The Long March-5 Y2 rocket takes off from Wenchang Satellite Launch Center in Wenchang, Hainan Province, China in July 2017.

REUTERS

Build on the Outer Space Treaty

Fifty years on, the agreement is being pushed to its limits by changing geopolitics, technology and commercial interests, warns **Joan Johnson-Freese**.

On 10 October 1967, the Outer Space Treaty went into force. Agreed on during a golden age of cooperation between the then-dominant superpowers, the Soviet Union and the United States, the treaty deems space a domain to be shared by all nations. It states: "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."

The treaty gave rise to a series of others that govern space today: the Rescue Agreement (1968), the Liability Convention (1972), the Registration Convention (1976) and the Moon Agreement (1984). Although the United States and Soviet Union declined to sign the Moon Agreement, to avoid having to share lunar resources and technologies, most issues were seemingly covered — liability for damage caused by space objects, the safety and rescue of spacecraft and astronauts, and the rules governing the exploitation of space resources and settling disputes.

A lot has changed since. Launch costs have plummeted — from US$20,000 to send one kilogram into orbit in the late twentieth and early twenty-first centuries to as little as $5,000 now. And more nations, people, businesses and organizations are seeking to establish themselves in space. 'NewSpace' entities — non-governmental actors, often with commercial interests and financed through personal wealth — are diversifying the space landscape, with motivations ranging from human settlement to economic development. SpaceX founder Elon Musk, for example, has said that becoming an interplanetary species is the only way for humanity to avoid an eventual extinction event on Earth, and that he wants to "die on Mars, just not on impact". Planetary Resources, a US-based asteroid-mining company, states that its vision is to extend the economy into space.

Meanwhile, conventional interests of prestige, geostrategic influence and military missions in space have come to the fore. Access to space is considered a "vital national interest" by the United States[1], an area of revitalized national interest by Russia, and an aspiration of China, India[2] and a growing number of other countries. India and China's 'space race', crucial to each country's national prestige, is arguably fiercer than even the twentieth-century US–Soviet race.

In terms of military competition, the United States sees China's encroachment on space as heightening the risk of a space war[3]. China's launch of a 'science mission' in May 2013 that nearly reached geosynchronous orbit (about 36,000 kilometres above Earth) caused quiet panic in the Pentagon and in US intelligence circles. The United States had considered that orbit a sanctuary, out of reach of foes, for some of its most strategically important spy satellites, such as those in the Keyhole series.

Fifty years on, the Outer Space Treaty and its spin-offs are still appropriate. But interpretations of its provisions are, more than ever, being influenced by commercial interests and politics. Supplementary rules and norms are needed. In an era in which international cooperation on treaties is tenuous, informal agreements and resolutions must guide space-faring actors, protect the environment and prevent wars.

COMPETING INTERESTS

The United States is the largest player in terms of space spending, capabilities and assets in orbit. The government alone spends about $40 billion each year on space activities through the Department of Defense and NASA, with China and Russia next, at about $6 billion each. Japan, France, Germany, Italy, India, Canada and the United Kingdom together spend around $11 billion. As of 1 January, there were 1,459 satellites in orbit, of which 593 belong to the United States, 135 to Russia and 192 to China.

US strategic thinking will largely shape the direction of future global space policies. And the 2011 US National Security Space Strategy described the official US view of space as "congested, contested, and competitive". Active satellites and debris from old missions clutter the skies. More than 500,000 pieces of debris, ranging in size from a baseball to a school bus, are being tracked in Earth orbit. Millions of smaller but nonetheless dangerous pieces are not.

The number of countries, consortia and companies involved in space is growing. In 1959, when the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) was formed, there were 24 members. Today, there are 84. Although few countries can afford to develop their own launch capabilities, none wishes to be left out of the expanding information age facilitated by space technology. Data that were once available only to or through governments, such as remotely sensed data, are now available through private companies. Commercial communications satellites increasingly carry military traffic. In 2013, US troops operating in Africa began using a Chinese Apstar-7 satellite to carry data.

Almost 50 commercial and non-profit organizations are listed in the informal directory of the Space Frontier Foundation in Arlington, Virginia, which is committed to facilitating the human settlement of space. These companies are exploring ideas from satellite refuelling to mining asteroids for water and providing extraterrestrial human habitats, among other projects.

The main driver of change in US thinking about space security is the number of countries that are developing capabilities with potential military uses. Since the 1990–91 Gulf War, when the use of the Global Positioning System (GPS) allowed coalition troops and equipment to be moved across the desert without being detected, the US military has reaped the advantages of its advanced space-based technologies. Satellites are used for command, control, communications, reconnaissance and intelligence.

Many countries desire similar capabilities and are developing a wide range of 'dual-use' space technologies, which are of value to both the civil and military sectors. China and Russia have their own versions of GPS. Missile-defence systems being built by the United States, China, Russia and India use targeting systems similar to those required for an anti-satellite weapon. Yet, so far, no country has crossed the Rubicon of explicitly and officially developing a space weapon.

SPACE SECURITY

Two debates have broken out among space-security analysts. First, are more rules needed for managing the space environment sustainably for all? Second, is space warfare inevitable or how should one deter it?

Space-resource ownership and traffic need to be managed. In 2015, the US Congress enacted legislation to protect the interests and investments of US companies, such as Planetary Resources, that seek to harvest the potentially vast mineral and water resources of the asteroid belt as early as the 2020s. The Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015, or SPACE Act, entitles US citizens to "possess, own, transport, use and sell" extracted materials, subject to the obligations of the United States under the various treaties it has previously signed[4].

"Encouraging mutual understanding and building trust between nations is crucial."

Some argue that this act violates Article II of the Outer Space Treaty. It states: "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." Even without making territorial claims, appropriation of resources could restrict access to resources for others and potentially encourage environmentally risky exploitation of the Moon, planets and asteroids.

Space-traffic management is the equivalent of air-traffic control. It is in no one's interest to have thousands of planes flying around unchecked, and so is the case with satellites. You need to know where they are and where they will be. Traffic-management systems must be able to notify parties of potential collisions and events, such as when a satellite 'goes rogue' and is beyond control, or suddenly comes back to life, as the LES-1 satellite did in 2016 after 46 years of silence.

Public organizations such as the US military's Joint Space Operations Center (JSpOC) and private bodies such as the Space Data Association are making progress on these issues, including coordination between the public and private sectors. The addition of a Commercial Integration Cell, where commercial operators are able to interact with their military counterparts, at JSpOC in 2015 was seen as a landmark in commercial–military cooperation. Nevertheless, some satellite owners, especially intelligence agencies, are reluctant to share too much information. That spurs the question of whether traffic rules for operation are needed, or even acceptable. Rules restrict actions, which neither companies nor governments welcome.

The United States has largely shunned multilateral rules for coordinating and limiting space operations beyond the provisions already in place through the Outer Space Treaty. Three key arms-control provisions of the Outer Space Treaty reside in Article IV. First, parties should not place in orbit around Earth any objects carrying nuclear weapons or other weapons of mass destruction, install such weapons on celestial bodies or station them in outer space. Second, the Moon and other celestial bodies must be used exclusively for peaceful purposes. And third, it is forbidden to establish military bases, installations or fortifications, or to test any type of weapon or conduct military manoeuvres on celestial bodies.

However, military personnel's involvement in scientific research or other peaceful endeavours is not prohibited. Many early astronauts and cosmonauts were members of the military. Similarly permitted is the use of military equipment or facilities for peaceful purposes. But the dual-use nature of many space technologies means that civilian efforts often concurrently improve military capabilities. For example, developing tracking stations for human spaceflight missions also improves missile-tracking ability. The many definitions of peaceful — ranging from non-military to non-offensive — have allowed space to slip through the cracks of arms-control efforts since 1984.

Although weapons of mass destruction are banned in space, weapons in general are not. Releasing energy or kinetic force in space, through lasers and electromagnetic pulses, flak or collisions, can pollute the orbital environment for decades. From the 1962 US Starfish Prime test of nuclear weapons in space to the more recent anti-satellite weapons test carried out by China in 2007, the debris created can take decades to clear. The 2007 Chinese test generated some 3,000 pieces of space debris through some of the most populated low-Earth-orbit positions. As more satellites switch off and

remnants break up, space becomes more difficult, expensive and dangerous to use. The International Space Station, for example, has had to manoeuvre several times to avoid colliding with space junk.

Since the contentious May 2013 Chinese launch, the United States has shifted its position on space warfare. Previously, its stance was strategic restraint, refraining from introducing offensive space capabilities in the hope of moderating the behaviour of friends and potential foes; since 2013 it has been preparing for war in space, whatever that might look like. US officials are now actively exploring offensive and defensive space-based activities, with the only caveat being to avoid creating debris.

In 2008 and again in 2014, China and Russia submitted a joint proposal to the United Nations for a Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects, dubbed the PPWT. Each time, the United States rejected the proposal as "fundamentally flawed". Among the reasons cited are that it is unverifiable — it is difficult to define a space weapon owing to the dual-use nature of most of the technology; it does not prohibit the development and stockpiling of space arms; and it does not consider ground-based space weapons, such as that demonstrated by the Chinese in 2007.

Rather than shift to aggressive policies, nations should instead show further restraint and cooperation.

THE WAY FORWARD

Space laws need to be updated for our time. Extending the Outer Space Treaty or writing a new one is unlikely to work, as US hesitancy to sign the PPWT shows. 'Soft law', driven by need, seems the best option for revising the rules for space operators.

Soft law comprises rules or guidelines that have legal significance but are not binding. It sets standards of conduct for agreeing parties, much like those that protect the environment and endangered species. 'Rules of the road' and best practices for space should be developed. These could take a similar form to the navigation guidelines set out in the 1972 Convention on International Regulations for Preventing Collisions at Sea, which govern when one vessel should give way to another, as well as other interactions.

Soft law works when it is in the interest of all parties to abide by it. If countries and companies want to maintain the space environment as a usable domain, then it is in their interests to accommodate a variety of operations. Space is more complex to manage than air, land or sea because of the distance, physics and technology involved. Just as in the cyber domain, technology has preceded regulation, making it difficult to impose after the fact.

AL SEIB/LOS ANGELES TIMES/GETTY

Sir Richard Branson presents Virgin Galactic SpaceShipTwo, part of the company's space-travel efforts.

The first focus of an analogous set of space guidelines should be environmental protection and debris avoidance, areas that most spacefaring nations agree on. Governments are engaged in groups such as the 13-member Inter-Agency Space Debris Coordination Committee (IADC). The 84-member COPUOS works through two subsidiary bodies to develop best practices for sustaining the space environment, including mitigating debris. COPUOS working groups will begin meeting again in January 2018 to continue developing best practices, with new proposals to be presented to the committee in June 2018. Commercial perspectives should be included through national delegations and external observers.

Politicization of any guiding principles must be resisted, for example, by seeking consensus. The IADC Steering Committee releases information and materials to the public only when all parties agree, and it works through sub-committees operating from a technical rather than a political perspective. COPUOS discussions are progressing, albeit slowly.

Encouraging mutual understanding and building trust between nations is crucial to avoid conflict. It is impossible to verify exactly what is happening in space if a satellite ceases to function: has there been an intentional attack, an act of nature or a technical glitch? This problem of distance and the nature of dual-use technology create ripe circumstances for mishaps. Transparency and confidence-building measures developed in 2013 by the UN-sponsored Group of Governmental Experts are designed to help avoid misunderstanding and miscalculations and should be widely adopted.

A coordinated human spaceflight mission, in which different nations work together towards a common goal, could build the kind of space environment envisioned in the Outer Space Treaty. US–Russian cooperation on the International Space Station has shown that when terrestrial tensions get high, working together can maintain ties.

Coordination is easier than cooperation when there are technology-transfer concerns. Proposing a big mission and inviting other countries to join would give the US human spaceflight programme a direction, as well as serving strategic purposes. A crewed fly-by mission of Venus and Mars, for example, has been on the table since the days of the Apollo missions and could yet be resurrected. An encouraging example is the 'space armada' of coordinated missions to study Halley's comet in 1986, involving the Soviet Union, European Space Agency and Japan.

With the expansion of national and commercial space activities, the Outer Space Treaty will be stretched to its limits. In that regard, it will be serving its intent — paving the way for the peaceful exploration and development of space. ■

Joan Johnson-Freese *is a professor of national-security affairs and chair of science, space and technology at the Naval War College, Newport, Rhode Island, USA.*
e-mail: johnsonj@usnwc.edu

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