

Regulation of the space tourism sector

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1. Introduction

We live in an epoch in which the experience of space travel is quickly becoming a form of private commercial activity. When the first artificial satellite, *Sputnik 1*, was launched in 1957, the possibility of commercial space tourist flights was at most a distant dream. The launch of *Sputnik 1* introduced the Cold War space era, in which space activities were intrinsically linked with the political objectives and priorities as well as with the national security or military concerns of the two superpowers, the United States (US) and the then Soviet Union (USSR).¹

Due to the strategic and political importance of space, the two space powers were reluctant to allow any non-governmental actors to explore outer space. In addition, the high cost and technological risks involved hampered private investment in outer space projects.² Since then, the space arena has also increasingly evolved to include non-State entities, which are becoming actively involved in outer space activities. Since the Russian Space Agency began to take persons to the International Space Station (ISS) in 2001,³ a number of private space tourism companies have been established, particularly in recent years.⁴ As a result, there has been an increase in the development of sub-orbital space travel and a rise in public interest that have paved the way for the growth of this industry.⁵ To provide a more accessible service, companies have made efforts to develop the necessary technology to venture into space and to reduce the price of such trips.⁶

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** Sections of this chapter are based on research for an earlier article by the author, *Legal problems relating to the commercial use of outer space, with specific reference to 'space tourism'* (2014) Potchefstroom Electronic Law Journal 2–50.

1 C Venet, 'The 'Political Dimension'', in C Brünner & A Soucek (Eds), *Outer Space in Society, Politics and Law* (2011) pp 73–74.

2 E Walter, 'The Privatisation and Commercialisation of Outer Space', in Brünner & Soucek, *op cit* (note), p 493.

3 To date, seven space tourists have travelled to the ISS on board the Russian *Soyuz* spacecraft. See *List of Space Tourists*, available at <https://didyouknow.org/lists/spacetourists/> (accessed 27 May 2017).

4 MJ Sundahl, *The Duty to Rescue Space Tourists and Return Private Spacecraft*, 35 *Journal of Space Law* 163–200 at 163, n 2 (2009) contends that "[s]pace tourism could be said to have truly begun in 1990 when Toyohiro Akiyama, a Japanese journalist who spent almost eight days on the Russian space station, *Mir*, became the first private person to go into space".

5 Organisation for Economic Co-operation and Development (OECD), *International Futures Programme Space 2030: Tackling Society's Challenges* (2005, OECD Publishing), p 304.

6 At present, the cost of such flights ranges from \$95,000 to \$200,000. The cost is, however, expected to drop to \$20,000 within the first few years of operation. See Paramount Business Jets, *Space Tourism*, available at <https://www.paramountbusinessjets.com/space-tourism.html> (accessed 24 May 2017).

In October 2004, one such company, Scaled Composites, won the Ansari XPRIZE⁷ with its space vehicle, *SpaceShipOne*, by flying past the altitude of 100 kilometres above the Earth's surface twice within two weeks while being operated by a civilian pilot and carrying extra weight equivalent to two other passengers.⁸ Subsequently, Sir Richard Branson's company, Virgin Galactic, announced its plans to take tourists on a 90-minute long journey, costing \$200,000, into sub-orbital space at three times the speed of sound with its spacecraft, *SpaceShipTwo*, launching from Spaceport America.⁹ *SpaceShipTwo* performed a successful maiden flight in 2010 and a fleet of these space vehicles is currently under construction.¹⁰ Space tourism operator XCOR Aerospace is developing a rocket-propelled winged vehicle, the *Lynx*, for passengers who wish to experience an 'individualised' half-hour long sub-orbital flight by sitting alongside the pilot and travelling to an altitude of 100 kilometres.¹¹ Armadillo Aerospace has plans to develop a sub-orbital two-seater space vehicle called *Hyperion*.¹² A capsule-styled spacecraft is being developed by Blue Origin, a company owned by Amazon.com co-founder Jeff Bezos.¹³ Two other companies, Bigelow Aerospace and Axion Space, plan to launch private space stations into orbit as soon as 2020. These 'habitat modules' could host a variety of inhabitants, including space tourists, scientists and National Aeronautical and Space Administration (NASA) astronauts.¹⁴ Other potential space tourism operators include Rocketplane,¹⁵ which plans to offer sub-orbital flights launched from Dubai, and SpaceX, owned by South African-born

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- 7 The XPRIZE Foundation awarded the largest prize in history, namely the \$10 million Ansari XPRIZE (sponsored by the Ansari family) to Scaled Composites for building and launching a three-person spacecraft which flew 100 kilometres above the Earth's surface twice within a period of two weeks. The prize is modelled on the Orteig Prize that was awarded to Charles Lindbergh in 1927 for being the first person to fly continuously from New York to Paris. According to the XPRIZE Foundation, the spaceflight by Scaled Composites meant that "[s]paceflight was no longer the exclusive realm of government. With that single flight, and the winning of the \$10 million Ansari XPRIZE, a new industry was born". See Ansari XPRIZE/XPRIZE Foundation <http://space.xprize.org/ansari-x-prize> (accessed 20 June 2013).
- 8 *SpaceShipOne Wins \$10 million Ansari X Prize in historic 2nd trip to space*, Space.Com, available at <http://ansari.xprize.org/news/media-mention/spaceshipone-wins-10-million-ansari-x-prize-historic-2nd-trip-space> (accessed 10 August 2017).
- 9 MJ Kleiman, JK Lamie & M-V Carminati, *The Laws of Spaceflight: A Guidebook for New Space Lawyers* (2012, American Bar Association), p 49; T Masson-Zwaan 'Article VI of the Outer Space Treaty and Private Human Access to Space', in 2008 *Proceedings of the International Institute of Space Law: 51st Colloquium on the Law of Outer Space* 536–546 at 539; T Masson-Zwaan & S Freeland, *Between heaven and earth: Legal challenges of human space flight* (2010) 66 *Acta Astronautica* 1597–1607 at 1598; S Freeland, 'Fly Me to the Moon: How will International Law Cope with Commercial Space Tourism?' (2010) 11 *Melbourne Journal of International Law* 1–29 at 3.
- 10 Walter, *op cit* (note 2), p 501. See further Virgin Galactic, *Our Vehicles and Spaceships*, available at www.virgingalactic.com/human-spaceflight/our-vehicles/ (accessed 24 May 2017).
- 11 Kleiman, Lamie & Carminati, *op cit* (note 9), pp 49–50; Masson-Zwaan, *op cit* (note 9), p 539. See further, *About Lynx* <http://xcor.com/lynx/> (accessed 3 September 2013). However, according to media reports, the project has been placed on hold indefinitely. See in this regard J Pappalardo, *The XCor Lynx space plane might be down for the count* (31 May 2016), available at www.popularmechanics.com/space/a21103/the-xcor-lynx-spaceplane-might-be-down-for-the-count/ (accessed 24 May 2017).
- 12 Kleiman, Lamie & Carminati, *op cit* (note 9), p 50. Due to a lack of funding, the project is currently on hold. See further *Citizens in Space*, www.citizensinspace.org/2013/08/armadillo-in-hibernation/ (accessed 26 May 2017).
- 13 Kleiman, Lamie & Carminati, *op cit* (note 9), p 50. See *Jeff Bezos Reveals 'Sneak Peek' of Blue Origin's Space Tourism Capsule*, Space.Com (29 March 2017) available at www.space.com/36267-blue-origin-space-capsule-interior-sneak-peek.html (accessed 26 May 2017).
- 14 M Wall, *Private Space Stations May Take Flight in 2020*, Space.Com (13 October 2016) available at www.space.com/34377-private-space-stations-may-take-flight-in-2020.html (accessed 26 May 2017).
- 15 See *The Space Experience*, available at http://rocketplane.ca/the_space_experience.html (accessed 26 May 2017).

Elon Musk, which has created a new type of rocket to deliver cargo on behalf of NASA to the ISS¹⁶ and plans to take private persons into space.¹⁷ European aerospace company EADS Astrium has also announced plans to provide space tourist flights for groups of four passengers to an altitude of 100 kilometres in a space vehicle named *Spaceplane*, which will take off and land on a runway.¹⁸

To launch the envisaged commercial space vehicles, the first commercial spaceport, Spaceport America,¹⁹ was constructed in New Mexico. A number of other spaceports are planned in countries and territories such as the United Arab Emirates, Singapore, Sweden, Scotland and the Netherlands Antilles.²⁰ Significant financial investment is also being made to develop reusable launch vehicle technology for the space tourism industry.²¹

Although space tourism is still in its infancy, it is estimated that the number of space tourists will reach into the hundreds (or, according to Virgin Galactic's predictions, even into the thousands) within the next few years.²² As space tourist activities increase, some legal and regulatory concerns arise in relation to commercial space travel and space tourism. Consequently, the development of this innovative industry has created a need for a suitable legal framework to regulate its activities.

2. Defining 'space tourism'

In a broad sense, the term 'space tourism' (or "personal space flight"²³) denotes "any commercial activity offering customers [a] direct or indirect experience with space travel".²⁴ A 'space tourist' has been defined as "someone who tours or travels into, to, or through space or to a celestial body for pleasure and recreation".²⁵ Possible space tourist activities include long-term stays in orbital facilities for research or entertainment purposes, short-term orbital or sub-orbital flights, and parabolic

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- 16 SpaceX developed the *Dragon* spacecraft and *Falcon 9* launch vehicle, which was launched from Cape Canaveral Air Force Station in Florida. In May 2012, the *Dragon* became the first commercial spacecraft to dock successfully with the ISS. See Kleiman, Lamie & Carminati, *op cit* (note 9), p 53.
- 17 See further SpaceX, available at www.spacex.com (accessed 26 May 2017).
- 18 Freeland, *op cit* (note 9), p 3. See also E Howell, *Spaceplane: Suborbital Vehicle for Space Tourism & Science*, Space.com (24 March 2016, available at www.space.com/19279-eads-astrium.html (accessed 3 September 2013)).
- 19 See *Spaceport America*, available at <http://spaceportamerica.com/> (accessed 26 May 2017).
- 20 Masson-Zwaan, *op cit* (note 9), p 539.
- 21 Freeland, *op cit* (note 9), p 3.
- 22 Sundahl, *op cit* (note 4), p 164. The European Space Agency (ESA) envisages that "space tourism offers the potential for sustained progress similar to what happened in the early days of aviation". In this regard, see A Galvéz & G Naja-Corbin, *Space Tourism: ESA's view on private suborbital spaceflights*, ESA Bulletin (August 2008), 19–24 at 19.
- 23 J Loizou, *Turning space tourism into commercial reality*, 22 *Space Policy* 289–290 at 289 (2006).
- 24 S Hobe & J Cloppenburg, "Toward a new aerospace convention? – Selected legal issues of 'space tourism'", in 2004 *Proceedings of the 47th Colloquium on the Law of Outer Space: International Institute of Space Law of the International Astronautical Federation*, p 377; Loizou, *op cit* (note 24), p 289. Kleiman, Lamie & Carminati, *op cit* (note 9) at p 26 merely define 'space tourism' as "space travel for recreational purposes". The ESA defines 'space tourism' as "suborbital flights by privately funded and/or privately operated vehicles and the associated technology development driven by the space tourism market": See Galvéz & Naja-Corbin, *op cit* (note 22), p 19. Masson-Zwaan & Freeland, *op cit* (note 9) at p 1599, however, suggest that 'private space travel' might be a better term, for the present at least, since this kind of space travel is still reserved for very few people and so can not yet be regarded as a mass tourist operation in which large groups of people are taken on space tours. See also Masson-Zwaan (n 9) at p 536, n 2.
- 25 Z O'Brien, 'Liability for injury, loss or damage to the space tourist', in 2004 *Proceedings of the 47th Colloquium on the Law of Outer Space: International Institute of Space Law of the International Astronautical Federation* at p 386, as quoted by Masson-Zwaan & Freeland, *op cit* (note 9), p 1599.

flights in aircraft in which space tourists are exposed to conditions of weightlessness.²⁶

- In the instance of sub-orbital spaceflight,²⁷ orbital velocity is not achieved as the space vehicle re-enters the Earth's atmosphere after three to six minutes of microgravity has been reached. The passengers therefore experience a few minutes of weightlessness and the launch vehicle is re-used later. The space vehicle is launched either horizontally or vertically and attains an altitude of around 100 kilometres.²⁸
- With orbital spaceflight,²⁹ orbital velocity must be reached to allow the space vehicle to fly along the curvature of the Earth without falling back to Earth, making it much more energy-intensive; it is therefore technically more challenging and more expensive than sub-orbital spaceflight.³⁰ Depending on atmospheric factors, an orbital spacecraft can remain in space for a period of between a few days and up to a few years.³¹
- In the case of intercontinental rocket transport, the idea is to shorten the travel time substantially from one point on Earth to another by transiting through outer space.³² This form of transport would be specifically useful for military purposes, as well as for the transport of persons and goods. Technical difficulties and safety risks are, however, associated with this form of transport.³³

Because of the technological and cost demands of orbital spaceflight and intercontinental rocket transport, most personal spaceflights currently on offer will be sub-orbital.³⁴

Article I of the Outer Space Treaty³⁵ requires that the exploration and use of outer space shall be carried out for the benefit and in the interest of all countries. Private human spaceflight may be regarded as a (mostly) recreational activity³⁶ and,

26 Hobe & Cloppenburg, *op cit* (note 24), p 377; S Hobe, *Legal Aspects of Space Tourism*, 86) Nebraska Law Review 439–458 at 439 (2007).

27 The term 'sub-orbital spaceflight' is defined as "[s]paceflight where the spacecraft reaches outer space, but does not have sufficient energy to complete a full revolution around the Earth before reentering the atmosphere": see Kleiman, Lamie & Carminati, *op cit* (note 9), p 30. See also F Tronchetti, 'Regulating sub-orbital flights traffic: Using air traffic control as a model?', in 2011 *Proceedings of the International Institute of Space Law: 54th Colloquium on the Law of Outer Space*, p 177.

28 Masson-Zwaan, *op cit* (note 9), 538; Masson-Zwaan & Freeland, *op cit* (note 9) p 1599; Kleiman, Lamie & Carminati, *op cit* (note 9), p 49; Freeland, *op cit* (note 9), p 9.

29 'Orbital spaceflight' is defined as "spaceflight where the spacecraft is launched with sufficient energy to complete at least one revolution around the earth": see Kleiman, Lamie & Carminati, *op cit* (note 9), p 29. See also Tronchetti, *op cit* (note 27), p 177.

30 Masson-Zwaan, *op cit* (note 9), p 538; Masson-Zwaan & Freeland, *op cit* (note 9), p 1599; Kleiman, Lamie & Carminati, *op cit* (note 9), p 51; Freeland, *op cit* (note 9), p 9.

31 Kleiman, Lamie & Carminati, *op cit* (note 9), pp 51–52.

32 Masson-Zwaan, *op cit* (note 9) p 538.

33 Freeland, *op cit* (note 9), p 10.

34 Masson-Zwaan, *op cit* (note 9), p 538; Masson-Zwaan & Freeland, *op cit* (note 9), p 1599. Companies such as Excalibur and SpaceX are, however, planning orbital space tourist flights. Space Adventures is already planning to take two space tourists beyond low Earth orbit on a circumlunar trip to the Moon in the near future, using a modified Soyuz spacecraft. One ticket has already been sold for \$150 million. See further Kleiman, Lamie & Carminati, *op cit* (note 9), p 54; Masson-Zwaan & Freeland, *op cit* (note 9), p 1599.

35 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space including the Moon and Other Celestial Bodies 1967, 610 UNTS 205 (Outer Space Treaty).

due to the high cost involved, space tourism is currently reserved mainly for the wealthy space travel enthusiast, which makes its benefit for all of mankind unclear.³⁷ Space tourism may, however, have certain long-term social and economic advantages:³⁸

- it will most probably lead eventually to more affordable access to space, which could be seen as beneficial for all mankind;³⁹
- private human spaceflight may have certain social and economic advantages, such as the development of new technologies in the area of human space travel and the boosting of private investment, which could alleviate pressure on the use of public funds for near-Earth space exploration;⁴⁰ and
- if private spaceflights also serve a scientific purpose by making it possible to carry out scientific experiments under certain space conditions, the benefit for mankind would be obvious.⁴¹

However, to ensure that space tourism activities do indeed serve the benefit of all mankind, they must be undertaken in a legally regulated as well as an ethical manner.⁴² It is self-evident that space tourism activities would significantly add to the pollution of both the Earth and outer space environments.⁴³ In this regard, Masson-Zwaan and Freeland point out that it has been claimed⁴⁴ that space tourist vehicles will eventually become the world's primary source of carbon dioxide emissions.⁴⁵ An even more pressing problem is that of space debris. No legally binding definition of 'space debris' has, however, been formulated yet.⁴⁶ In addition, the core United Nations (UN) space treaties pay very little attention to environmental issues, and the problem of space debris is not specifically addressed in the Outer Space Treaty (nor in any other space treaties), as these matters were not high on the agenda of the spacefaring nations at the time of the conclusion of the treaties.⁴⁷ At present, the mitigation of space debris is a matter of voluntary compliance by States with the

36 M Chatzipanagiotis, 'The impact of liability rules on the development of private commercial human spaceflight', in 2011 *Proceedings of the International Institute of Space Law: 54th Colloquium on the Law of Outer Space*, p 56. Chatzipanagiotis describes space tourism as "a kind of extreme sport".

37 Masson-Zwaan, *op cit* (note 9), p 536. Masson-Zwaan observes at p 545 that –
 "[s]afe, efficient private human access to space at reasonable cost will boost space activity, the global economy, and thus will benefit Mankind as a whole. Article 1 of the Outer Space Treaty therefore does not stand in the way of seeing space tourism as a legitimate use of space."

38 Chatzipanagiotis, *op cit* (note 36), p 56.

39 Masson-Zwaan, *op cit* (note 9), p 536. Referring to a tourism market study conducted by a US-based consultancy firm in 2002, the ESA envisages that the cost of space tourist flights will gradually decrease. The projected cost of \$200,000 for a seat on *SpaceShipTwo* (with 200 people who have already made advanced payments in 2008) is expected to drop to \$50,000 in 2021 (with approximately 16,000 interested passengers by 2021): see Galvéz & Naja-Corbin, *op cit* (note 22), p 20.

40 Chatzipanagiotis, *op cit* (note 36), p 56.

41 *Ibid.*

42 For a further discussion of these ethical considerations, see Freeland, *op cit* (note 9), pp 25–28.

43 Masson-Zwaan & Freeland, *op cit* (note 9), p 1606.

44 *Ibid.*

45 In addition to the protection of the space environment from pollution, Masson-Zwaan & Freeland, *op cit* (note 9), p 1606 submit that legal regulation for the protection of so-called 'heritage sites' in outer space will be needed. These areas would, for example, include the site of the first manned Moon landing.

46 See Anél Ferreira-Snyman, *Environmental liability for space debris* (pp 263-289 below).

47 F Lyall & PB Larsen *Space Law: A Treatise* (2009) p 303; L Viikari, *The Environmental Element in Space Law – Assessing the Present and Charting the Future* (2008), p 32.

space debris mitigation guidelines⁴⁸ and national legal rules in this regard. Given the increasing commercial use of outer space, including the planned space tourism ventures, it is imperative that this problem is addressed as a matter of urgency, as it could significantly hamper the future exploration and use of space.⁴⁹

This is an extract from the chapter 'Regulation of the space tourism sector' by Yanal Abul Failat and Anél Ferreira-Snyman in Outer Space Law: Legal Policy and Practice, published by Globe Law and Business.

48 The Space Debris Mitigation Guidelines of the Committee of the Peaceful Uses of Outer Space (2010, United Nations Office for Outer Space Affairs (UNOOSA)), available at www.unoosa.org/pdf/publications/st_space_49E.pdf (accessed 27 May 2017).

49 A Ferreira-Snyman, *Legal challenges relating to the commercial use of outer space, with specific reference to space tourism*, 2014 (17) Potchefstroom Electronic Law Journal 1–52, at 8.

50 T Neger & E Walter 'Space law – An Independent Branch of the Legal System', in C Brünner & A Soucek (Eds), *Outer Space in Society, Politics and Law* (2011), p 238.

51 *Ibid*, pp 238–239. According to the authors, these activities include those which “can be considered as facilitating access to and the return from outer space, like all kinds of launching and return facilities (spaceports as well as spacecrafts)” and those activities which “regulate the operation and control of human conduct in outer space, like all activities concerning the functioning of satellites and other outer space systems (eg ISS)” (at p 239).

52 Neger & Walter, *op cit* (note 50), p 239.

53 In the *North Sea Continental Shelf Cases (Federal Republic of Germany v Denmark; Federal Republic of Germany v Netherlands)*, *Merits*, 1969 ICJ Rep 3 at 230, it was stated by Lachs J that “[t]he first instruments that man sent into outer space traversed the airspace of States and circled above them in outer space, yet the launching States sought no permission, nor did the States protest. This is how the freedom of movement into outer space, and in it, came to be established and recognized as law within a remarkably short period of time.”

See also Freeland, *op cit* (note 9), pp 10–11.

54 See Olavo Bittencourt, *Delimitation of outer space and Earth orbits* (pp 49-60 above).