The Leading Role Australia Could Play in Fostering Uniformity of National Space Legislations among the Asia-Pacific Countries

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Abstract

At the time international air and space law were conceived, the prospective of future activities embracing both regimes was not given much thought. However, today, the arising of hybrid air-space activities has made the lack of uniformity and interaction between air and space law regimes worthy of attention. Future commercial suborbital flight activities will make the choice of which legal regime to follow unclear. Different solutions to this problem have been adopted (or attempted) by some space-faring -but also non-faring- nations, on grounds of divergent political reasons. The lack of a legal definition of those vehicles from which their legal status could be determined and the lack of a defined demarcation line between air and space impede to frame, within a single international legal regime, important aspects of this industry such as safety, liability, traffic management, etc. In the hard prospective of an international solution on this issue, the most probable outcome is that countries which play leading roles in substantial geographical areas could set national regulations to best satisfy the exigencies of the industry within the international legal regimes applicable. For example, the Australian Government had already made clear at the 41st session of the UN COPUOS Legal Subcommittee that the lack of a legal demarcation between air and space had led to uncertainty with respect to which activities are covered by the Australian Space Activities Act of 1998. Therefore, since nothing has moved internationally, in 2002, with the coming into force of its Space Activities Amendment Act, Australia formalized the boundary line at 100km, beyond which the Act is applicable. Although some may complain that, should something happen at an altitude close to the demarcation line, it shall be difficult to establish where exactly the vehicle was at the moment of the event, this step greatly facilitates the certainty of applicable law. Clear regulations are essential to foster the industry. This study aims to highlight the leading role Australia could play in the Asia-Pacific area by serving as a model to foster the development and uniformity of national space legislations of the Asia-Pacific countries. A critical analysis of approaches, theories and the positions some states have

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already adopted on the issue is done with the objective to suggest which steps Australia could further play in the context of different national space legislations in the Asia Pacific area.

1. Introduction

In providing an overview on selected legal issues that, if not properly and quickly addressed, will hinder the development of the commercial suborbital flight industry, especially of human space flights, this paper is divided into five main parts. The first addresses the technical aspects of the commercial suborbital industry; the second focuses on those articles of the space treaties that influence the outcome of national legislation in terms of responsibility, international liability and registration; the third provides an overview of the Australian national space legislation applicable to those flights and on those provisions that should be modified in terms of licensing, insurance, application fee, specific definitions, etc. to foster this industry; the fourth part takes into account one of the most prominent element, essential for the development of those flights, which is totally absent from the current and from the envisaged Australian Act: safety of people on board. This part analyzes the results reached under the US regime, which currently excludes the human factor from these activities, and it further provides a reference within the US system on a possible approach Australia could take in addressing the issue; the fifth and last part addresses the importance of an Australian Space Agency in the development of commercial activities, especially for those new emerging modes of aerospace transportation. The aim of the paper is to foster the discussion on some of those elements that, if properly addressed, could help the growth of the commercial suborbital industry in Australia, and, consequently, could provide the Country a leading role within the Asia-Pacific area.

2. Overview of the Emerging Modes of Commercial Aerospace Transportation

In the attempt to select the main legal issues that are relevant to foster the Australian role in the development of the suborbital flight industry, it is necessary to present an overview of the emerging modes of commercial aerospace transportation and of the scopes for which they are projected to analyze the current applicable law and to understand its flaws, if any.
A sub-orbital flight could be defined as “a flight up to a very high altitude which does not involve sending the vehicle into orbit”:[1] the flight does not

1 Concept of Sub-orbital Flights, ICAO Working Paper, Council – 175 Session, C-WP/12436 (2005). Definition also used by the Committee on the Peaceful Uses of

complete one orbital revolution around the Earth, but, rather, follows a sub-orbital trajectory which could be intended as the "intentional flight path of a launch vehicle, reentry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth."[2] On the contrary, to pursue an orbital flight path, a spacecraft enters a trajectory in which, by maintaining a certain orbital speed, it could remain in space for at least one orbit.[3] Therefore, the difference between suborbital and orbital flights is given by the trajectory, not by altitude.[4] Consequently, aerospace planes, hybrid machines that combine aerodynamic lift with rocket propulsion, could be distinguished into two categories, rocket planes and orbiters.[5] Even though some of the former can reach orbital altitudes, unlike the latter, they cannot keep the necessary speed which allows them to maintain the orbital trajectory.[6] Spacecraft may be diversified also on the base of their re-usability, vertical or horizontal takeoff/landing and number of stages. The first distinction is the one between reusable and expendable launch vehicles known as RLV and ELV respectively. Historically, rockets, since their early appearance in China, around 3000 B.C., have been conceived as warfare instruments, being therefore designed for a single-time use.[7] RLVs are conceived with the primary objective of drastically reducing costs and providing routine access to space. They are the logical and inevitable progression of space technology: in terms of increasing a systematic access to space, it is neither affordable nor feasible-especially to commercial space businesses- to rely on ELVs.[8] As Musk reported: "If one can figure out how to effectively reuse rockets just like airplanes, the cost of access to space

Outer Space Legal Subcommittee Forty-ninth session (doc numb.) A/AC.105/C.2/2010/CRP.9 (date) 19 March 2010 p. 2 at 1.2.

2 United States Code, Title 51 § 50902 (23). [Hereinafter: U.S.C.].

3 Derek Webber, "Point-to-point sub-orbital tourism: Some initial considerations" (2010) 66 Acta Astronautica 1645, 1646 [Hereinafter D. Webber, "Point-to-point"].

4 US Government Accountability Office, "Commercial Space Transportation: Development of the Commercial Space Launch Industry Presents Safety Oversight Challenges for FAA and Raises Issues Affecting Federal Roles" GAO-10-286T (2 December 2009) (Statement of Gerald L. Dillingham, Director of Physical Infrastructure, before the Subcommittee on Aviation, Committee on Transportation, US House of Representatives) online: www.gao.gov/assets/130/123783.pdf at 10, fn. 8.

5 Charles W. Stotler, "Air and Space Law in the Context of Globalization and Fragmentation", McGill University, Institute of Air and Space Law, (2015) Montreal, at 31. [Hereinafter: Stotler, "Air and Space Law"].

6 D. Webber, "Point-to-point" at 1646.

7 Nicholas Mateesco Matte, ed, Space Activities and Emerging International Law, (Montreal: Centre for Research of Air and Space Law, McGill University, 1984) at 13. See also: Stotler, "Air and Space Law", *supra* note 5, at 29.

8 John E. Ward Jr., Reusable Launch Vehicles and Space Operations, Occasional Paper No. 12 Center for Strategy and Technology Air War College, Air University, Maxwell Air Force Base, May 2000, at 2, 4, 5.

will be reduced by as much as a factor of a hundred. A fully reusable vehicle […] is the fundamental breakthrough needed to revolutionize access to space."[9] Commercial enterprises are also developing Vertical Take-off / Vertical Landing, and Horizontal Take-off / Horizontal Landing Vehicles. Examples of the former are Space X's Falcon 9 or Blue Origin's New Glenn Booster and New Shepard. Nevertheless, the commercial developments of machines capable of Vertical take-off and Horizontal Landing is not excluded. Example of this latter mode of operation are orbital spaceplanes such as the Boeing X-37, the NASA Space Shuttle, the 1988 Soviet Buran space shuttle, and the USAF Boeing X-20 Dyna-Soar project. Another category that should be taken into consideration is commercial High Altitude Balloons, an example of which is the WorldView's enterprises capsule developed with Paragon technology, already operative for unmanned missions and "currently taking reservations for manned flights and private tours."[10] The capsule, capable of eight seats, is tethered to a helium balloon which lifts the capsule for about two hours until it hits an altitude of about 40km above the Earth's surface.[11]

A key aspect of space vehicles is whether they have single, double or more stages. A single-stage-to-orbit (or SSTO) vehicle is the ideal machine: it reaches orbit from a body's surface without jettisoning any hardware, only expanding propellants and fluids. SSTO are often conceived as RLV, but they may also be fully or partially expandable.[12] Although they constitute the ideal concept, the most relevant projects aiming at this were those of XCOR and EADS Astrium which, however, had experienced a definitive halt in their development.[13] Those kind of vehicles, in fact, represent for now the ultimate design challenge as "the dual aims of maximizing both mass ratio […] and payload capacity […] directly conflicting with one another: […] by the time

9 SpaceX News, *Reusability: The Key to Making Human Life Multi-Planetary*, JUNE 10, 2015, at www.spacex.com/news/2013/03/31/reusability-key-making-human-life-multi-planetary.

10 Paragon, WorldView at: www.paragonsdc.com/current-projects/.

11 Zephyr, Helium balloon ride to offer drinks in space, at http://askzephyr.com/helium-balloon-ride-offer-drinks-space/.

12 R. Varvill; A. Bond, A Comparison of Propulsion Concepts for SSTO Reusable Launchers, (2003), JBIS, Vol. 56 at 110.

13 XCOR have put on hold the development of its Linx vehicle -which was supposed to bring into space only one "tourist" each launch- and concentrated its resources to develop a liquid hydrogen engine under a contract with United Launch Alliance; see: Jeff Foust, *XCOR lays off employees to focus on engine development*, May 31, 2016 at http://spacenews.com/xcor-lays-off-employees-to-focus-on-engine-development/; Similarly, EADS confirmed that its projected suborbital vehicle capable to take off and landing as an aircraft and of bringing people up to a 100km height had been placed on hold indefinitely, see: Decision taken in 2009. See: March, Rayon. "EADS Astrium puts its "space jet" on hold indefinitely – Hyperbola". Flightglobal.com. Retrieved 2013-03-27.

these vehicles reach the Earth orbit, 90% of the vehicle is completely empty."[14] This is also the reason why, for the near future, intercontinental suborbital commercial flights are difficult to envisage, although a possible solution could be to refuel those vehicles in orbit.[15] Therefore, at the moment, the most common near-future commercial vehicles on which the legislator should focus are two (or more)-stage reusable ones.

Among the commercial suborbital human space flights companies, those closer to the objective of flying people up to 100km seem to be Virgin Galactic[16] and Blue Origin.[17] Virgin relies on a two-stage spaceflight system consisting of two vehicle types: WhiteKnightTwo (WK2), a custom-built, four-engine, dual-fuselage jet aircraft which carries the Virgin defined "spacecraft"-SpaceShipTwo (SS2)- from the take-off up to around 16km, at which point it is released for a supersonic air launch. SS2 is a reusable vehicle powered by a hybrid rocket motor[18] capable of carrying as many as eight people (including two pilots) up to an altitude of 100km. The system SpaceShipTwo uses to re-enter the Earth's atmosphere mimics the performance of a capsule when it fluctuates in a free flight at 100km and, gradually, operates as a winged vehicle through its reentry, gliding until it lands as an aircraft.[19] Blue Origin, headquartered in Kent, Washington, is a company of Jeff Bezos, founder of Amazon, and, like Virgin, uses a two-stage fully reusable vehicle. However, while Virgin adopts an aircraft (WK2) and a hybrid vehicle rocket-aircraft (SS2) which hosts the "tourists", Blue Origin uses an unmanned rocket, the New Glenn Booster (first stage) with a capsule on top, the New Shepard (second stage), which is made to accommodate up to six persons.[20] The capsule does not have independent propulsion and it is brought up by the booster to 100km above the sea level, at which point it is released so that it can fluctuate in a free flight before it re-enters, descending under three independent parachutes.[21]

14 Matthew A. Bentley, Spaceplanes: From Airport to Spaceport, (Rock River, Wyoming: Springer, 2009) at 46 [hereinafter Bentley, "Spaceplanes"]. For a complete overview of the emerging modes of commercial aerospace transportation see: Stotler, "Air and Space Law", *supra* note 5, at Chapter 2.

15 Bentley, "Spaceplanes" at 47.

16 Virgin Galactic, www.virgingalactic.com. See also Irene Klotz, *Virgin Galactic Aims to Fly Space Tourists in 2018, CEO Says*, (April 28, 2017), Space.com at www.space.com/36654-virgin-galactic-fly-space-tourists-2018.html.

17 Blue Origin, https://www.blueorigin.com, Christian Davenport – The Washington Post, *Jeff Bezos shows off Blue Origin's crew capsule that could soon take tourists to space*, (April 6, 2017) at www.latimes.com/business/la-fi-blue-origin-20170406-story.html.

18 i.e. a motor which combines elements of solid rockets and liquid rocket.

19 Virgin Galactic website, Our Vehicles, at www.virgingalactic.com/human-spaceflight/our-vehicles/.

20 Blue Origins website at https://www.blueorigin.com/technology.

21 *Ibid.*

One must also be aware of the difference between aircraft and spacecraft. The Chicago Convention Annex 7 defines an aircraft as "any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface."[22] Airplane wings, in fact, "are shaped to make air move faster over the top of the wing […], the difference in pressure creates a force on the wing that lifts the wing up into the air."[23] The trust that moves the plane through the air may be generated by two types of propulsion systems: propeller or jet. Therefore, aircrafts can operate only in that part of atmosphere where air is available at a quantity and density sufficient to allow thrust and lift. Contrary to aircraft, spacecraft "does not rely on the air, neither for propulsion nor for its flight properties", air density being an obstacle to overcome.[24] Rockets work better in a vacuum, and they store with them the oxidizer needed to aliment the fuel combustion: the escape of hot gasses through the nozzle creates lift from Earth and propulsion in space.[25]

3. Space Treaties' Relevant Norms of Responsibility, International Liability and Registration

Australia, as party to the five space treaties, is bound to comply to their norms. Articles VI, VII and VIII of the Outer Space Treaty[26] respectively bind Australia under a regime of responsibility, international liability and registration, the latter two frameworks being further detailed in the Liability[27] and the Registration[28] Conventions. Art. VI OST provides *international responsibility* of States Parties for their national activities, whether they are carried out by governmental agencies, private entities or international organizations of which the state is party and for assuring they are carried out in conformity to the treaty. Further, the article obliges the *appropriate State Party* to authorize (license) and continuously supervise that

22 Convention on International Civil Aviation, 7 December 1944, 15 UNTS 295, ICAO Doc. 7300, Annex 7 – Aircraft Nationality and Registration Marks.

23 National Aeronautics and Space Administration NASA [Hereinafter NASA] at https://www.grc.nasa.gov/www/k-12/UEET/StudentSite/dynamicsofflight.html.

24 Marietto Benkö and Engelbert Plescher, Essentials in air and space law: reconsidering the definition/delimitation question and the passage of spacecraft through foreign airspace, (The Hague: Eleven International Publishing, 2013) at 8.

25 NASA, Rocket Propulsion, at https://www.grc.nasa.gov/www/k-12/airplane/rocket.html.

26 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205 [Hereinafter OST].

27 *Convention on International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187 [Hereinafter LC].

28 *Convention on Registration of Objects Launched into Outer Space*, 14 January 1975, 1023 UNTS 15 [Hereinafter RC].

such activities are carried out in conformity to the treaty. According to Bing Cheng, art. VI "[international] responsibility means essentially answerability, answerability for one's acts and omissions, […] for compliance with [its] legal duties, and for any breaches thereof."[29] Therefore, international responsibility of art. VI must be intended as including both liability and responsibility of the States Parties under general international law, except when differently specified under international space law. To Manfred Lachs, art. VI "is intended to ensure that any outer space activity, no matter by whom conducted, shall be carried on in accordance with the relevant rules of international law, and to bring the consequences of such activity within its ambit. […] The acceptance of this principle removes all doubts concerning imputability."[30] Therefore art. VI removes the typical international law concept "that the responsibility only arises when the act or omission complained of is *imputable* to a State"[31] requiring, for the attribution of responsibility or liability, only *a genuine link* to be found in the rules of international law related to the exercise of jurisdiction between the state and the subject who is carrying out the activity.[32] There is no definition of appropriate state in the Treaty, and many authors have provided different interpretations of it according to international law principles.[33] Dempsey raised the question of whether there may be one *most appropriate state* or if there can be many appropriate states, in fact, more states can be involved in a space activity and all could be deemed "appropriate." Further, considering the international responsibility of states for their national activities in space and the launching states' liability for damage caused by their space objects, "it is doubtful whether States would agree to allow only one State to be in charge of supervision and authorization, while they themselves continue to be responsible and liable under the space treaties. Thus, all States involved in a space activity, including the launching State(s), would be "appropriate"

29 Bin Cheng, "Article VI of the 1967 Space Treaty Revisited: 'International Responsibility', 'National Activities', and 'The Appropriate State'", 1998 26:1 Journal of Space Law, p. 7 at 9.

30 M. Lachs, The Law of Outer Space:An Experience in Contemporary Law-Making, 1972, at p. 122.

31 I. Brownlie, *Principles of Public International Law*, 7th Edition, (Oxford University Press, 2008) p. 436.

32 Nottebohm Case, *Liechtenstein v. Guatemala*, ICJ Report 1955, P. 23. See also: The Barcelona Traction Case, *Belgium v. Spain*, ICJ Reports 1970, § § 85, 88.

33 See for example: Ricky J. Lee, Liability Arising from Article VI of the Outer Space Treaty: States, Domestic Law and Private Operators, in Proceedings of the Forty-Eighth Colloquium on the Law of Outer Space 216 (2005). See also Stephen Gorove, Liability in Space Law: An Overview, 8 ANNALS AIR & SPACE L. 373, 377 (1983); Bin Cheng, Article VI of the 1967 Space Treaty Revisited: "International Responsibility", "National Activities", and "The Appropriate State", 26 J. SPACE L. 7, 28–29 (1998).

States."[34] N.M. Matte asserted that art. VI reflects a compromise between the Americans and the Soviets on the participation of private entities, without which agreement the latter would not have agreed.[35] This is further evidenced by Howard who, in citing Blasingame, asserts that only some aspects of the OST are self-executing while others -*i.e.* when it applies to private activities ex. art. VI- necessarily require "a Congressional obligation in enacting legislation that assumes [State] responsibility."[36]
Art. VII OST categorizes four types of launching states -that *launches* or *procures the launching* or *from whose territory* or *facility* an object is launched- and establishes an international liability regime applicable to them. Launch sites or spaceports fall within the term "facility" and in most cases also "territory".[37] In case more launching states are involved in a launch, it is not always an easy task to identify all of them, especially in the case of private entities with multinational links. The confusion on the launching state determination has led to the UNGA Res. A/RES/59/115 on the Application of the concept of the "Launching State,"[38] which, however, has not provided much guidance besides reminding the importance of implementing national laws and of the agreement of joint launches under the Liability Convention. Therefore, in cases where there is uncertainty on the appropriate state identification, the relevant elements such as *territory*, *effective control*, *nationality*, *genuine link*, etc. must be determined in accordance to the international law principles.[39] The same four states are identified in art. I of the Liability Convention, which further provides important definitions although their meaning is very uncertain. *Damage* is defined as loss of life or personal injury or any impairment to health or loss of or damage to property, which from the reading of art. XII[40] should arguably include psychological as

34 P S Dempsey, "National Laws Governing Commercial Space Activities: Legislation, Regulation, & Enforcement", Northwestern Journal of International Law & Busines, Volume 36, Issue 1, Winter 2016 at 7.
35 N.M Matte, *Aerospace Law: Telecommunications Satellites* (Toronto and Vancouver, Butterworths, 1982) at 309.
36 Diane Horward, *The Emergence of an Effective National and International Spaceport Regime of Law* (Montreal: Institute of Air and Space Law, 2014) at 24. [Hereinafter: Howard, The Emergence].
37 OST Art. VII: "Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies."
38 United Nations General Assembly Resolution on the Application of the concept of the "launching State" (A/RES/59/115 of 25 January 2005).
39 Nottebohm case, *Liechtenstein v. Guatemala*, ICJ Report 1955, P. 23. See also: The Barcelona Traction Case, *Belgium v. Spain*, ICJ Reports 1970, § § 85, 88.
40 LC art. XII.

well as indirect damages; *Launching* includes attempted launch; and *Space Object* "includes components part of a space object as well as its launch vehicle and parts thereof."[41] Art. II and III of the Liability Convention provide two types of liability for the launching state, respectively, absolute for damages on the surface of the Earth or to aircraft in flight, and fault elsewhere than on the surface of the Earth to another launching state's object or people and property onboard. Especially because of the first tier, states have a vivid interest in regulating and monitoring space activities and to put in place insurance and financial capability requirements.

Art. VIII OST provides a principle of functional sovereignty by establishing jurisdiction and control over the space object on whose state party's registry the object is carried.[42] The Registration Convention, following art. VIII OST, further specifies the establishment of national registries for objects launched into Earth orbit or beyond, and creates an international register to complement the one previously established by the UN General Assembly Resolution 1721 (XVI).[43] Therefore, a launching state is under the obligation to register the space object launched into space in its national registry[44] and send the object's information to the UN Secretary General in order to allow the registration in the UN register.[45] In this sense, spaceports could facilitate registration by forwarding to the state the list of the occurred launches.[46] However, the RC doesn't specify whether a RLV shall be re-registered every time it is launched. This could create unnecessary duties on registration procedures.

4. Australian Regulatory Regime: What Should Be Addressed and Why

In December 1998, the Australian Parliament passed the Space Activity Act 1998, which is the country's first regulatory framework that specifically applies to national space activities. The Bill's explanatory memorandum describes the principal purpose of the legislation as transporting in Australian law the UN space treaties' obligations and as providing a predictable regulatory framework for the Australian's space launch facilities development and operation. The above-mentioned articles are important because they essentially permeate and heavily influence the Act's main structure. In fact, the main three parts of the Act -parts 3, 4 and 5- respectively represent the transposition of the obligations (and the measures to face with their

41 LC art. I(d).
42 OST art. VIII.
43 General Assembly Resolution on the "International co-operation in the peaceful uses of outer space" 1721 B (XVI).
44 RC, *supra* note 69, Art. II 1.
45 RC, *supra* note 69, Art. IV 1; Art. III.
46 Howard, *The Emergence*, at 28.

consequences) of art. VI, VII and VIII of the OST and of the related Liability and Registration Conventions' articles. The Act implicitly establishes that a space activity is 'national' based on territoriality and/or nationality. In fact, private space activities carried out in Australia, or by an Australian national from outside Australia would require an appropriate license or exemption certificate.[47] Part 3 of the Act establishes licences, permits, approvals and authorizations of private space activities -each relating to a specific launch-related activity- that could be grouped as following: a *space license*, "covering a particular launch facility in Australia, a particular kind of launch vehicle and a particular flight path",[48] to operate a launch facility or to do anything connected with its operation;[49] a *launch permit* to launch 'a particular space object' or 'a particular series of launches of space objects."[50] The *permit* may also authorize "particular space objects to be returned, in connection with the launch or launches, to a specified place or area in Australia;"[51] an *overseas launch certificate* for Australian national to launch 'a space object […] from a launch facility located outside Australia;"[52] an *authorization of return* for the return in Australia of a space object that was not launched from Australia;[53] an *exemption certificate* to specific space activities, to be issued under the circumstances provided in the Regulations.[54]

The Act does not address suborbital flights, neither is there any reference to human space flights, however, it can be applied to commercial suborbital launches or to spaceports as launch facilities. Nevertheless, to accommodate commercial suborbital space activities, especially human spaceflights, the licensing regulations should specifically address the intent and scope of commercial suborbital flights in contrast to other types of launches (such as satellite launches) and especially the human component involved in these activities should be considered together with the fact that not all suborbital activities will cross the 100km height. For these purposes, many definitions of the Act should be modified. The Act, in fact, defines *launch* as to "launch the object into an area beyond the distance of 100km above mean sea level, or an attempt to do so." *Return* "means return of a space object from an area beyond the 100km […] or attempted to do so." Similarly, a *launch vehicle* is defined as "a vehicle that can carry a payload into or back from an area beyond the distance of 100km above mean sea level."

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47 Space Activities Act 1998, Part 3, Division 1.
48 Space Activities Act 1998, section 18.
49 Space Activities Act 1998, section 15.
50 Space Activities Act 1998, sections 11 and 26(1).
51 Space Activities Act 1998, section 26(2).
52 Space Activities Act 1998, section 12(a).
53 Space Activities Act 1998, sections 14(a) and 14(b).
54 Space Activities Act 1998, section 46. Space Regulations 2001, 6.01.

Greater complications, however, come from the application of the current Act's definitions of *space object* and *payload*. *Space object* is defined as "a thing consisting of (*a*) a launch vehicle; and (*b*) a payload (if any) that the launch vehicle is to carry into or back from an area beyond the distance of 100km above mean sea level; or any part of such a thing, even if: (*c*) the part is to go only some of the way towards or back from an area beyond the distance of 100km above mean sea level; or (*d*) the part results from the separation of a payload or payloads from a launch vehicle after a launch."[55] *Payload* is defined as "a load to be carried for testing purposes or otherwise on a non-profit basis."[56] The term payload excludes the human passenger and the for-profit factors, therefore, if an RLV aimed at carrying human aboard to a height beyond 100km falls within the definition of a launch vehicle, once it detaches either from the aircraft or the rocket plane, it will fall under a definition of payload. Further, even supposing that the RLV is a single stage vehicle, which would solely fall under the definition of launch vehicle, the human factor is still completely missing from the licensing requirements. As Langston pointed out, "the definitions of "launch vehicle" and "space object" are inextricably intertwined with the term "payload," and the latter subsequently excludes human passengers for profit, these definitions must be revisited for purposes of governing commercial suborbital space activities."[57]

The above terms should be revisited considering also that the Airspace Regulations 2007 apply up to a height of 18km[58] and therefore, there is a need to render the space regulatory regime specifically applicable also to the suborbital commercial activities conducted between the upper regulatory limit of the Airspace Regulations 2007 and the lower regulatory limit of the Act. In this sense, the new envisaged Australian Space Act could, perhaps, define commercial (human) suborbital activities on the base of their *scope and trajectory* and therefore introduce a *functional definition* of spacecraft and its components that considers their nature and the fact that they serve space-related purposes while mostly functioning in airspace. This would allow the application of the space law regime to those new activities that happen within this range.[59] Such functionalist approach based upon the classification of the vessel and its purposes does not signify a recognition of the limit of airspace being at 18 km but, rather, that any vehicle intended to operate above this altitude which does functionally and mainly respect the

55 Space Activities Act 1998, Part 2 Definitions, Section 8.
56 *Ibid.*
57 Sara M. Langston, Suborbital Flights: A Comparative Analysis of National and International Law, 37 J. Space L. 299, 392 (2011) at 349.
58 Australian Airspace Regulation 2007 part 2, 5(b).
59 Questions on suborbital flights for scientific missions and/or for human transportation, UN A/AC.105/1039/Add.6 at 7.

definition of spacecraft is considered as such.[60] For example, in the US,[61] World View Enterprises plans are to undertake commercial "space flights" utilizing a balloon that only ascends to around 30km.[62] Nevertheless, for the purposes of safety and regulation of their human-rated module, the FAA is regulating this vehicle as a spacecraft because of its design specifications and despite its low maximum altitude. Similarly, the Blue Origin's New Sheppard system is considered a spacecraft. The system consists of a pressurized capsule atop a booster which, at approximately 93km, separates from the capsule and returns to Earth. The capsule, after being propelled into low Earth orbit, re-enters the Earth's atmosphere and lands assisted by parachutes.[63] This functional approach could coexist with the current Australian delimitation of airspace at 100km of altitude and it will provide a uniform legal regime that will specifically apply to the complete launch and return journey of private suborbital flight activities. This could also simplify the regulations of "hybrid" circumstances where a space vehicle is launched from an aircraft in air space by allowing the application of air law to the "combined" vehicle (aircraft + spacecraft) and then applying space law to the spacecraft from the moment it detaches for launch until it returns to Earth. Perhaps the new Australian Act should insert in a subordinate instrument the definitions and specifications of high-altitude, high-altitude vehicle and high-altitude payload other than a high-altitude license. An example of those definitions and licensing regime could be found in the New Zealand's *Outer Space and High-altitude Activities Act 2017*.[64]

The Act's definition of *launch facility* can be extended to commercial suborbital space activities since it adequately describes the indented use and legal scope of the facilities. However, it should be modified to encompass new kinds of facilities such as sea platforms. Further, in the Act there is a 'nexus' which requires that only the launch-facility license holders can obtain a launch permit[65] and while extensive requirements -some more related to the launch than the facility itself- are established for an Australian facility, much less requirements are provided for a launch conducted from it. For the new suborbital flight industry, it would be more appropriate to break this nexus

60 See for example: US CFR 14, 71.33 (a) and FAA Order 7400.11A.

61 According to FAA, "whatever operates above the controlled airspace (18.3km, or "FL600" in aviation language) is considered spacecraft", nevertheless the Administration underlines in its documents that this does not mean that the airspace is at 18.3km. See: Questions on suborbital flights for scientific missions and/or for human transportation, UN A/AC.105/1039/Add.6 at 7.

62 Questions on suborbital flights for scientific missions and/or for human transportation, UN A/AC.105/1039/Add.6 at 7.

63 *Ibid.*

64 New Zealand's Outer Space and High-altitude Activities Act 2017, Part 1, at 4 and Part 2 Subpart 6.

65 Space Activity Act 1998 sections 26(3)(a) and 27.

and to delete the unnecessary requirements from the launch facility license. In this way, both private spaceport and launch operators that are not the same person will be facilitated in meeting the proper requirements. A launch permit should be considered for launches from Australian vehicles in flight, nevertheless, the object released from the vehicles in flight or from Australian airspace would be covered by the payload license, as envisaged above. A launch permit should further be utilized for return to Australia of an Australian launched space object, also in this sense, the regime should be modified because the current definition of space object includes a launch vehicle. However, a payload may return without the launch vehicle.

The issuance of the above authorizations types essentially relies on certain *common* criteria that may be non-exhaustively classified as following:

a) Competence of the applicant, or of its personnel, to operate the launch facility and/or the launch vehicle.
b) Economic: *i.e.* sufficient funding to construct and operate a launch facility, or sufficient insurance/financial requirements for the specified launch(es) and/or re-entry(ies).
c) Safety protection: intended as the low probability of “causing substantial harm to public health or public safety or causing substantial damage to property.”[66]
d) National security and compliance with foreign policies and international obligations.[67]
e) Environmental concerns, which require a plan for monitoring and mitigating environmental hazards.[68]

The licensing regime further developed in the Space Activities Regulations 2001 is administrated by the Space Licensing and Safety Office (SLASO) which, under the responsibility of the DIIS, has the role of assisting the development of Australian space activities through the Act’s administration.[69] The role of SLASO is to ensure that national space activities: a) do not jeopardize safety and property of the public, the environment and Australia’s national security, foreign policy, or international obligations; b) are covered by an adequate third-party insurance or other appropriate financial capacity; and c) that any accidents are investigated.

One of the main aspects which has been the subject of intense international debates among industry, academia and institutions in the past few years -and which is lacking in the Act’s authorization regime- is the *safety* of the space

66 For example, see Space Activities Act 1998, Section 18(d); 26(e).
67 For example, see Space Activities Act 1998, Section 18(e); 26(g).
68 For example, see Space Activities Act 1998, Section 18(b).
69 Steven Freeland, Analysis Report, Public Submissions into the Australian Government’s Review of the Space Activities Act 1998, August 2016, at 20.

flight participants. The Regulations, in fact, refer to the Flight Safety Code's requirements to demonstrate the safety of the proposed activities and whoever seeks approval to conduct space launch activities in Australia must comply with it.[70] The Code sets out mandatory safety standards that should, however, be met only in respect of the risks to third parties arising from space launches and it further sets the methodology to be followed to calculate such risks.[71] The Code differentiates between *third party casualty safety standards* aimed at ensuring a low risk to public health, safety and community facilities and *asset safety standards,* of which objective is to identify and ensure the lower potentiality of risk to designated assets.[72] It further provides that the proponent prepares a *safety case,* in respect of the proposed site, launch vehicle and flight paths, to be presented to the SLASO which assesses applications for licenses and permits, and provides recommendations on their granting.[73] The case should *inter alia* "draw on all material provided with an application for a space license, particularly the *Program Management Plans*, completion of the *Risk Hazard Analysis* and demonstrated capacity to meet the *Launch Safety Standards*."[74] For the identification, analysis and control of hazards posed to the public safety and property by the space object's flight, the Code refers to a U.S. Department of Transport's (outdated) document of May 1988, the *Hazard Analysis of Commercial Space Transportation*, OCST-RD-RES01-88, Volume II, which puts in place very complex procedures.[75] The Code further provides that, with except to suborbital human space flights, a flight safety system at least a single fault tolerant and capable of terminating the flight shall be installed in all the licensed vehicles.[76]

The outcome of the online Australian governmental survey, aimed at receiving the space players' opinions regarding the Act, has significantly labelled the above application processes as unnecessarily complex and onerous in terms of time and financial resources. Of great interest are the comments of the Space Industry Association of Australia (SIAA) which has recommended a complete review of the Flight Safety Code -which, *inter alia*, "places limitations on Australian launches that are unique among world launch jurisdictions"- to remove its unnecessary burdens and to consider the technology advancements that have occurred since this Code was originally

70 Commonwealth of Australia, Space Licensing and Safety Office, Flight Safety Code 2nd Edition, 1 July 2002 [Hereinafter: Flight Safety Code] at 1.1.3.
71 Flight Safety Code at 1.1.4.
72 Flight Safety Code at 1.1.4.
73 Flight Safety Code at 1.2.1, 1.2.3, 1.3.1, 1.3.2.
74 Flight Safety Code 1.2.3.
75 Flight Safety Code 1.5.2 see also Executive Summary of the "Hazard Analysis of Commercial Space Transportation, 10/2/95 rev, vol. II at https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/hazard.pdf.
76 Flight Safety Code 1.7.1, 1.7.2, 1.7.3.

developed.[77] The SIAA has further pointed out that because "the Australian Government is not in the practice of assessing the technical data supplied under the Flight Safety Code, [it] relies on external consultants to perform this task." This leads to a paradoxical situation where, on one side, launch proponents must acquire, develop or contract expertise to perform the required Flight Safety Code analysis, and, on the other, the Australian Government must seek and contract expertise to assess the submissions. Most of this expertise, on both sides, is sought in the US. However, the US International Traffic in Arms Regulations' (ITAR) restrictions have made extremely burdensome for SIAA members to engage US expertise to conduct the necessary analysis.[78] SIAA further submits that although suborbital flights might receive some regulations currently imposed on orbital launches, in most cases the characteristics of such flights are different and less critical compared to those of orbital flights and, therefore, the Act -by applying a single set of orbital requirements- exponentially increases the burden for this emerging industry. This further evidences the need of a diversified regime for these activities.[79] The compliance with the above procedures and requirements is resources and time-consuming and does not justify the elevated fees that the Act imposes. Fees should be reduced, perhaps to a fee based on costs-recovery, to relieve the industry of further unjustified expenses. For a space license, in fact, the fee is of A$ 300.000 plus an annual review fee of A$ 190.000,[80] further, an A$ 40.000 of application fee is provided for a single-launch Launch Permit or for the first launch of a Launch Permit for a series of launches, with a fee of A$ 10,000.00 for every subsequent launch in the series.[81] An A$ 10.000 application fee is provided for the return authorization[82] as well as for an oversee launch certificate.[83]

Part 4 of the Act provides a two-type liability regime on the part of the launch operator -absolute[84] or fault-[85]in circumstances that mirror Articles II and III of the Liability Convention, the regime is applicable where Australia falls under the definition of launching State. The permittee is required to possess insurance coverage or a proof of assets sufficient to cover the liability arising from possible damages to third party and/or to the Australian government during the

77 Space Industry Association of Australia – SIAA, Comments on Legislative Proposals Paper for Reform of the Space Activities Act, 24 April 2017, at p. 7, 8.
78 *Ibid.*, at 8.
79 *Ibid.*, at 9.
80 Space License fee: Space Activities Regulations 2001, at 9.04(1); Annual Review fee: Space Activities Act 1998 Section 59(3A); Space Activities Regulations 2001, at 9.05(1).
81 Space Activities Act 1998, Section 59; and Space Activities Regulations 2001, at 9.02.
82 Space Activities Regulations 2001, at 9.03 (1)(a).
83 Space Activities Regulations 2001, at 9.02 (1)(a).
84 Space Activities Act 1998, Section 67.
85 Space Activities Act 1998, Section 68.

launch operation. The amount, premising that the permit or certificate holder was authorized and didn't breach any conditions, is either 750 million AUD or maximum probable loss (MPL) determined according to 7.02 – Regulations. Beyond this amount and up to 3billion AUD, the Commonwealth is liable to pay.[86] Clearly, to foster commercial space activities, the insurance coverage could be aligned to the average of most European countries, which is around €60 million.[87] Further, to provide certainty, it appears necessary to delete the MPL coverage parameter. It is worth noting that the Act limits itself to repeat the uncertain -but key- definitions (such as *compensation, damage, fault, gross negligence, launching State*) of the Liability Convention without specifying further their meaning, thus creating gross uncertainty to the industry on the range of its possible liability exposure. It is preferable, therefore, if the new Act revisits those definitions.

Part 5 of the Act requires the Minister to maintain a national Register of Space Objects in which the following information must be included: Space object's registration number, launch facility, date of launch, object's orbital parameters and general functions, and name of the launching state.[88] Nevertheless, there is no provision for the relevant information to be sent to the Secretary-General of the United Nations in accordance with Article IV of the Registration Convention.

Part 7 provides that in the event of an accident or incident, the space permit is automatically suspended and the space object remains in the custody of the Minister until the appointment of an investigator who shall provide a written report. The launch operator must bear all costs associated with any investigation of accidents or incidents involving the launch operator during the "liability period", thirty days from the day of launch, up to a limit of A$ 3,000,000.00. One must be aware that this potential liability is not considered in the MPL calculations.[89] It is preferable that the new Space Act will provide that the cost of accidents investigation is entirely borne by the Government since the entire industry could apprehend from and benefit of lessons-learned of any accident.

5. Safety: The Engine of the Industry. An Overview of the US Regulatory Approach to Commercial Suborbital Activities

Since the Australian Space Act promulgation, the global space industry has continued to move from an almost total reliance on public funds to increased

86 Space Activities Act 1998, Sections 48 and 69.
87 Steven Freeland, Analysis Report, Public Submissions into the Australian Government's Review of the Space Activities Act 1998, August 2016, at pages from 69 to 73.
88 Space Activities Act 1998, Sections 76, 77.
89 Space Activities Regulations 2001, at 3.02B(1)(a) and 3.02C(1)(a).

participation of private investors.[90] The involvement of private entities, today, represents a *sine qua non* in the exploration and use of outer space, and the Act appears unsuitable for the development of commercial suborbital activities, especially for human suborbital flights. One must be aware that safety is the industry driver. An unsafe design may result in a major disaster capable of jeopardizing the future of an entire commercial space sector.[91] In this sense, the US regime is a tremendously-significant learning parameter on the *validity* and *impact* of excluding the human factor (of those onboard) from the licensing requirements to lighten the regulatory burden on this emerging industry.

The first private manned spaceflight is attributable to Mike Melvill who, on June 21, 2004, flew SpaceShipOne through a suborbital trajectory which led the machine to reach an altitude of 100km above Earth's surface.[92] Although for these flights it was initially considered to extend the existing FAA FAR-21 experimental regulation, the US government opted for a more general approach based on a simplified process with the scope of fostering the industry development without imposing burdensome regulations.[93] The result has been the introduction of a regulatory "learning period", first established under the 2004 through the CSLAA, under which the FAA could not implement regulations regarding spacecraft design or operation. This safety moratorium, extended by the 2015 U.S. CLCA until the 2023 FY, excludes certification -therefore, there is no safety consideration for humans on board- and relies on the participants' "informed consent" and on FAA licensing of launches.[94] A FAA/AST launch license focuses on public health and safety, safety of property, national security interests, and foreign policy interests of the United States, and is required to launch from the US or for American persons launching from abroad.[95] It must be noted that, in the case of air-launches such as those of Virgin Galactic, the FAA/AST would license the

90 Steven Freeland, Analysis Report, Public Submissions into the Australian Government's Review of the Space Activities Act 1998, August 2016, at 24.

91 Tommaso Sgobba et al., Space Safety and Human Performance 1st Edition, International Association for the Advancement of Space Safety – IAASS, September 15th, 2017, Chapter 8, at 8.5.3.2 Safety Institutes.

92 Tim Sharp, *SpaceShipOne: The First Private Spacecraft | The Most Amazing Flying Machines Ever*, Space.com at www.space.com/16769-spaceshipone-first-private-spacecraft.html.

93 Jürgen Cloppenburg, Legal Aspects of Space Tourism, in Space Law – Current Problems and Perspectives for Future Regulation 193 (Marietta Benkö & Kai-Uwe Schrögl eds., 2005) at 211.

94 Federal Aviation Administration Oversight of Commercial Space Transportation, Hearing Before the Subcommittee on Aviation of the Committee on Transportation and Infrastructure, House of Representatives, One Hundred Fourteenth Congress, Second Session, Washington, DC, June 22, 2016, at 2, 3.

95 51 U.S.C. § 50904.

suborbital-craft (SpaceShipTwo) as a launch vehicle, while its mothership (WhiteKnightTwo) would operate under an aircraft certificate. The Act further introduces an alternative authorization, the "experimental permit", issued "only for reusable suborbital rockets or reusable launch vehicles that will be launched into a suborbital trajectory or reentered" for the exclusive purposes of research and development, testing design concepts, equipment, or operating techniques, showing compliance with license requirements, or crew training.[96] The permit, if "consistent with the protection of the public health and safety, safety of property, and national security and foreign policy interests of the United States" is issued within 120 days and with fewer requirements than the FAA/AST license.[97] Contrary to the FAA/AST license, the permit doesn't allow to carry property or humans for compensation or hire[98] and, once the particular design for which the experimental permit has been requested is licensed, the permit ceases to exist.[99] But how should this "learning period" be intended? As a total freedom to design and operating from scratch? Could 50 years of government experience in space be ignored? One author commented that "Safety requirements, organizational models and lessons learned from government programs need to be adapted to new realities or there will be the risk of going back to the beginning of the learning curve […] and accidents during flight testing, attributed to single-human error, seem to point to such direction".[100] Therefore, how has the industry effectively benefitted of this "learning period"? It is true that "a threat to any nascent industry is overregulation that might stifle innovation and cut off potential solutions to difficult technical problems",[101] but is the choice of not regulating safety beyond protection of that of the public and its properties the right path? Nancy Leveson sustains that safety can be designed into a spacecraft from its early concept and study stages and that building in safety is more efficient than adding protective features to a completed design. Leveson, in fact, identifies that "70 to 90 percent of the design decisions that affect safety are made in concept development, requirements definition, and architectural design [and that] the degree to which it is economically feasible to eliminate or minimize a hazard rather than to control it depends on the stage in system development at which the hazard is identified and

96 51 U.S.C. § 50906 (d).
97 51 U.S.C. § 50906 (a).
98 51 U.S.C. § 50906 (h).
99 51 U.S.C. § 50906 (g).
100 Tommaso Sgobba et al., Space Safety and Human Performance 1st Edition, International Association for the Advancement of Space Safety – IAASS, September 15th, 2017, Chapter 8, at Introduction.
101 Federal Aviation Administration Oversight of Commercial Space Transportation, Hearing Before the Subcommittee on Aviation of the Committee on Transportation and Infrastructure, House of Representatives, One Hundred Fourteenth Congress, Second Session, Washington, DC, June 22, 2016, at 10.

considered." Leveson emphasizes how system safety allows for the early identification of hazards so that action can be taken in time towards their elimination or minimization in early design decisions. Therefore, the early integration of safety measures into the development process allows maximum safety with minimum negative impact. On the contrary, it is usually "more expensive and less effective to design first, identify the hazards, and then add on protective equipment to control the hazards when they occur".[102]

On October 31, 2014, the Scaled Composites LLC's SpaceShipTwo (SS2), operating under an FAA/AST's experimental permit under CFR 14 Part 437, broke into pieces during a test flight. The NTSB's investigation revealed that the co-pilot was supposed to unlock the feather at 1.4 Mach, however, he did so at 0.8 Mach, causing the destruction of the vehicle.[103] The Board found that behind this human error, important safety deficiencies are attributable to both Scaled and the FAA/AST's system:

- Lack of human factors guidance for commercial space operators without which Scaled could not identify, in the design, operation, hazard analysis and training, that a catastrophic impact could derive from a human error.
- Lack of efficacy of the FAA/AST's pre-application consultation process: since individual operators can decide when to initiate the application, SS2 was already designed and built prior to submission of the application, making any safety change highly costly and with very scarce result –if at all.
- Limited interactions between the FAA/AST and Scaled during the permit evaluation: the FAA/AST questions that did not specifically concern public safety were filtered by its management to reduce the burden on Scaled.
- FAA/AST's incapacity to recognize SS2's hazards and/or to ensure their effective mitigation. The FAA/AST analysis, in fact, did not identify the catastrophic potential of a single human error. Further, after the issue identification, the FAA/AST issued two waivers without ensuring that Scaled put in place the mitigation cited in the waivers or without effectively assessing them.
- The FAA/AST inspectors tasked with ensuring the compliance with federal regulations had limited or no familiarity with commercial space

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102 Nancy Leveson Aeronautics and Astronautics Dept., Massachusetts Institute of Technology in Tommaso Sgobba et al., *Space Safety and Human Performance*, 1st Ed, International Association for the Advancement of Space Safety – IAASS, September 15th, 2017, Chapter 8, at 8.1.2 "Key principles of System Safety".

103 In-Flight Breakup During Test Flight Scaled Composites SpaceShipTwo, N339SS Near Koehn Dry Lake, California October 31, 2014, at https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1502.pdf [Hereinafter: NTSB SS2 Report].

operators since they were assigned to individual launch operations rather than to specific operators.

- The FAA/AST's failure to complete the 2010 Commercial Space Transportation Lessons Learned System, a database that should have been capable of documenting mishaps, findings and corrective actions and of disseminating the lessons-learned.
- Deficiencies of the emergency response planning. The day of the test, the helicopter tasked with responding to a potential SS2 accident was not prepositioned and another helicopter with advanced life support capabilities was not placed on standby. This resulted in unjustifiable delay in reaching the injured pilot.[104]

Scaled performed a comprehensive systems safety analysis (SSA) for SS2 to comply with the requirements of 14 CFR 437.29 which provides that an experimental permit applicant must conduct a risk analysis according to 437.55 (a) and provide the results to the FAA. Nevertheless, 14 CFR 437.55 (a) obliges the permittee to identify and assess only those hazards which could provide risk to public health and safety and the safety of property resulting from each permitted flight. Similarly, the procedure outlined in the FAA/AST Advisory Circular (AC) 437.55-1 of April 2007, which Scaled further followed in its SSA, provides guidance for the analysis of public safety hazard only. The SSA also included a functional hazard assessment (FHA) and a fault tree analysis (FTA) in accordance to-the now cancelled- AC 23.1309-1D. This latter circular provided guidance to comply with the requirements of 14 CFR 23.1309 (a) and (b) for equipment, systems, and installations in 14 CFR part 23 *airplanes*.[105]
The dividing line between the assessment of risks to the public and those related to a mission's objectives is not always clear and certain aspects of a vehicle's design and operation could impact both public safety and mission safety assurance. The NTSB found, in fact, that the correct application of the above circulars, although respectively directed to protect the safety of the public and to verify the correct installation of system and equipment of an aircraft, would have provided means for Scaled to avoid that a single human error could cause a catastrophe. Nevertheless, the NTSB concluded that, on one side, the Scaled inability to apply the circulars and, on the other side, the lack of direct communication between FAA/AST's and Scaled's technical staff, the 120-days time constraint to approve experimental permit, and the lack of a defined line between public safety and mission safety, rendered the FAA unable to properly evaluate the permit applications.[106]

104 NTSB SS2 Report at pages from vii to ix.
105 NTSB SS2 Report at 1.4 Organizational and SpaceShipTwo Program Information.
106 NTSB SS2 Report at 2. Conclusions.

Clearly the US regulatory approach to commercial suborbital human spaceflights presents substantial lacunae that need to be addressed the soonest possible. Nevertheless, concrete references on how to properly guide the design and construction of those vehicles without imposing tremendous burdens may come from the NASA Commercial Crew Program (CCP).[107] The US legal moratorium on safety regulations for humans on board commercial space vehicles, in fact, does not apply in the case operators provide commercial transportation services to the International Space Station. Although the NASA CCP requires the involved commercial operators to obtain a NASA safety certificate for the safety of those on board, it allows them to freely design the space system they believe best fits their economic scope, and to use the manufacturing and business plans they prefer. Such freedom is, however, mitigated by the companies' obligation to meet or exceed a pre-determined set of NASA technical and safety requirements and to implement the safety policy of the ESMDCCTSCR-12.10 document named "*Commercial Crew Transportation System Certification Requirements for NASA Low Earth Orbit Missions*".[108] The document processes are built upon NASA's vast knowledge and experience in human spaceflight and it is aimed "to define the requirements, standards, and certification package contents that will be used to certify a CCTS to carry NASA crewmembers on Low Earth Orbit (LEO) Missions."[109] NASA, in fact, should -under the Procedural Requirement (NPR) 8715.3C, NASA General Safety Program Requirements, paragraph 1.14-analyze the risk and decide on safety when NASA personnel rely on non-NASA designs or operations.[110] Per this policy, NASA bases CCTS certification on NPR 8705.2, *Human Rating Requirements for Space Systems*, a certification that will solely apply to NASA missions.[111] Therefore, NASA, in the CCP during the safety review, will isolate the dangerous issues and provide recommendations without however imposing the suggested operational or design solutions. Nevertheless, because NASA Technical

107 NASA, Commercial Crew Program – CCP, at https://www.nasa.gov/exploration/commercial/crew/index.html.

108 Tommaso Sgobba et al., Space Safety and Human Performance 1st Edition, International Association for the Advancement of Space Safety – IAASS, September 15th, 2017, Chapter 8, at 8.5.2.1 Experience in United States. See also NASA Commercial Crew Transportation System Certification Requirements for NASA Low Earth Orbit Missions ESMD-CCTSCR-12.10 Revision-Basic at 6, 7.

109 NASA Commercial Crew Transportation System Certification Requirements for NASA Low Earth Orbit Missions ESMD-CCTSCR-12.10 Revision-Basic at 4.

110 NASA Procedural Requirement (NPR) 8715.3C, NASA General Safety Program Requirements, paragraph 1.14 at https://nodis3.gsfc.nasa.gov/npg_img/N_PR_8715_003C_/N_PR_8715_003C_.pdf.

111 NASA Procedural Requirement (NPR) NPR 8705.2B, Human-Rating Requirements for Space Systems, at https://nodis3.gsfc.nasa.gov/npg_img/N_PR_8705_002B_/N_PR_8705_002B_.pdf.

Authority has the final word on the risk acceptability, it can refuse to accept the risk if the vehicle's system does not achieve the results at which NASA recommendations aim. This creates a virtuoso circle where, on one side the company has a vast degree of autonomy, and, on the other, NASA provides significant insights during the development process, providing to the company its wide resources and expertise.

6. The Importance of an Australian Space Agency

Australia has enormous potentialities in the space sector in terms of access to space, leading technology and expertise. However, its resources are dissipated and not properly utilized due to a lack of Government coordination and a space regulatory regime essentially oriented to shield the country from international and national liability. As other countries' experiences -such as the US- have demonstrated, the need for significant Government coordination and support of commercial space projects, especially when they are still emerging, is *essential*. Space industry, especially the new emerging one, cannot be put in the same basket of other technological areas where all parties shall compete for Government support through generic funding programs,[112] but, rather, it needs dedicated funds and coordination through a space agency. In the Asia-Pacific area there are many examples of virtuoso effects a space agency may provide in terms of managing resources and providing results.[113] A space agency should be set in Australia through an appropriate Space Agency Act. Further, it is necessary to establish clear and long term National Space Policies which set precise strategies and objectives in which the Agency would play a key role towards their achievement. Among these strategies, the Agency should set the goals to seek and encourage, to the maximum extent possible, the commercial use of space, engage in international cooperation programs and manage the academic, industrial, and entrepreneurial communities' participation to coordinate under its umbrella the Australian potentialities in terms of knowledge and skills. The Agency should provide industry facilitation and government coordination/liaison and should be "the central 'go-to place', a body that would assist applicants and other interested parties with their space-related needs."[114]

112 Freeland, Steven – "When Laws Are Not Enough – The Stalled Development of an Australian Space Launch Industry" [2004] UWSLawRw 4; (2004) 8(1) University of Western Sydney Law Review 80, "A revised 'market-driven' approach to space engagement" at www5.austlii.edu.au/au/journals/UWSLRev/2004/4.html.

113 China, Japan, India, Thailand, Singapore and Taiwan have obtained great results through their national space agencies. ISRO is one example of this virtuoso effect by placing low-cost high-return investment in space. See www.isro.gov.in.

114 Communications Alliance – Submission on the legislative proposal paper on the reform of the Australian Space Act, April 2017, at 4.

While foundation principles are to be included in the new Act, detailed operational issues -such as the application process/requirements for Commercial "high altitude" activities and suborbital flights- should be specifically regulated in subordinate instruments conceived to allow the relevant Minister to swiftly modify their provisions, without the need of parliamentary approval, to cope with technological advancement. Further, the core value of a proper regulatory environment for the development of suborbital flights is safety, especially of the occupants of these new vehicles. To give the Agency a contributive role in the commercial development of suborbital human flights, the new Space Act could provide the possibility for the Minister to delegate the Agency of establishing minimum safety-oriented objectives, including participants' safety, that commercial ventures should meet to be authorized. Such standards should be introduced in a subordinate regulatory instrument that will replace the Flight Safety Code. The Minister should further delegate the Agency to provide the applicants with assistance, guidance, information exchange and technical support towards these safety achievements. Perhaps, the Agency, to facilitate the new emerging technologies, may be delegated to introduce industry-and-Agency-developed consensus standards, and, to the industry, may be given the opportunity to freely decide which path to take to reach them while assisted by the Agency. This would, of course, require the injection of considerable amount of funds into the Agency's budget, since, as the American experience teaches, there is a constant need of interaction and support between the expert government bodies (either FAA or NASA) and any developing technology.[115] The use of Australian expertise under the Agency coordination will avoid seeking support in the US, removing an issue of costs but also of time (because of the ITAR restrictions). Further, the license application process may be scaled in phases, each of which is signed off by the Government once completed so that the license is released after the achievement of them all.

Alternatively, the Agency could be "responsible for developing and administering Australian civil space legislation and regulations, and for implementing the licensing of space activities covered by the legislation."[116] Cases where the Agency has complete authorization and oversight functions of commercial space systems are the Ukrainian and the Russian Space

115 See for example: The SS2 accident "demonstrate […] the continued necessity of public-private cooperation to lay the foundation for a future regulatory framework. The FAA can both maximize safety and foster a vibrant and competitive industry by working with the private sector in fora such as the Commercial Space Transportation Advisory Committee (COMSTAC). US Subcommittee Hearing on "FAA Oversight of Commercial Space Transportation", Washington, DC, June 17, 2016.

116 Space Industry Association of Australia – SIAA, White Paper – Advancing Australia in Space, 21 March 2017, p. 10.

Agencies.[117] In this case, the new Australian Agency should fully absorb the role of the SLASO. In any case, the Agency should be responsible for developing a lessons-learned database in which all the relevant information gathered through experience will flow to avoid (potentially fatal) error repetitions.

7. Conclusion

In the hard near-future perspective that the international community agrees on the creation of a new international binding instrument that, within the respect of the customary international space law principles, will supersede and modernize the current space treaties' regimes to accommodate the exigencies of new emerging industries such as commercial suborbital activities, national space laws increasingly play a key role. Australia has all the geopolitical and economical potentialities to be a leading country for the commercial space activities. However, its current national legislation is clearly unsuitable for their development. Major modifications are required in the Australian national space law and, among those, the drawing of a new Act, a comprehensive set of definitions, a new licensing regime and new regulatory approaches are the most pressing. Australia needs to coordinate and convey its resources under a Space Agency that will support the industry development. Insurance requirements and application fees shall be drastically reduced and adapted to the international average. Finally, the human safety factor of commercial space activities should have a key role in the new regulatory regime and in this the Space Agency should be able to use the national resources to ensure light but effective safety parameters and to guide those new ventures in meeting them.

If Australia is able to effectively modernize its national space regime -within the limits imposed by the space treaties and by balancing its potential liability exposure- it could serve as a model for the Asia-Pacific countries, which could align their national space legislations to those of Australia. This could lead the Asia-Pacific states to enter in multistate agreements that will further provide uniformity, certainty and support to the new emerging commercial space activities and that, perhaps, could provide the international community a hint for the modernization of the international space law regime.

117 Russia, *see*: art. Art. 10(1) and art. Art. 6(2), 6th bullet, Law of the Russian Federation on Space Activities; Art. 5(h), Statute on Licensing Space Operations, February 2, 1996. Ukraine, *see*: Art. 12, Art. 1, 9th bullet, Art. 6, 7th bullet, Law of the Ukraine on Space Activities.