United Nations Office for Outer Space Affairs (UNOOSA) Background Guide

Cleveland Council on WORLD AFFAIRS

United Nations Office for Outer Space Affairs (UNOOSA)

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The United Nations Office for Outer Space Affairs (UNOOSA) is the legal body responsible for overseeing all international space activities, working towards the development of international cooperation in the use, exploration, and utilization of space science and technology for sustainable economic and social development. UNOOSA supports United Nations member states in forming legal and regulatory structures to govern space activities and strengthen the ability of developing countries to utilize space science technology. The establishment of these frameworks enables the integration of space capabilities into national development programs.[1]

UNOOSA has adopted a holistic approach to space in its Space2030 agenda. The agenda is an all-encompassing document for strategies in space to support the Sustainable Development Goals of the UN. The four pillars within the agenda were formed in 2016 in Dubai during the High Level Forum: Space as a Driver for Socio-Economic Sustainable Development.[2] The forum established a "space economy" that strives to deliver space-related economic benefits to the world. The forum also established a space society that focuses on utilizing space technology, services, and applications to enhance the quality of life in societies worldwide. One of the most important topics discussed in the forum was equality. To ensure that space benefits all, space accessibility works to provide access to the use of space technology, data, information, production, and, most importantly, physical access to space for all countries.[3] During this forum, UNOOSA stressed the importance of mutual respect and equal engagement among nations supported by space diplomacy to address the challenges of humanity through collaboration.

Furthermore, UNOOSA operates in the area of disaster risk reduction through its UN-SPIDER program. This helps countries use space data and technologies, such as satellite imagery, to prevent and manage disasters.[4] These operations extend to working with space

[1]"UNOOSA United Nations Office for Outer Space Affairs | Department of Economic and Social Affairs," n.d.
[2]"UNOOSA United Nations Office for Outer Space Affairs | Department of Economic and Social Affairs," n.d.
[3]Robert.Wickramatunga, "About Us."
[4]Martin.Stasko, "Roles Responsibilities."

agencies and space leaders to formulate solutions to challenges that require an international response, such as the threat of a Near-Earth Object impact.[5]

UNOOSA helps nations understand the foundations of international space law and build their capacity to draft or revise national space law and policy in line with international normative frameworks on space. This is especially important as more and more actors enter space. Transparency over activities in space is important and can be observed through the Register of Objects Launched into Outer Space. The register was created by UNOOSA to allow countries to work collaboratively over objects they have launched into space to keep track of them. This also promotes sustainability through bringing attention to the rapid increase in space debris.[6] UNOOSA continuously advocates for transparency and for the peaceful and equal use of space through its many initiatives.

I. Space Tourism and New Space Actors

Statement of the Issue:

In the face of fast-advancing space technology, space travel is becoming more frequent, introducing conversations on a wide range of issues. Rising companies such as SpaceX and Blue Origin are commercializing travel to space and the use of space technology, causing a growth in the market and encouraging the development of more companies in this industry. The increase in non-state actors in space is dangerous, as there is a lack of regulations towards them, and current laws place the responsibility on the states themselves. The dependence on states causes a lack of standardization amongst laws, as different states have different objectives and goals for their activities in space. The increase of non-state actors will also cause an increase in geopolitical security concerns and cyber attacks.

Companies will also be conducting tourism-based trips to space. Although the cost of space travel remains high; technological advances are making it more accessible. Conversations about different types of space travel now being available, such as sub-orbital, orbital, and interplanetary, have also sparked an increase in space tourism. Space tourism raises concerns of liability associated with tourism incidents, the ability of individuals to handle the physical and

[5]Martin.Stasko, “Roles Responsibilities.”
[6]Martin.Stasko, “Roles Responsibilities.”

mental stresses of space travel, as well as the risks and dangers that are associated with space travel. Astronauts traveling to space go through intense training before they're considered eligible for space travel, so it is important to recognize the difficulty of space travel and potential hazards.

Both space tourism and the existence of non-state actors in space open the floodgates to a slew of security and geopolitical issues that current space treaties do not address. Space affairs are left in the responsibility of governments, which causes a lack of consensus and differences in regulations. This will eventually lead to conflict as space is shared and cannot be distributed. UNOOSA's position within this discourse is incredibly important as its guidance is needed now more than ever. Space treaties must be revised to address the nature of modern space activities and ensure safety and accountability.

History:

On October 4, 1957, the USSR successfully launched Sputnik 1 into Earth's orbit. This signified the beginning of the space age and the start of the space race between them and the U.S.[7] The success of Sputnik 1 caused global waves and spurred endless conversations on the possibilities of space. A year later, 1958 marked an important year in the development of space technology, laws, and governance. After two failed attempts by the U.S. to launch satellites into space, on January 31, 1958, the U.S. successfully launched a rocket that carried a satellite called Explorer.[8] In October 1958, the U.S. formed a new government agency, the National Aeronautics and Space Administration (NASA).[9] NASA is the agency responsible for civilian space programs and aeronautical technology. Finally, December 13, 1958, was when UNOOSA was created to serve as the ad hoc committee to the Peaceful Uses of Outer Space.[10]

Since the beginning of the movement towards human spaceflight, some have contested that the benefits of sending humans into space do not justify the risk or cost associated. Their argument relies on the fact that sending robotic missions to space produces the same or even greater results with lower expenditure.[11] On the other hand, those who supported the presence of

[7]"Sputnik 1 - NASA."
[8]"The History of the Space Race."
[9]"The History of the Space Race."
[10]United Nations Office for Outer Space Affairs, "Space Science and Technology for the Benefit of Humanity"
[11]Logsdon and M, "Space Exploration | History, Definition, & Facts."

humans in space claimed that humans have intelligence, flexibility, and reliability that are imperative for carrying out experiments, repairing missions, and maintenance work. They cite that robotics should be used as a supplementary means to aid in space travel, but that humans are necessary for missions.[12]

The Space Race of the 1960s, a technological competition between Cold War rivals, the Soviet Union and the U.S., led to pioneering milestones including the development of space technology, space walks, and the lunar landing. On April 12th, 1961, Yuri Gagarin, a soviet citizen, became the first human to fly into space.[13] This event solidified the future of humans in space and sparked the formation of a series of treaties to be formed. In 1967, the 'Outer Space Treaty,' written in 1967, was the first treaty to be written and formed to extend international laws to space and was called 'The Outer Space Treaty'. The treaty addressed space exploration, the claiming of space territory, and the testing and use of weapons in space. 100 countries signed the treaty, and it has since been ratified by 95 additional countries.[14] The treaty has not been revised, renewed, or revisited since its creation in 1967.

On July 16, 1969, Neil Armstrong became the first human to land on the moon. The Apollo 11 mission launched the U.S. into the stratosphere in terms of space technology.[15] By achieving the great feat of conquering the moon, the Americans won the Space Race. This achievement also caused conversations of humans in space to evolve, as Americans were now concerned about the Soviets in space. The cosmonauts even carried weapons on their space missions - a TP-82 gun, which broke international treaties that ruled against weapons in space.[16] However, due to the lack of methods of enforcement, nothing was done to combat this action.

After the moon landing, space technology advanced rapidly and became accessible to companies for commercial use. The U.S. commercial space industry launched in March 1989 when Services, Inc., sent a scientific payload on a suborbital trip.[17] The commercial space industry has been projected to grow to $2 trillion by 2040.[18] A key non-state actor in space is

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[12]Logsdon and M, "Space Exploration | History, Definition, & Facts."
[13]United Nations, "International Day of Human Space Flight | United Nations."
[14]Robert.Wickramatunga, "The Outer Space Treaty."
[15]"Apollo 11 - NASA."
[16]Dimri, Dimri, and Dimri, "The TP-82 Pistol: Why Did the Soviets Take Guns to Space?"
[17]Dole et al., "Origins of the Commercial Space Industry."
[18]PricewaterhouseCoopers, "Next in Space 2025."

SapceX, a company founded by Elone Musk. SpaceX develops and launches rockets for commercial and government missions. They also operate the Starlink satellite internet constellation. At the moment, their biggest goal is establishing dependable methods for interplanetary travel and establishing a human colony on Mars.[19] Arianespace is another non-state actor in space that originates from Europe. Arianespace specializes in the manufacturing and deployment of space transportation services for all types of satellites at any level of orbit, any mass, and any time.[20] Their market flexibility makes them a great competitor for other companies in space. Non-state actors in space exist all over the globe, from the U.S, Europe, Japan, China, and India. The space industry is open for all countries to take part in and utilize, making it even more important to establish regulations.

Technological advancements have grown exponentially since Sputnik I, with multiple states and non-state actors now having access to space. Astronauts now travel regularly into space, and the prospects of travel to other planets are on the horizon. With so many actors having access to space and the technological ability to reach it, UNOOSA must address the risks that are associated with the vague language that is presented in current space treaties. UNOOSA must recognize the dangers that come with space tourism and the possibility that tourists may be giving uninformed consent to the hazards of space. A consensus on appropriate and inappropriate space activities must also be addressed, as current treaties leave the responsibility up to the states, which leaves room for differences in opinion when space is a shared responsibility.

Analysis:

For more than two decades, humans have lived and worked in low Earth orbit.[21] Currently, there are a multitude of ways and reasons for space travel, including commercial cargo spacecraft and commercial crew spacecraft. Commercial cargo spacecraft carry cargo to and from space stations; these missions are needed to send necessary resources to astronauts

[19] "SpaceX."
[20] "Arianespace Uses Space for a Better Life on Earth."
[21] NASA, "Humans in Space - NASA."

that aid them in their discoveries and their survival.[22] NASA's Commercial Crew Program delivers human transportation to and from the International Space Station.[23]

Space tourism is another opportunity for space travel. In 2023, space tourism was deemed one of the fastest-growing aspects of the space industry according to Pew Research.[24] Almost half of all Americans stated that they would "definitely or probably be interested" in orbiting the Earth. These statistics translate to roughly 4 out of 10 Americans, or 133 million people. This proves that there is high interest in casual space travel.[25]

One of the main concerns of increased space tourism is liability. Space tourism, in the way that it is currently being operated, remains a dangerous adventure with a multitude of unknown factors that affect the success of a mission. In 2014, an incident occurred on a Virgin Galactic flight test, when the spacecraft broke apart, killing one pilot and severely injuring the other.[26] A more recent and highly publicized example occurred on September 7, 2024, when 'The Starliner,' a Boeing crew transport capsule, returned to Earth without its two-person crew. The capsule was remotely piloted, leaving astronauts Butch Wilmore and Sunita Williams behind on the International Space Station for months longer than expected due to technical issues with the thruster in the capsule that deemed it unsafe for a return flight.[27] Accidents occur in space that are much harder to resolve due to the technical complications associated, the cost of travel, and, most obviously, the large distance between Earth and spacecrafts in orbit. The majority of space-faring nations have decided that liability is the responsibility of the space tourists themselves. Many question whether common individuals can wholly comprehend the dangers and risks of space travel.[28]

Another consideration that should be discussed is the mental and physical readiness of common individuals to travel in space. It is a well-known fact that during emergencies, adrenaline levels will increase, affecting a human's ability to make rational decisions. Astronauts are mentally trained to handle the stress of the possibility of accidents, but are also trained to understand the technology that they're interacting with, enabling them to act quickly

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[22]"Commercial Cargo Spacecraft - NASA."
[23]"Commercial Cargo Spacecraft - NASA."
[24]"How to Visit Space as a Tourist: The Space Age of Adventure."
[25]"How to Visit Space as a Tourist: The Space Age of Adventure."
[26]"Navigating the Legal Frontier of Space Tourism: Regulations, Risks, and Opportunities."
[27]"The Boeing Starliner Has Returned to Earth Without Its Crew."
[28]"Navigating the Legal Frontier of Space Tourism: Regulations, Risks, and Opportunities," n.d.

and safely when faced with challenges. Astronauts have to train rigorously on all aspects of space travel for two years before they are even eligible to go to outer space.[29] Many individuals traveling to space for travel will not understand the specifics of spacecraft technology needed to handle emergencies. They will also likely not be able to handle the physical stress that is placed on the body by being in a zero-gravity environment for long periods of time.

Moreover, space tourism is led by private companies. The Space Foundation has announced that the global space economy has reached revenues of $570 billion in 2023, which is an increase of 7.4% from revenues in 2022.[30] The growing private sector of the industry encourages competition as they try to maximize profits. These companies are also growing the space industry through orbital construction,in-space manufacturing, lunar resource extraction, AI and robotics in space, and space-based energy production. Some of the challenges that this industry faces are regulatory uncertainty and geopolitical concerns. The current legal framework to regulate their activity is heavily reliant on the policies of the launching state rather than an agreed-upon consensus by the international community. This is dangerous because many states have different perspectives on space, differing laws and guidelines, leaving the definition of what is legal in space up to interpretation.[31] Current international legal frameworks contain vague language that is subject to opinion and does not address non-state actors in space, leaving behind a large and dangerous gap in the regulatory framework.

Non-state actors, however, are not limited only to companies. The term non-state includes: non-governmental organizations (NGOs), communities, individuals, and armed groups. This gives rise to potential cybersecurity threats and increases geopolitical tensions. There are approximately 11,700 satellites actively orbiting the Earth at the moment, with more expected to enter space as the industry grows.[32] Satellites carry the sensitive information and data of millions of people on Earth, and in the modern world, information is currency. Although attacks of large scale, such as terrorist attacks, drone strikes, and missile attacks, are not likely or feasible in space, cyber attacks are a very real possibility. The 2022 cyberattack on American satellite internet provider, Viasat is a great example of this, as it knocked out internet service for tens of thousands of satellite modems in Ukraine and many countries around Europe. With the

[29]NASA, “Astronaut Selection and Training.”
[30]PricewaterhouseCoopers, “Next in Space 2025,” n.d.
[31]PricewaterhouseCoopers, “Next in Space 2025,” n.d.
[32]Markovic, “The Final Frontier of Cybersecurity Is Now in Space - Help Net Security.”

societal shift towards increased use of technology and modernization in almost every industry, cyberattacks will become a threat that satellites and space technology are not excluded from.

'The Outer Space Treaty' of 1967 is one of the only legal documents that provides a framework or any semblance of regulations for how activities in space should be conducted. The language in the document is vague and makes general statements such as "The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes."[33] This statement does not define what would be considered a peaceful purpose and what wouldn't be, leaving much of it up to interpretation. What is considered peaceful is subjective and will be perceived differently by different states, making the ambiguity of this text extremely dangerous. Treaties on space law have not been updated or revised due to difficulty in achieving a consensus within the international community. The U.S. is trying to gain private ownership of space resources through the 2020 "Artemis Accords." However, this contrasts with the foundational idea of "common heritage of mankind" that space law was built upon.

Conclusion:

Space is a resource for all of mankind that will exponentially progress our potential as human beings. Space exploration will expand our potential for tourism and the kinds of resources that can be acquired. The privatization of space will bring about a multitude of benefits, including rapid advancements in space technology as companies try to make space travel easier, more efficient, accessible, and less costly. Private companies, such as SpaceX, are already working on the construction of reusable rockets to protect the environment from space debris and reduce the cost of space travel. The benefits of companies in space are undeniable; however, regulations must be put in place as soon as possible to prepare for issues that may arise in the future. Cybersecurity attacks from non-state actors pose a significant threat to the privacy and safety of individuals worldwide. Liability towards space tourists who may be providing uninformed consent to the mental and physical challenges of space travel must be addressed. These are foundational issues that will cause chaos in space and halt the progression of space exploration. UNOOSA must act fast and provide a regulatory framework for non-state actors and tourists to adhere to that does not depend on the state's interpretation of the law.

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[33] "Technical Difficulties."

Space treaties need to be revised and reconsidered to provide the legal framework for peaceful, responsible, and equitable access to and use of outer space..

Questions to Consider:

1. What are some consequences that can occur with the involvement of non-state actors in space when regulations are left in the hands of states?
2. Considering the mental and physical difficulties of space travel, is it ethical to encourage space tourism?
3. What are some updates or revisions that should be made to the “Outer Space Treaty” of 1967?

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"Technical Difficulties," n.d. https://2009-2017.state.gov/t/isn/5181.htm#:~:text=The%20Moon%20and%20other%20celestial%20bodies%20shall%20be%20used%20by,shall%20also%20not%20be%20prohibited.

"The Boeing Starliner Has Returned to Earth Without Its Crew," September 9, 2024. https://stories.tamu.edu/news/2024/09/09/the-boeing-starliner-has-returned-to-earth-without-its-crew/#:~:text=Boeing's%20crew%20transport%20space%20capsule%2C%20the%20Starliner%2C,right%20after%20midnight%20Eastern%20time%20on%20Sept.

"The History of the Space Race," n.d. https://education.nationalgeographic.org/resource/history-space-exploration/.

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II. Space Debris Mitigation and Removal

The United Nations Office for Outer Space Affairs (UNOOSA) is the legal body that supports the development of international law in space. Since their inception in 1958, space debris has always been a topic of debate and a matter that they have taken seriously. It has also become an increasing problem with the growth of the space exploration industry and the possibilities of commercialization. In 2010, UNOOSA released the Space Debris Mitigation Guidelines, a document detailing the issues that arise with space debris and ways that it can be managed. UNOOSA recommends that space debris mitigation measures be implemented, as debris can cause potential damage to spacecraft that results in the loss of spacecraft, loss of mission, and loss of life in cases of manned spacecraft. In the cases of manned spacecraft, space debris mitigation measures are crucial in ensuring the safety of the crew and their ability to return.[34] Along with establishing guidelines for space debris, UNOOSA also encourages the use of Space-Track, which is run by the U.S., which is a system that can predict objects re-entering the Earth's atmosphere.[35] UNOOSA acknowledges the importance of tackling space debris as its presence is expected to increase over time. Confronting space debris will ensure that future missions, astronauts, and satellite technology are all protected from possible collisions.

Statement of the issue:

Space technology is advancing rapidly and has opened doors to space exploration with plans to travel to Mars, explore neighboring planets, and study different materials in space. The increase in space activity has increased space debris that affects current missions to space and places astronauts' lives at risk. Space debris will only increase with time as the operations to space continue and become more commercialized. Satellites that we depend on for communication, navigation, utilities, and services could be damaged by space debris. Restoring the satellite services could take years and hundreds of millions of dollars to fix.[36]

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[34]UNITED NATIONS, "Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space."

[35]UNOOSA, accessed August 18, 2025, https://spacesustainability.unoosa.org/sites/spacesustainability.unoosa.org/files/21-02562_lts_ebook_english_june2021.pdf.

[36]"Space Debris 101 | the Aerospace Corporation."

Space debris also greatly affects life on Earth directly. When an object is going through the process of re-entering the Earth's atmosphere, the temperature and pressure cause it to burn up and release chemicals that deplete the ozone layer and contribute to atmospheric pollution.[37] Debris re-entry also causes clutter in the Earth's orbit that increases the risk of collision and further complicates space missions and satellite functions.[38]

Another rising concern is that the tracking and mitigation of space debris come with many financial challenges. Space missions will require more funding in order to account for frequent maneuvers to avoid debris and extra fuel being carried to complete these maneuvers. The tracking of space debris is also a necessary, but expensive, endeavor. Protecting satellites and missions from space debris is expensive since it requires continuous surveillance, tracking, and moving satellites out of the trajectory of incoming debris. At times, the price of avoiding debris could be remodeling and replacing a mission altogether.[39]

The reason why much of the space debris is not being addressed promptly is due to the lack of legal guidelines and consequences. Many of the treaties addressing space were formed in the Cold War era and have not been revised since then. This is dangerous, especially with the increased travel to space and the introduction of non-state actors in space.

Space debris is an ongoing problem that affects our ability to progress in with safe exploration in a safe manner. It affects the crew's ability to avoid collision and the operations in space as they continuously have to readjust their course or mission plan to account for incoming debris. Space debris also affects life on Earth as it contributes to damage to the ozone layer and the safety of humans and property. Debris is an issue that is spreading into many aspects of space travel and, if not controlled, could have deadly consequences for astronauts, as well as loss of services and economic setbacks for many corporations.

History:

Space debris is defined as different materials that are left behind from missions to space. This includes old or inactive satellites, rocket stages, discarded hardware, fragments of vehicles that exploded or collided, and debris that is shed off of satellites.[40] Currently, there are about

[37]Writer, "The Environmental Impact of Space Debris."
[38]Writer, "The Environmental Impact of Space Debris."
[39]"The Cost of Space Debris."
[40]"Space Debris 101 | the Aerospace Corporation."

25,000 pieces of space debris that are large enough to be tracked and catalogued.[41] The creation of space debris first appeared during the launch of Sputnik I in 1957. This is the first record of manmade material in space since Sputnik I was the first to break through Earth's orbit. When the rocket was launched, the stage detached to propel the satellite further into space while staying behind in Earth's orbit. The realization that there could be material floating in Earth's orbit pushed the United States Air Force to create Project Space Track, a system that tracked artificial space objects belonging to foreign countries as well as those launched domestically. This system was also used to differentiate between objects in orbit that posed no threat and sub-orbital ballistic weapons that did.[42]

Initiatives to improve the tracking of debris continued through projects such as the North American Aerospace Defense Command (NORAD). NORAD sought to establish a space object catalogue that built on the foundation that the Space Track system had set. The records in the database tripled in size during the explosion of the stage of the Thor-Albestar rocket. This explosion marked the first-ever satellite breakup incident and created more than 200 cataloged fragments.[43]

The advocacy for mitigation of space debris started in the 1970s when Don Kessler, a NASA scientist, formulated the Kessler theory. The theory states that there will be a point in time when more debris will be caused by different pieces of debris colliding. This would start a chain reaction where debris quantity is multiplying due to itself rather than from new launching activities.[44] During the late 1980s-1990s, The Aerospace Corporation started developing a breakup modeling code called IMPACT and a collision hazard assessment tool called DEBRIS. These codes made it possible to conduct the first real-time risk analysis of a space shuttle flying through a debris cloud created by the breakup of rockets. Two years later, the first recorded collision between two tracked objects occurred between a French satellite and debris from a French rocket that had exploded a decade prior.[45]

More recent incidents include the 2007 antisatellite weapon test by China that occurred at 800 to 900 kilometers and created thousands of trackable fragments, resulting in more than

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[41]"A Brief History of Space Debris | the Aerospace Corporation."
[42]"A Brief History of Space Debris | the Aerospace Corporation."
[43]"A Brief History of Space Debris | the Aerospace Corporation."
[44]Lahuerta, "The Kessler Effect, the Potential Danger of the Domino Effect for Space Debris."
[45]"A Brief History of Space Debris | the Aerospace Corporation."

3500 pieces of space debris.[46] Another recent example is the 2021 Russian anti-satellite test that caused a major disruption to the global space industry. This test deliberately destroyed a defunct satellite and created over 1500 trackable debris pieces.[47]

For as long as space travel has existed, the presence of debris has always been acknowledged and considered. However, without urgent and active solutions to the crisis, the Kessler syndrome could be activated, causing the complexity of space travel to rise and become almost impossible. States must implement a plan to not only track their debris, but also methods to reduce it and eventually clean it up. Space debris will stay moving in orbit and could threaten a collision with other states' satellites, missions, and hurt astronauts on board.

Analysis:

The volume of debris is growing at a rapid rate. From 2011 to 2021, the number of large debris objects grew from 15,000 to 30,000. Without methods of intervention, the Kessler effect could occur and make some areas in space unusable.[48] The space debris mitigation guideline released by UNOOSA highlights methods to reduce debris. One of them is through limiting debris during normal operations. When a rocket launches, the stage, along with various hardware such as covers and bolts, is all released as space debris. Many other smaller pieces of debris consist of paint and pieces of insulation.[49] The manufacturing of reusable rockets must be implemented to reduce the volume of debris being created. Reusable rockets feature a stage that returns to Earth using its own set of engines rather than being left to float in orbit. The design contains components that are easy to disassemble and refurbish in between flights. Heat shield technology can also be applied to protect the paint from chipping during flight and re-entry. The rockets are manufactured to ensure durability through multiple launches rather than being discarded.[50]

Reusable rockets offer many economic benefits. The implementation of these rockets can be up to 65% cheaper than using the traditional rocket. This model would lower the cost of

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[46]"A Brief History of Space Debris | the Aerospace Corporation."
[47]Artemis, "Space Junk Crisis: How Clean Space Technology Is Protecting Earth'S Orbital Environment | Happy Eco News."
[48]Artemis, "Space Junk Crisis: How Clean Space Technology Is Protecting Earth'S Orbital Environment | Happy Eco News."
[49]"Space Debris 101 | the Aerospace Corporation."
[50]Kentnstxl, "Reducing the Cost of Space Travel With Reusable Launch Vehicles - NSTXL."

regular resupply missions to the International Space Station (ISS) and missions to the Moon and Mars.[51] SpaceX is a corporation that has already manufactured a reusable rocket called Falcon 9. Falcon 9 is a reusable two-stage rocket used for safely transporting people and payloads into Earth's orbit and beyond. The Falcon 9 booster can be reused over 10 times with minimal maintenance between flights.[52] This creation opens the doors for governmental agencies and other corporations to invest in reusable rocket technology while also reducing space debris and the cost of rocket manufacturing.

Moreover, space agencies are also investing in the development of space debris capture and removal methods. ClearSpace-1 is the first mission, planned by the European Space Agency (ESA) and Swiss startup ClearSpace, to remove a piece of space debris from orbit.[53] A variety of different debris removal methods are also being developed, such as harpoon technology, net capture systems, robotic arms and claws, laser ablation, and magnetic capture systems. Harpoon technology captures and secures large pieces of debris. Airbus, a European multinational aerospace corporation, has tested harpoon technology as a part of its RemoveDEBRIS mission. The harpoon spears a giant piece of debris and then either repositions it to minimize collision risk or de-orbits it completely.[54] The net capture system uses a large net to trap debris and prevent it from traveling further into the orbit. This method has been successfully tested by ESA and can be used more commonly.[55] Robotic arms and claws are pieces of technology that provide more precise capture and removal of space debris. They are used to grab dysfunctional satellites and lead them to a controlled return into the Earth's atmosphere. Laser ablation involves using ground-based or space-based lasers to alter the pathways of small debris. Despite this method still being in its early stages of testing and modeling, it maintains its importance as a method that provides a non-contact approach that could be used on any-sized space debris.[56] Finally, the magnetic capture system is one that uses powerful magnets or electromagnets to attract and secure space debris that contains magnetic metals. Astroscale, a Japanese company, is leading the industry in magnetic debris capture technology with its End-of-Life Services

[51]Kentnstxl, "Reducing the Cost of Space Travel With Reusable Launch Vehicles - NSTXL."
[52]Kentnstxl, "Reducing the Cost of Space Travel With Reusable Launch Vehicles - NSTXL."
[53]Vivatechnology, "Space Debris Mitigation: Techniques the World Uses."
[54]Vivatechnology, "Space Debris Mitigation: Techniques the World Uses."
[55]Vivatechnology, "Space Debris Mitigation: Techniques the World Uses."
[56]Vivatechnology, "Space Debris Mitigation: Techniques the World Uses."

operations. This features satellites that are equipped with plates that are responsive to magnets.[57]

There are numerous methods for reducing and removing space debris. However, a larger consideration than methods is participation. The current legal framework for space law is vague and doesn't provide any consequences for nations that participate in the increase in space debris. The Outer Space Treaty (1967) is the heart of international space law, and yet it provides vague language and a lack of detail concerning environmental obligations with activities in outer space. The treaty does not consider the rapid growth of space waste. The language in the treaty ('contamination' rather than a more general 'destruction' or 'pollution' or, even, 'congestion') is increasingly being used towards commercial activity and is unlikely to prevent the further decline of the outer space environment.[58]

Furthermore, there is no legal incentive at the international level to address the crisis of space debris. States are not bound to design missions in sustainable ways, deorbit satellites at the end of their lives, or reduce space debris. Without nations taking initiative to pass and enforce legislation to fight against debris, the crisis will continue to grow.[59]

Conclusion:

Space debris is a crisis that currently has no serious method of combating due to the lack of a legal framework to enforce it. States and non-state actors continue to travel to space, leaving behind remnants of their rockets in Earth's orbit, waiting to re-enter the atmosphere and cause environmental and property damage. The growth and progression of technology towards space tourism also contributes to the crisis, as more citizens are expected to be making the trip into outer space. Increased travel to space will result in increased debris, which will increase the chances of a potential collision, placing the astronauts and civilians in danger. Satellites are also in danger of breaking up as large pieces of debris, such as rocket stages, are difficult to avoid. Damage to a satellite would cost time and money to rebuild.

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[57]Vivatechnology, "Space Debris Mitigation: Techniques the World Uses."
[58]O'Grady, "Rush Hour Beyond the Kármán Line: Managing and Resolving Disputes About Space Debris and Orbital Congestion."
[59]O'Grady, "Rush Hour Beyond the Kármán Line: Managing and Resolving Disputes About Space Debris and Orbital Congestion."

Questions to Consider:

1. What are the methods that can be used to hold states accountable for their debris?
2. Should states develop protections for possible debris re-entering Earth's orbit?
3. Can a universal space debris tracking mechanism be established?

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