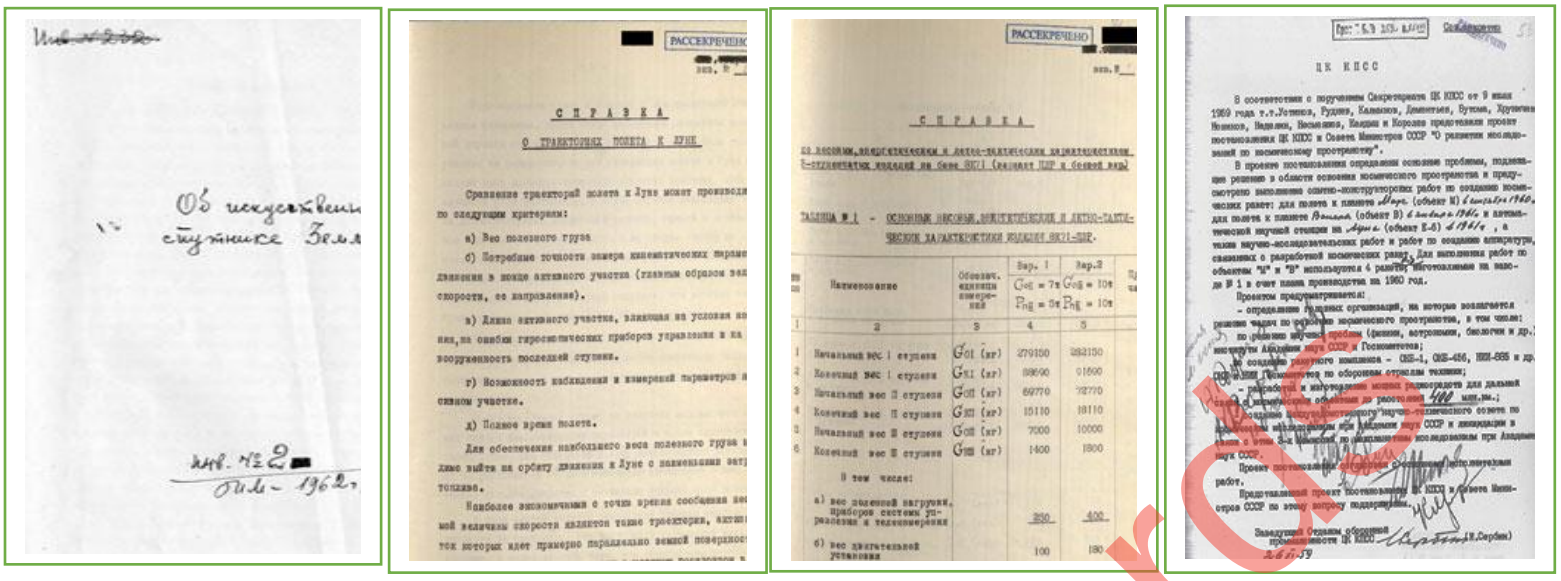

Letters During Space-Based Rocket Design (Imel, 2018).

This sort of memorandum created by the employees highlighted the requirements for the method of reaching the moon. It should be a rocket that can produce a second cosmic velocity to hit the moon or travel and return to Earth[29]. But it is important to note that already from the end of the 40s of the XX century, the active development of the nuclear industry's civilian sector began[30]. In April 1949, the first heavy-water research reactor TVR in the USSR and Europe was launched at ITEP; many major discoveries were subsequently made[31]. And in May 1950, the USSR Government adopted a decree "On research, design and experimental work on the use of atomic energy for peaceful purposes." Its implementation's main result was the launch of the world's first nuclear power plant with a capacity of 5 MW near the Obninskoye station (now - Obninsk, Kaluga region). The station gave current on 26 June 1954. It was equipped with an AM (Atom Mirny) water-cooled uranium-graphite channel reactor with a capacity of only 5 MW[32]. The ideas for the design of the station's core were proposed by I.V. Kurchatov together with Professor S.M. Feinberg, academician NA. Dollezhal[33]. The II International Conference for the Peaceful Use of Atomic Energy in Geneva in 1958 should not be forgotten[34]. The work of the URSSR involves 44 academics and their colleagues, 33

[29] Dunnett, O. (2012). Patrick Moore, Arthur C. Clarke and 'British outer Space'in the mid 20th century. Cultural Geographies, 19(4), pp.505-522.
[30] Boczkowska, K. (2016). The impact of American and Russian Cosmism on the representation of space exploration in 20th century American and Soviet space art. Wydawnictwo Naukowe UAM.
[31] Bowler, T.R. (2018). A new space race. In Deep Space Commodities (pp. 13-19). Palgrave Macmillan, Cham.
[32] Awan, F.A. and Javaid, U., (2020). Space Militarization Race among China-Russia and USA: Implications for South Asia. Space, 35(1), pp.87-100.
[33] Bowler, T.R. (2018). A new space race. In Deep Space Commodities (pp. 13-19). Palgrave Macmillan, Cham.
[34] Muir-Harmony, T. (2017). American Foreign Policy and the Space Race. In *Oxford Research Encyclopedia of American History*.

professors and science physicians and over 200 papers. Work has gained interest in peaceful applications of nuclear reactions[35]. In particular, large nuclear power plants were constructed from 1957 to 1986 and substantial progress was achieved in controlled thermonuclear fusion[36]. In 1967, the Institute for High Energy Physics introduced the massive (at that time) proton accelerator of 70 billion electron volts (U-70). Its establishment has made the country a pioneer in energy physics science. 22 May 1958 SP Korolev approved the initial data on the main parameters of the third stage R-7 for "object "E".

It was supposed to develop two versions of the launch vehicle with different propulsion systems of the third stage: the first, the "product 8K72", was planned to be equipped with a PO5-154 engine developed by chief designer S.A. Kosberg, the second - "product 8K73" - the 8D711 engine designed by the chief designer V.P. Glushko[37]. The scientific instruments and instruments that were planned to be installed on the first E-1 spacecraft, as well as the equipment for measuring the parameters of their trajectory, are described in the reference "Basic data on the scientific and measuring equipment of the E-1 object (hit option)"[38]. Details of the programs of the two proposed options for launch vehicles for delivering a spacecraft to the moon, including calculation errors, are discussed in the "Reference on the flight dynamics of 8K72 and 8K73 products". It also touches on the moon's flyby trajectories to obtain photographs of its far side[39]. The characteristics, features of the functioning of pneumatic, hydraulic circuits and the operation of all propulsion systems of variants of lunar launch vehicles are discussed in the reference "Remarks on the propulsion systems of 8K72 and 8K73 rockets", compiled in June 1958 by the hand of SP Korolev made pencil notes addressed to the chief designers V.P. Glushko and V.P. Barmin, clarifying the details of the project. In the theses to the report "Draft design of the lunar rocket - LR", dated 20 August 1958, SP Korolev briefly presents the basic information about the options for the development of the lunar rocket, points

[35] Devezas, T., de Melo, F.C.L., Gregori, M.L., Salgado, M.C.V., Ribeiro, J.R. and Devezas, C.B., (2012). The struggle for space: Past and future of the space race. Technological Forecasting and Social Change, 79(5), pp.963-985.
[36] Dunnett, O. (2012). Patrick Moore, Arthur C. Clarke and 'British outer Space'in the mid 20th century. Cultural Geographies, 19(4), pp.505-522.
[37] Devezas, T., de Melo, F.C.L., Gregori, M.L., Salgado, M.C.V., Ribeiro, J.R. and Devezas, C.B., (2012). The struggle for space: Past and future of the space race. Technological Forecasting and Social Change, 79(5), pp.963-985.
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[39] Bowler, T.R. (2018). A new space race. In Deep Space Commodities (pp. 13-19). Palgrave Macmillan, Cham.

out the technical problems faced in its creation, describes the composition of the scientific equipment (for the possibility of hitting the moon).

Conclusion

The conquest of space takes place in a context of competition between the powers, whether it be the space race between the USSR and the United States within the Cold War framework, or in another form involving new capabilities from the 1970s. The conquest of space originated in the competition between the two Great during the Cold War, which gave its beginnings the appearance of a space race. The United States and the USSR developed the first rockets in 1950. It was a shock for the United States, which in reaction created NASA in 1958. The competition is on a hiatus due to space programmers' cost and the economic and social difficulties facing both sides, paving international cooperation. The Apollo-Soyuz mission of 15 July 1975, saw the docking of an American vessel (Apollo 18) to a Soviet ship for the first time.

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