

SPACE TOURISM AS RUSSIAN ROULETTE: CONCERNING ON THE ACCEPTABILITY OF THE SPACE TOURISM IN THE VIEW OF ILLEGAL CONTRACT

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Abstract: The outer space becomes more approachable. As the developments occur in a row, the space launch vehicles are bigger, better, and faster, so that people can get to the outer space more quickly and efficiently. With this currency, space tourism appears which gives people special experiences, such as enjoying sight of the outer space and playing in the micro-gravity circumstances.

However, the possibility of crashes also goes up. Yet the perfectly safe vehicles to carry the passengers into the outer space are not developed. Risk cannot be eliminated in the real world, especially in the case of the rocket launch vehicles, and the risk of failure in launching process is quite high. Already, there was a crash of private spaceship, which was designed to carry tourists.

This article will bring forward the questions about the acceptability of the space tourism because there are similarities between the space tourism and Russian roulette game. If the risky space tourism is accepted, the other activities, which have the similar level of possibility of risks, should be accepted. This article focuses the situations and, as the conclusion, tries to suggest a solution to prevent this problem.

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Table of Contents

1	Introduction	2
2	Space tourism	3
2.1	Definition of space tourism	3
2.2	Human spaceflight as tourism	5
2.2.1	Definition of “human spaceflight”	5
2.2.2	History of human spaceflight	7
2.3	Private spaceflight in three ways	10
2.3.1	Private spaceflight as an agency for government	10
2.3.2	Private spaceflight as a tourism	12
2.3.3	Private spaceflight as a hobby	14
2.4	The mechanism of space tourism in Virgin Galactic	15
2.5	Possible risks in space tourism	17
2.5.1	Risks during the launch	17
2.5.2	Risks in outer space	18
2.5.3	Risks during the reentry	19
2.6	Comparison between the risks of space travel and the risks of extreme sports	20
3	Comparison with a Russian roulette game	21
3.1	Space tourism as an illegal contract	21
3.2	Corporate homicide	22
3.3	Assumption of risk	22
3.4	Imbalance of information between Virgin Galactic and the consumers	23
4	Conclusion	23
5	References	24

1 Introduction

One of the two men sitting opposite to each other takes the revolver on the table placed between them and loads a bullet into the cylinder of the gun. After rotating the cylinder, he pulls the trigger. “Click” means the opposite grabs a luck while “bang” does a reward of the shooter. At least, if one is engaged in the “Russian Roulette” game, he is dead in one sixth.

Russian roulette is an interesting activity in the view of law. It appears like a contract, and “sometimes” transforms into a homicide crime. It, however, seems to be out of the range of law the feature of the game that the possibility, which is totally out of the human conscious causes the serious results. Russian roulette in itself has an aggressively interesting topic to the scholars of law.

Recently, “space tourism” is gradually arising which is interesting as much as Russian Roulette game. Space tourism looks different from the existing spaceflight program. Space tourism has three natures: private, voluntary, and risky. As there is no governmental enforced safe Russian roulette game, space tourism has similar appearance as Russian roulette.

Does a government prevent people from Russian roulette? Yes. Does a government prevent people from space tourism? It can be a hot potato in the agora of law study.

If there is a difference between the Russian roulette and the space tourism, it is only the matter of possibility. The Russian roulette has a bullet with the five void cylinders and the space tourism has a death case out of fifty-five test launch and reentry. Therefore, in this article, this article carefully concerns the space tourism and the other dangerous recreational activities can be regarded as another kind of homicide, or suicide, which is up to random result.

For the better thought, in this article, variable contexts will be concerned. Criminal law is used to explain what illegal contract is. Tort law should be used to clarify the concept of assumption of risks with contract law explaining the freedom of contract and informed consent. Some part of ethical philosophy is required to explain what the differences are among the space tourism, Russian roulette, and suicide.

The goal of this article is analyzing the space tourism comparing with Russian roulette and to suggest how law and philosophy deals with the result of the comparison. For better concerning, this article will take the steps as following:

First, an introduction on the space tourism will be made. From the beginning of the space tourism to the expected future of it, all about space tourism is concerned in this article. The history of the space tourism and the possibility of spaceship crashes also would be covered. The imaginary situation is supposed which the government accept the space tourism like other tourisms. At the end of this chapter, it is going to bring the main issue whether the space tourism is acceptable or not with focusing on a private space tourism company, Virgin Galactic.

Second, Russian roulette game will be concerned with a question whether it is acceptable or not. In the hypothetical idea that the condition of Russian roulette is almost same with the space tourism, this article will profound how the legislatures react. In addition, the space tourism will be compared with a hit man contract, euthanasia, and mercenary contract in the view of contract law. After the comparison, the answer to the main question of this article will be clearer.

Finally, the possible solutions, which can be applied to the space tourism, will be suggested. In the three different thoughts: unenforceable contract against a public policy, assumption of risk or informed consent, and corporate homicide.

2 Space tourism

2.1 Definition of space tourism

Before getting the definition of space tourism, the definition of tourism is required. "Tourism," in the Parsonian scheme¹, is acknowledged as a recreational activity² that regulates one's tensions and dissatisfactions from refreshing and restoring herself,

¹ The interaction of individual actors, that is, takes place under such conditions that it is possible to treat such a process of interaction as a system in the scientific sense and subject it to the same order of theoretical analysis, which has been successfully applied, to other types of systems in other sciences. Parsons 1991, at 1.

² "Action" is a process in the actor-situation system, which has motivational significance to the individual actor, or, in the case of a collectivity, its component individuals. *Ibid.* at 2. With the type of expressively oriented activity we may call recreation or entertainment. Indeed in all probability what is usually thought of as friendliness should probably be placed in this category. It is a kind of "recreational penumbra" of orientations, the core of which belongs on another level. *See, Ibid.* at 88.

without destroying her motivation to perform the tasks of his everyday life. Tourism is essentially a temporary reversal of everyday activities — it is a no-work, no-care, no-thrift situation; but it is in itself devoid of deeper meaning: it is a ‘vacation’.³

Travelling for pleasure beyond the boundaries of one’s life-space assumes that there is some experience available ‘out there’, which cannot be found within the life-space⁴, and which makes travel worthwhile.⁵

The word “tourist” appears for the first time in English at the beginning of the nineteenth century and the first definition, in chronological terms, was given by Herman Von Schullard in 1910:

[Tourism is] the total sum of operators, mainly of an economic nature, which directly relate to the entry, stay and movement of foreigners inside and outside a certain country, city or a region.⁶

The task of defining tourism by recalling some other definitions that alternatively assume a holistic approach and underline, in a more comprehensive way, all phenomena associated to tourism flows. Jafari’s definition of 1977 is:

Tourism is the study of man away from his usual habitat, the industry which responds to his needs, and the impact that both he and the industry have on the sociocultural, economic, and physical environments.⁷

In the view of law, tourism is defined similarly. Law generally operates within notions of time and space; these legal zones are called jurisdictions.⁸ To travel is to move between these jurisdictional spaces, yet often we carry duties and connections to the legal spaces and jurisdictions left behind. On tour, we are liminal between home and alien, between this law and that law.⁹

Therefore, the features of space tourism can be given in the context. Space tourism is the industry, which leads people out of everyday life by taking people into the outer space to meet the recreational demand of people. In the view of law, the everyday life is

³ See, Cohen 1979, at 181.

⁴ Cohen 1979, at 198, endnote 4. If the experience were available within the life-space, there would be no need to take the trouble to travel: *cf.* Stouffer, 1950.

⁵ Cohen 1979, at 183. Modern mass tourism is predicated upon a different development: the gradual abandonment of the traditional, sacred image of the cosmos, and the awakening of interest in the culture, social life and natural environment of others. *Ibid.* Experimental mode of the touristic experience is characteristic of people who do not adhere any more to the life-space of their own society, but engage in a quest for an alternative in many different directions. Cohen 1979, at 189.

⁶ Candela and Figini 2012, at 25 citing Gilbert 1990, at 8. The process of defining tourism experienced a decisive and definitive step forward when, with the joint efforts of UNWTO and UNSTAT, the definition of tourism was approved, with universal acceptance, in 1994: The activities of persons travelling to and staying in places outside their usual environment for less than a year, for any main purpose (leisure, business or other personal purpose) other than to be employed by a resident entity in the country or place visited. *Ibid.*, at 26.

⁷ *Ibid.*, at 27. Whereas in 1979 the British Tourism Society claimed, on the basis of the definition provided by Burkart and Medlik (1974), that: Tourism is deemed to include any activity concerned with the temporary short-term movement of people to destinations outside the places where they normally live and work, and their activities during the stay at these destinations. *Ibid.*

⁸ Partain 2014, at 264, citing Black 1990: 853.

⁹ *Ibid.*

regarded as the home jurisdiction and the outer space is the alien jurisdiction. Therefore the space law is applied to the customers of space tourism additionally.

2.2 *Human spaceflight as tourism*

2.2.1 Definition of “human spaceflight”

Space tourism consist of human spaceflight. To define what “human spaceflight” is, it is required to define where is “outer space” since, if the altitude where a man stands decides whether he is in the sky or the outer space, the specified boundary is required. In fact, there is no the specific boundary which divides between the sky and the outer space; the gases in the atmosphere scatter. Strictly speaking, an atmosphere does not end at any given height, but becomes progressively thinner with altitude.¹⁰

Before the space era was opened, some thought space began at about 15,000 feet, since that's where the partial pressure of oxygen in the atmosphere is too low to permit humans to function for extended periods of time.¹¹ This definition soon gave way to others that defined the beginning of space as the end of the stratosphere, the thermosphere or the exosphere.¹²

The practical possibility of designating a boundary between airspace and outer space derives from the fact that the maximum altitude of stable aerodynamic flight is significantly below the minimum altitude of stable orbital flight.¹³ Although the precise altitude differed based on several variables Theodore von Kármán calculated that above an altitude of approximately 100 kilometers (62 miles, or 328,084 feet), a vehicle would have to fly faster than orbital velocity in order to derive sufficient aerodynamic lift from the atmosphere to stay aloft.¹⁴ The result of Kármán's calculation is referred as "Kármán Line."¹⁵

¹⁰ Dennis Jenkins, Extra Feature, Dryden Flight Research Center, 2005, http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html.

¹¹ See, *Ibid.* Cf. Jasentuliyana 1992, at 185.

¹² *Ibid.*

¹³ Jasentuliyana 1992, at 185. At higher altitudes, atmospheric density is more variable and a theoretical minimum altitude for space flight is more difficult to specify. Observations of satellite orbits have shown at least two dozen instances of orbital perigees between 130km and 110 km, and about a dozen, with a lifetime of slightly over one orbit—about 90 minutes—between 110 km and 100 km. As a spacecraft descends below these altitudes, it is decelerated to such an extent that it either disintegrates or reaches the ground before completing an orbit. These scientific and technical criteria suggest that a practical boundary between airspace and outer space could be designated at an altitude between 84 km and 100km. Within this range of altitudes, science and technology provide little guidance for a more precise determination; hence it would seem to be up to the legislators, if they are so inclined, to choose a boundary within that range. *Ibid.* at 185. Theodore von Kármán, in 1957, showed that the theoretical upper limit air flight was at an altitude of about 84km, where aerodynamic lift becomes less than centrifugal force and the aircraft goes into uncontrolled ballistic flight. Cf. Dennis Jenkins, Extra Feature, Dryden Flight Research Center, 2005, http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html.

¹⁴ Dennis Jenkins, Extra Feature, Dryden Flight Research Center, 2005, http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html.

¹⁵ This 100-kilometer "Kármán Line" was recommended to the Fédération Aéronautique Internationale (FAI), the internationally recognized body for recording aeronautic achievements. Dennis Jenkins, Extra Feature, Dryden Flight Research Center, 2005, http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html. The FAI

The discussions in the Committee on the Peaceful Uses of Outer Space (COPUOS) have generally focused on the criterion of the lowest perigee of an orbiting satellite.¹⁶ As considering the fact that the COPUOS regards the Kármán Line, the starting line of outer space seems to be the Kármán Line — about 60 miles above the land.

Defining the outer space contributes to define what “spaceflight” is as the term, spaceflight has “space” which discriminates itself from the term, “flight” which means “to fly” including the airspace and the outer space but usually reminds people “blue sky,” airspace. A person who has flown above the Kármán Line now can be defined as the astronaut.

NASA, however, has taken the less strict criterion which defines the boundary between airspace and outer space—50 miles above the land— since NASA rewarded the former agents who had flew up to 50 miles above as “astronauts.”¹⁷ It looks unreasonable at a glance since NASA has acknowledged outer space with the Kármán Line.¹⁸ Therefore the rewards for the former agents should be considered just as a ritual for the honor of them.

In some cases “Low-Earth Orbit”¹⁹ performs the role of the boundary to define outer space.²⁰ In this definition, however, it is not efficient for human spaceflight to apply the

takes the Kármán line to define the boundary between aeronautics and astronautics: Aeronautics — For FAI purposes, aerial activity, including all air sports, within 100 kilometers of Earth's surface; and Astronautics — For FAI purposes, activity more than 100 kilometers above Earth's surface.

¹⁶ Jasentuliyana 1992, at 185. As Eilene Galloway has noted: “Since the space age began, we have been proceeding on the basis that outer space begins where an object goes into orbit.” Given this scientific and technical knowledge, which has long been widely available, the unwillingness of the Scientific and Technical Subcommittee to take a position on the matter, and the inability of the Legal Subcommittee to reach agreement after many years of discussion, reflects a lack of political will rather than a lack of scientific and technical criteria. *Ibid.* Upon adoption, Kármán Line became the internationally accepted boundary to space for the purposes of world records and many treaties. See, Dennis Jenkins, Extra Feature, Dryden Flight Research Center, 2005, http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html.

¹⁷ McKay and Joseph A. Walker, received civilian astronaut wings acknowledging their flights above 264,000 feet altitude □ 50 miles high. The men were honored in a quiet ceremony at NASA's Dryden Flight Research Center on Edwards Air Force Base in California, site of their achievements. Frederick A. Johnsen, X-15 Space Pioneers Now Honored as Astronauts, NASA Dryden Flight Research Center (2005) <http://www.nasa.gov/centers/dryden/news/NewsReleases/2005/05-57.txt>.

¹⁸ Dryden Flight Research Center, 2005, http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html.

¹⁹ Most scientific satellites and many weather satellites are in a nearly circular, low Earth orbit. The satellite's inclination depends on what the satellite was launched to monitor. The Tropical Rainfall Measuring Mission (TRMM) satellite was launched to monitor rainfall in the tropics. Therefore, it has a relatively low inclination (35 degrees), staying near the equator. Holli Riebeek, Catalog of Earth Satellite Orbits, Earth Observatory, NASA, 2009, <http://earthobservatory.nasa.gov/Features/OrbitsCatalog/>.

²⁰ Space debris are all man made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non functional. IADC 2007, at 5. For most of the last decade, as astronauts and cosmonauts orbited the Earth aboard the International Space Station they were circling the globe at an altitude of approximately 220 statute miles, or about 350 kilometers. Even though the space station orbits in what most people on Earth would consider to be the “vacuum of space,” there still are enough atmospheric molecules that contact the surfaces of its large solar array panels, truss structure backbone and pressurized modules to change its speed, or velocity, which is about 17,500 miles, or 28,000 kilometers an hour. The station is so large (as big as a football field with the end zones included) that the cumulative effect of these tiny particles contacting its surfaces reduces its

same criteria with non-manned mission. Therefore, in this article, space means sky above the Kármán Line.

2.2.2 History of human spaceflight

The X-15 was one of the "X" vehicle²¹ Built in the 1950s, she became the fastest and highest-flying winged aircraft of its time. During 199 flights from 1959 through 1968, she collected data about hypersonic flight that was invaluable to aeronautics and to developers of the space shuttle.²² The X-15's role has been to sustain interest in manned, maneuverable flight in high-speed aircraft during a period when the world's gaze turned to orbital space flight.²³ Since the pilots having engaged in the X-15 mission were rewarded the astronaut wings²⁴, X-15 is well known as the ancestor of the space launch vehicles.

After World War II, the United States and the Soviet Union created their own missile programs. On October 4, 1957, the Soviets launched the first artificial satellite, Sputnik 1, into space.²⁵

The first U.S. satellite, Explorer 1, went into orbit on January 31, 1958. The first U.S. satellite, Explorer 1, went into orbit on January 31, 1958. Project Mercury came into being on 7 October 1958, only a year and three days after the Soviet Union's Sputnik I satellite opened the Space Age. The goal of sending people into orbit and back had been discussed for many years before that, but with the initiation of the Mercury project, theory became engineering reality.²⁶

Three years later to the Explorer 1 on April 12, 1961, Russian Lt Yuri Alexeyevich Gagarin became the first human to orbit Earth in Vostok 1. His flight lasted 108 minutes, and Gagarin reached an altitude of 327 kilometers (about 202 miles).²⁷ The Soviet Union has beaten the USA in the race to get the first man into space.

speed and causes a minute but continuous lowering of its altitude, or height above the Earth. NASA, Higher Altitude Improves Station's Fuel Economy, International Space Station, 2011, http://www.nasa.gov/mission_pages/station/expeditions/expedition26/iss_altitude.html.

²¹ X-15 achieved a maximum speed of Mach 6.06 and a maximum altitude of 354 200 ft. Its launch weight was 33 000 lb.; landing weight, 14 700 lb. The lower half of its vertical tail had to be jettisoned before landing, since, as the little head-on view makes clear, it otherwise would have protruded below the landing extended. *See*, Stillwell 1965, at 3.

²² Dennis R. Jenkins, X-15: Extending the Frontiers of Flight, NASA, 2012 http://www.nasa.gov/connect/ebooks/aero_x15_detail.html.

²³ *According*, Stillwell 1965, at 6.

²⁴ *See*, Frederick A. Johnsen, X-15 Space Pioneers Now Honored as Astronauts, NASA Dryden Flight Research Center (2005) <http://www.nasa.gov/centers/dryden/news/NewsReleases/2005/05-57.txt>.

²⁵ A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>.

²⁶ Rumerman 2007, at 11.

²⁷ *See*, A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>. At just after 0700BST, Gagarin was fired from the Baikonur launch pad in Kazakhstan, Soviet central Asia, in the space craft Vostok (East). Major Gagarin orbited the Earth for 108 minutes travelling at more than 17,000 miles per hour (27,000 kilometers per hour) before landing at an undisclosed location. 1961: Soviets win space race, On this day 1950-2005, BBC, http://news.bbc.co.uk/onthisday/hi/dates/stories/april/12/newsid_2477000/247715.stm.

“Landing a man on the moon and returning him safely to Earth within a decade” was a national goal set by President John F. Kennedy on 25 May 1961.²⁸ In 1961 Alan Shepard became the first American to fly into space. Gemini mission’s success was critical to the achievement of President Kennedy’s goal of reaching the Moon “by decade’s end.” The program was announced to the public on 3 January 1962, after Apollo was already well under way. On February 20, 1962, John Glenn’s historic flight made him the first American to orbit Earth.²⁹

On July 20, 1969, Astronaut Neil Armstrong took “a giant step for mankind” as he stepped onto the moon. Six Apollo missions were made to explore the moon between 1969 and 1972.³⁰ The Apollo program had been under way since July 1960, when NASA announced a follow-on to Mercury that would fly astronauts around the Moon. But with President John F. Kennedy’s speech in 1961 declaring the goal of landing an astronaut on the surface of the Moon and returning to Earth by decade’s end, Apollo shifted its focus. That goal was achieved with five months to spare when on 20 July 1969, Neil Armstrong and Edwin “Buzz” Aldrin touched down in the Sea of Tranquility. Six expeditions landed on the Moon, and one, Apollo 13, was forced to return without landing. Before that, there had been two crewed checkouts of Apollo hardware in Earth orbit and two lunar orbit missions.³¹

Skylab, America’s first space station, was a human-spaceflight highlight of the 1970s, as was the Apollo Soyuz Test Project, the world’s first internationally crewed (American and Russian) space mission.³²

In April 1981 the launch of the space shuttle Columbia ushered in a period of reliance on the reusable shuttle for most civilian and military space missions. Twenty-four successful shuttle launches fulfilled many scientific and military requirements until January 1986, when the shuttle Challenger exploded after launch, killing its crew of seven.³³ Before the Space Shuttle, launching cargo into space was a one-way proposition. Satellites could be sent into orbit, but they could not return. The world’s first reusable

²⁸ A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>.

²⁹ *Ibid.* Gemini’s primary purpose was to demonstrate space rendezvous and docking, which are techniques that would be used during Apollo, when the lunar lander would separate from the Command Module (CM) in orbit around the Moon and then meet up with it again after the astronauts left the lunar surface. Gemini also sought to extend astronauts’ stays in space to two weeks, longer than even the Apollo missions would require. Stillwell 1965 at 15.

³⁰ A Brief History of Space Exploration, <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>.

³¹ *See*, Rumerman 2007, at 21.

³² A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>. NASA had studied concepts for space stations, including an inflatable, donut-shaped station, since the earliest days of the space program. But it was not until the Saturn rocket came into existence in the mid-1960s that the Skylab program was born. Initially called the Apollo Applications Program, Skylab was designed to use leftover Apollo hardware to achieve extended stays by astronauts in Earth orbit.³² The final mission of the Apollo era, in July 1975, was the first in which spacecraft from two nations rendezvoused and docked in orbit. The idea for this U.S./Soviet “hand-shake in space” had been initiated three years earlier with an agreement signed by U.S. President Richard Nixon and Soviet President Aleksey Kosygin. *Ibid.*

³³ A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>

space vehicle changed that and revolutionized the way people worked in space. The Space Shuttle was approved as a national program in 1972.³⁴

The International Space Station (ISS) is a research laboratory in low Earth orbit (LEO). With many different partners contributing to its design and construction, this high-flying laboratory has become a symbol of cooperation in space exploration, with former competitors now working together.³⁵

While the space shuttle will likely continue to carry out important space missions, particularly supporting the International Space Station, the Columbia disaster in 2003 signaled the need to step up the development of its replacement. Future space launch systems will be designed to reduce costs and improve dependability, safety, and reliability. In the meantime most U.S. military and scientific satellites will be launched into orbit by a family of expendable launch vehicles designed for a variety of missions. Other nations have their own launch systems, and there is strong competition in the commercial launch market to develop the next generation of launch systems.³⁶

However, America has not had the ability to put a human into space since 2011. The only nations with this capability are terrestrial competitors, Russia and China. The space shuttle, although striking and dramatic, was an expensive dead end. Shuttle missions were unimaginative, limited to resupplying the space station. This was not exploration nor was it a significant contribution to science. The collapse of the U.S. manned program illustrates the failures of space strategy and the lack of political interest.³⁷

The military implications of a presence on the moon are limited. The military value of space lies in services with terrestrial applications. A later section will discuss the use of force in space, but neither manned spaceflight nor lunar bases provide military advantage. The same is true for commercial activities. Given current technological limitations, which make it expensive to get into space and to return, mining on the moon or on asteroids or manufacturing in weightless environments are not commercially viable.³⁸ Space tourism on the moon will not pay for themselves as long as we depend on

³⁴ Rumerman 2007, at 35. Part spacecraft and part aircraft, the Shuttle required several technological advances, including thousands of insulating tiles able to stand the heat of reentry over the course of many missions and sophisticated engines (Space Shuttle Main Engines [SSMEs]) that could be used again and again without being thrown away. *Ibid.*

³⁵ A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>. ISS represents the unprecedented cooperative efforts of 16 nations to undertake one of the largest and most complex scientific projects ever. The completed version of the ISS will be four times larger than the former Russian space station Mir and easily visible from Earth with the naked eye. Its massive interior space will be able to support a six-person crew that will conduct research and experiments that will help send humans back to the Moon, to Mars, and beyond. *Ibid.* The origins of ISS date back to the 1980s, when NASA drew up plans for an expandable station constructed of pressurized modules. President Ronald Reagan gave the proposal, then named Space Station Freedom, his seal of approval during the 1984 State of the Union Address. The program faltered in the following years, however, with numerous design changes and increasing cost outlooks. In the late 1980s, members of Congress threatened to kill the program, and in 1993, continued funding for the program was approved by a one-vote margin. *See also*, Rumerman 2007, at 75.

³⁶ A Brief History of Space Exploration <http://www.aerospace.org/education/inspiring-the-next-generation/space-primer/a-brief-history-of-space-exploration/>.

³⁷ Lewis 2014, at 2.

³⁸ *Ibid.* at 3, citing A DOD estimate put the cost of launching a single pound in orbit at \$10,000 using existing launch vehicles. Entrepreneurial operators of space launch vehicles expect the cost to put a

expensive and fragile transportation systems. High-end space tourism in low earth orbit may be economically viable, but this will be a small market and not a source of national prestige.³⁹

Entrepreneurial space companies will provide automated supply vehicles and a “space taxi” so that the United States will no longer have to rely entirely on foreign providers to service the shuttle, but will not have the ability, given current funding and technology, to do more than this.⁴⁰

2.3 Private spaceflight in three ways

2.3.1 Private spaceflight as an agency for government

The space industry, nowadays, gives seats to the private space corporations. As news has reported the whole steps of transferring the espresso machine to the International Space Station (ISS), National Aeronautics and Space Administration (NASA) has endowed the private the authority to play a role in the process of space missions. What this recent phenomenon suggests is, therefore, the space industry is now coming out of the monopoly of the governments and making its own “market.” A space mission as an item of the market is enabled to have its price but not only an expense. Whoever can realize the imagination of the government is able to appeal her ability to the potential buyer and bid the buyer on the space mission.

SpaceX is one of the most active company in the government cooperation market.⁴¹ Dragon⁴² that is a cargo ship designed and manufactured by SpaceX to be the “first

pound into orbit to fall to \$3,000. David Kestenbaum, “Spaceflight Is Getting Cheaper. But It’s Still Not Cheap Enough,” NPR, July 21, 2011, <http://www.npr.org/blogs/money/2011/07/21/138166072/spaceflight-is-getting-cheaper-but-its-still-not-cheap-enough>.

³⁹ *Ibid.* at 3.

⁴⁰ *Ibid.* at 6.

⁴¹ SpaceX is a private company, which is incorporated March 2002, owned by management and employees, with minority investments from Founders Fund, Draper Fisher Jurvetson, and Valor Equity Partners. The company has more than 1,800 employees at its headquarters in Hawthorne, California; launch facilities at Cape Canaveral Air Force Station, Florida, and Vandenberg Air Force Base, California; a rocket-development facility in McGregor, Texas; and offices in Houston, Texas; Chantilly, Virginia; and Washington, DC. *See*, NASA, SpaceX 2012, at 18. SpaceX is one of NASA's commercial partners working to develop a new generation of U.S. spacecraft and rockets capable of transporting humans to and from Earth's orbit from American soil. Ultimately, NASA intends to use such commercial systems to fly U.S. astronauts to and from the International Space Station. Brian Berger, Orbital ATK Org Charts Detail the Newly Merged Company, <http://spacenews.com/orbital-atk-org-charts-detail-the-newly-merged-company/>. For more information on SpaceX; *See*, Ashlee Vance, Elon Musk’s Space Dream Almost Killed Tesla, Bloomberg Business, 2015 <http://www.bloomberg.com/graphics/2015-elon-musk-spacex/>.

⁴² SpaceX, Dragon, <http://www.spacex.com/dragon>. The Dragon spacecraft, designed to carry people into Earth's orbit, received a few upgrades as SpaceX refines its vehicle in partnership with NASA’s Commercial Crew Program. Today, SpaceX revealed these changes as it unveiled the Dragon V2 at the company's Hawthorne, California, headquarters. Vehicle upgrades include solar arrays that will be affixed to the side of the spacecraft's trunk instead of on fold-out wings and a new launch escape system that will allow crew members to escape an anomaly at any point during flight. The vehicle is intended to ferry seven astronauts, along with critical cargo and supplies. *Ibid.*

private space craft to the space station” and Falcon 9⁴³ that is a space launch vehicle to carry Dragon to the outer space have substantially opened the market. With the cargo ship and the launch vehicle, in 2008, Space X was offered a proposal from NASA for a commercial ISS resupply cargo vehicle to replace the Space Shuttle, which was in the verge of retirement. SpaceX accepted the offer and NASA awarded SpaceX a contract, which is called Commercial Resupply Services (CRS)⁴⁴, with \$1.6 billion for 12 cargo transport missions. Of course, astronauts can board on Dragon and fly to ISS if NASA requires SpaceX to transport crews.⁴⁵

SpaceX CRS-1 is the first of at least 12 missions to the International Space Station that SpaceX will fly for NASA under the Commercial Resupply Services (CRS) contract. In December 2008, NASA announced that SpaceX’s Falcon 9 launch vehicle and Dragon spacecraft had been selected to resupply the space station after the end of the space shuttle program in 2011. Under the CRS contract, SpaceX will restore an American capability to deliver and return significant amounts of cargo, including science experiments, to the orbiting laboratory — a capability not available since the retirement of the space shuttle.⁴⁶

SpaceX has gained worldwide attention for a series of historic milestones. It is the only private company ever to return a spacecraft from low-Earth orbit, which it first accomplished in December 2010. The company made history again in May 2012 when its Dragon spacecraft attached to ISS, exchanged cargo payloads, and returned safely to Earth—a technically challenging feat previously accomplished only by governments.⁴⁷

The commercial effort to build a private, human-rated spacecraft began about four years ago and is the first stepping stone in NASA's strategy to send humans on a path to explore deeper into space than ever before, including visits to Mars in the 2030s.⁴⁸

⁴³ SpaceX, Falcon9, <http://www.spacex.com/falcon9>. Falcon 9 is a two-stage rocket designed and manufactured by SpaceX for the reliable and safe transport of satellites and the Dragon spacecraft into orbit. As the first rocket completely developed in the 21st century, Falcon 9 was designed from the ground up for maximum reliability. Falcon 9’s simple two-stage configuration minimizes the number of separation events — and with nine first-stage engines, it can safely complete its mission even in the event of an engine shutdown. Falcon 9 made history in 2012 when it delivered Dragon into the correct orbit for rendezvous with the International Space Station, making SpaceX the first commercial company ever to visit the station. Since then SpaceX has made a total of seven flights to the space station, both delivering and returning cargo for NASA. Falcon 9, along with the Dragon spacecraft, was designed from the outset to deliver humans into space and under an agreement with NASA, SpaceX is actively working toward that goal. *Ibid.*

⁴⁴ For more information, *See*, http://www.nasa.gov/home/hqnews/2008/dec/HQ_C08-069_ISS_Resupply.html.

⁴⁵ NASA has awarded two contracts — one to Orbital Sciences Corp. of Dulles, Va., and one to Space Exploration Technologies (SpaceX) of Hawthorne, Calif. — for commercial cargo resupply services to the International Space Station. At the time of award, NASA has ordered eight flights valued at about \$1.9 billion from Orbital and 12 flights valued at about \$1.6 billion from SpaceX. NASA, NASA Awards Space Station Commercial Resupply Services Contracts, 2008, http://www.nasa.gov/home/hqnews/2008/dec/HQ_C08-069_ISS_Resupply_prt.htm.

⁴⁶ NASA, SpaceX 2012, at 3.

⁴⁷ *Ibid.*, at 17.

⁴⁸ NASA Partner SpaceX Unveils Human-Carrying Dragon V2 | NASA, May 29, 2014; <http://www.nasa.gov/content/nasa-partner-spacex-unveils-human-carrying-dragon-v2/#.VUxyLNOqqko>.

As well as SpaceX, Orbital Science⁴⁹ has provided the services in favor of the government of the U.S., especially NASA.⁵⁰ Antares rocket is the representative vehicle of the corporation.⁵¹ Orbital Science, however, is better to be out of concerning in this article, since the corporation does not concentrate on the space activities. Orbital Science is the corporation which manufactures weapons and military instruments⁵² after the merger with Alliant Techsystem in 2014.⁵³

2.3.2 Private spaceflight as a tourism

With the agency of the government, the private human spaceflight as a tourism is also acknowledged as a commercialized spaceflight. SpaceX, however, looks indifferent to offer laypeople a chance to experience beyond the sky. If SpaceX does, it must be the request of NASA because the direction of business is an “agency” of the government.⁵⁴ In contrast, there is a purely private, that is, without any intervention of the government, company which operates its business in the outer space. Virgin Galactic⁵⁵ is more passionate to develop a tourism item, which provides the opportunity to be in the outer space for meeting the demand of people with wealth. Before Virgin Galactic, the chosen people, astronauts, were only people who have the right to feel the outer space.

In the 1990s, Richard began the process of building the world’s first commercial spaceline, a company designed to help people around the world fulfill their dreams of flying in space. Before the incorporation of Virgin Galactic, SpaceShipOne is designed with the helps of Scaled on a project called the Virgin Atlantic Global Flyer.⁵⁶ Before the Ansari X Prize was awarded, Richard agreed with Paul Allen and Burt Rutan that, should they win, Virgin would engage Scaled to develop a commercial version of the SpaceShipOne system, and build organizations to manufacture and operate the new vehicles for private passengers. As SpaceShipOne touched down on October 4, the partnership between Virgin Galactic and Scaled began.⁵⁷

⁴⁹ Orbital Sciences Corporation (commonly referred to as Orbital) was an American company specializing in the design, manufacture and launch of small- and medium- class space and rocket systems for commercial, military and other government customers.

⁵⁰ Miriam Kramer, Orbital Sciences Corporation: Satellites, Rockets and the Space Station, <http://www.space.com/20652-orbital-sciences-corporation.html>. See also, John Yembrick, NASA Awards Space Station Commercial Resupply Services Contracts, http://www.nasa.gov/home/hqnews/2008/dec/HQ_C08-069_ISS_Resupply_prt.htm.

⁵¹ Dan Roberts, Antares rocket on ISS resupply mission explodes seconds after launch, The Guardian, October 29th, 2014, <http://www.theguardian.com/science/2014/oct/28/antares-rocket-explodes-nasa-launch-pad-orbital-science>.

⁵² Orbital Science, Products & Services, <http://www.orbitalatk.com/products-services/>.

⁵³ Brian Berger, Orbital ATK Org Charts Detail the Newly Merged Company, <http://spacenews.com/orbital-atk-org-charts-detail-the-newly-merged-company/>.

⁵⁴ <http://www.nasa.gov/content/nasa-partner-spacex-unveils-human-carrying-dragon-v2/#.VUxyLNOqqko>.

⁵⁵ This corporation has been founded in 2004, as a child company of Virgin Group. The self-introduction of Virgin Galactic follows, “Virgin Galactic is comprised of hundreds of dedicated and passionate professionals — including rocket scientists, engineers, and designers from around the world — united in creating something new and lasting: the world’s first commercial space line.” Virgin Galactic, <http://www.virgingalactic.com/who-we-are/>.

⁵⁶ See, Virgin Galactic, History of human spaceflight, <http://www.virgingalactic.com/human-spaceflight/history-of-human-spaceflight/>.

⁵⁷ Virgin Galactic, History of human spaceflight, <http://www.virgingalactic.com/human-spaceflight/history-of-human-spaceflight/>.

Virgin Galactic grew out of the success of the Ansari X Prize contest in 2004⁵⁸, for the first privately built and financed craft that could rise above the 62-mile boundary of space.⁵⁹ Scaled Composites won the \$10 million prize with a smaller version of SpaceShipTwo, an effort financed by Paul Allen, the co-founder of Microsoft. Immediately after the X Prize, Mr. Branson announced his plans for a spaceship that would carry two pilots and six passengers on suborbital flights — in which the plane does not go into orbit but offers a few minutes of weightlessness at the top of an arcing trajectory.⁶⁰

Virgin Galactic provides research flights as an agency of NASA.⁶¹ However, the main business of Virgin Galactic is, unlike SpaceX, space tourism. Virgin Galactic made an item, which gives customers the opportunity to see the sight of outer space. Virgin Galactic began to receive applicants by the Virgin Galactic Future Astronaut Application. According to the explanation from Virgin Galactic, a seat to space with Virgin Galactic and membership of the Future Astronaut community requires the full price of US\$250,000 to be paid as an up-front deposit. Rights to refunds and other terms is sent for the consideration as a part of the application process.⁶²

Furthermore, Virgin Galactic criticizes the history of spaceflight that the human spaceflights in the past were only conducted by the agency of the government justifying their business.⁶³

⁵⁸ In the Ansari X Prize, the team which became Virgin Galactic later was Mojave Aerospace Ventures, a team funded by Microsoft co-founder Paul Allen and led by legendary aerospace pioneer Burt Rutan and his company, Scaled Composites. *See*, Virgin Galactic, History of human spaceflight, <http://www.virgingalactic.com/human-spaceflight/history-of-human-spaceflight/>, citing, Scaled Composites, <http://scaled.com/>. Scaled Composites, LLC is an aerospace and specialty composites development company located in Mojave, California (about 80 miles north of Los Angeles). Founded in 1982 by Burt Rutan, scaled has broad experience in air vehicle design, tooling and manufacturing, specialty composite structure design, analysis and fabrication, and developmental flight tests of air and space vehicles. The employees at Scaled come from a diverse background of talents, experience, and interests. This unique combination of individuals helps promote an innovative and creative atmosphere. Scaled offers the opportunity to pursue career and personal interests in a manner that can be found nowhere else by following one simple rule: have fun. Scaled Composites, About us, <http://scaled.com/about/>. In 2004 Burt Rutan made international headlines as the designer of SpaceShipOne, the world's first privately-built manned spacecraft to reach space, and as winner of the \$10 million Ansari X PRIZE, the competition created to spur the development of affordable space tourism. Rutan retired from Scaled Composites on March 31, 2011. Scaled Composites, Burt Rutan, http://scaled.com/about/burt_rutan/.

⁵⁹ As concerned before, Kármán line.

⁶⁰ International New York Times, http://www.nytimes.com/2014/11/01/science/virgin-galactics-spaceshiptwo-crashes-during-test-flight.html?_r=0.

⁶¹ SpaceShipTwo of Virgin Galactic's frequent flights, the ability to carry as much as 1,300 pounds (600 kilograms) of research experiments and support equipment, and low pricing. NASA is an early customer of SpaceShipTwo's research flights, through its Flight Opportunities Program. NASA has already announced twelve different experiments that are planned to fly on SpaceShipTwo's first research flight, including cutting-edge experiments related to in-space 3D printing, on-orbit propellant depots, asteroid formation, and biological gene expression. Virgin Galactic, Research flight, <http://www.virgingalactic.com/human-spaceflight/research-flights/>. To find out what "Flight Opportunity Program" is; *See*, NASA, Flight opportunity, <https://flightopportunities.nasa.gov/>.

⁶² Virgin Galactic, <http://www.virgingalactic.com/human-spaceflight/fly-with-us/>. The contract to human spaceflight will be concerned as followed.

⁶³ *See*, Virgin Galactic, History of human spaceflight, <http://www.virgingalactic.com/human-spaceflight/history-of-human-spaceflight/>. For more than five decades, the exploration of space has

Federal Aviation Administration (FAA) recognizes “a new paradigm” which the government gives the private corporations the chances to join the human spaceflight project.⁶⁴

2.3.3 Private spaceflight as a hobby

There has been, surely, the amateurs who have enthusiasms to take people or herself to the outer space without any interests on profit. A private Danish rocket group, Copenhagen Suborbitals⁶⁵ seems to have no interest on profit while SpaceX has earned money by fulfilling the requests of NASA and Virgin Galactic has tried to make new business item for the people. The members of Copenhagen Suborbitals have made a rocket and a spacecraft, Tycho Brahe⁶⁶ which is designed to protect a human from the damage during the travel above the Kármán line. At the test launch, however, HEAT-1X rocket and Tycho Brahe reached to the apogee, 2021 meter above the land.

been driven by government programs. Beginning with the first person in space — Yuri Gagarin in 1961 — human space exploration has been conducted by a handful of superpower government agencies. Their missions are pioneering, important, and inspiring, but they are also expensive, infrequent, and generally inaccessible to all but a select group of highly trained government astronauts from a limited number of nations. *Ibid.*

⁶⁴ To date, the high cost and risk of human space missions have required the government accept the financial, technical and programmatic risk. This made the government the funder, customer, and overall manager. Key questions arising from the planned commercial human program are, ‘What has changed to enable true commercial programs now? What has lowered the risk to make it appropriate for commercial companies? The answers lie in the fact that NASA is proposing to approach human space flight differently than in past programs. Whereas previous programs incorporated cutting edge technology and challenged systems to achieve very high levels of technical performance, the proposed commercial program is focused on relatively simple systems to provide routine access to low earth orbit at acceptable levels of safety. The more aggressive programs of exploration and cutting edge technology expansion will remain the domain of the government, while commercial companies focus on orbital flight using mature technology and conservative designs. FAA, 2010 at 8-9.

⁶⁵ Copenhagen Suborbitals was founded in 2008 to prove that human spaceflight can be different from the usual expensive and governmental controlled projects. *See*, <http://copenhagensuborbitals.com/about/mission/>.

⁶⁶ Tycho Brahe is the first prototype spacecraft designed and built by CS. It is named in honor of the Danish astronomer Thyge Ottesen Brahe (1546-1601). It was originally designed to fit the largest rocket CS believed itself capable of building at the time of its conception in 2008. Thus, it has a diameter of just 64 cm which means the astronaut will be in a half sitting and half standing position, as seen in the original concept drawing below. The top of the spacecraft is an acrylic dome which provides the astronaut a full view of the sky during the flight to and back from space. The spacecraft is now retired after its flight on June 3rd 2011, carried by the HEAT-1X rocket. The rocket veered of course shortly after lift off, and the engine had to be cut after 15 seconds of flight. During flight the spacecraft had acquired a high lateral velocity which caused the parachutes to partially tear at deployment. This caused Tycho Brahe to impact the water at about 200 km/h and sustain significant damage. Copenhagen Suborbitals, Tycho Brahe, 2011, <http://copenhagensuborbitals.com/spacecraft-2/tycho-brahe/>. Next to Tycho Brahe, Copenhagen Suborbitals had Tycho Deep Space, tested in 2012. Copenhagen Suborbitals, Tycho Deep Space, 2012, <http://copenhagensuborbitals.com/spacecraft-2/tycho-deep-space-1/>. Finally, Copenhagen Suborbitals has a plan to improve Tycho Deep Space with making Tycho Deep Space II. Copenhagen Suborbitals, Tycho Deep Space, 2015, <http://copenhagensuborbitals.com/spacecraft-2/tycho-deep-space-2/>.

Besides Copenhagen Suborbitals, there are numerous private amateur rocketry clubs including Perigee Rockets in Korea.⁶⁷ Perhaps people on Earth are engaging the private amateur rocketry clubs more frequently than the private companies but it is not sure. Therefore it can be hazardous if the unclarified private rocket launch damages people. Tripoli Rocketry Association⁶⁸ is the premier high-power rocketry organization⁶⁹ for the private amateur rocketry clubs which provides the rocketry club members who joined Tripoli Rocketry Association the rocket launch insurance.⁷⁰

Spaceflight as a hobby is not a target of this article. However, rocket launch as a hobby is a valuable topic for another research in the view of law.

2.4 The mechanism of space tourism in Virgin Galactic

To clarify the possibility to death in the human spaceflight, it is required to set a limit on the space tourism. As concerned above, Virgin Galactic is the pioneer-like company in the space tourism industry. It has concreted the concept of private space tourism. Virgin Galactic acknowledges the Kármán line so that Virgin Galactic has developed the tourism item which takes the customer beyond the Kármán line.⁷¹

The application form for the space travel requires the potential customers to provide 7 kinds of personal information and 3 thoughts on variable topics at least: for the personal information — name, age, nationality, e-mail, phone number, address and occupation; and for the thoughts — motivation to go to space, thought to the community whose name is Galactic United.⁷² After the application, the Astronaut Relations Team deal with the new applicant including to make an opportunity meet the potential customers each other.⁷³ As the tourism item of Virgin Galactic begins, the passengers can get to the outer

⁶⁷ Perigee Rocket is Non-profit amateur rocketry club. Since 2013, it has had the plan to make a spacecraft to get the 150 kg payload to the low-Earth orbit till 2020. For more information about Perigee Rocket, in Korean; <http://perigee.cc/>.

⁶⁸ Tripoli is a non-profit organization dedicated to the advancement and operation of amateur high power rocketry. Tripoli Rocketry Association, INC., <http://www.tripoli.org/Membership/tabid/57/Default.aspx>.

⁶⁹ Tripoli Rocketry Association, INC., Top Ten Reasons Why You Should Join Tripoli <http://www.tripoli.org/Membership/WhyJoinTRA/tabid/76/Default.aspx>. Tripoli is an international organization, with prefectures worldwide. At TRA launches in the US, you may meet some of the members from Canada, Australia, the U.K., Sweden, Germany, Switzerland, and many more. *See, Ibid.*

⁷⁰ Tripoli Rocketry Association, INC., Tripoli Launch Insurance: Liability Coverage for Rocketry Related Activities by Members of the Tripoli Rocketry Association <http://www.tripoli.org/Launches/LaunchInsuranceForms/tabid/178/Default.aspx>.

⁷¹ *See, Virgin Galactic, Human Spaceflight, <http://www.virgingalactic.com/human-spaceflight/your-flight-to-space/>.* There is no discrete physical boundary between the Earth's atmosphere and outer space. Different organizations have named different altitudes in an attempt to codify space's official border: (i) NASA and the US Air Force use the threshold of 50 miles (80 kilometers) to award astronaut wings, recognizing the pilots of the iconic X-15 program that so inspired Virgin Galactic's own vehicles; and (ii) The "Kármán line" of 100 kilometers (62 miles) is also used, particularly outside of the USA. Although its exact apogee may vary from flight to flight, SpaceShipTwo is designed to reach altitudes above these thresholds. *See, Ibid.*

⁷² *See, Virgin Galactic, Application form, <http://www.virgingalactic.com/human-spaceflight/fly-with-us/application/>.*

⁷³ There will be plenty of opportunity to ask questions, as well as discuss all aspects of community membership and your spaceflight reservation with our Astronaut Relations Team as your application

space by riding SpaceShipTwo model,⁷⁴ whose name is VSS Enterprise. VSS Enterprise is carried to 15,500m height by the carrier plane, WhiteKnightTwo model,⁷⁵ whose name is VMS Eve,⁷⁶ and dropped from the aircraft. The space ship has own hybrid engine to carry itself to the 100,000m height. About the altitude, the passengers can feel the micro-gravity circumstance and spectacular sight from the window. After the five-minute experience, the vehicle glides down to the spaceport⁷⁷. The article on the homepage of Virgin Galactic describes the process of item:

As SpaceShipTwo coasts up into space, our astronauts will leave their seats and experience true, unencumbered weightlessness. The pilots will maneuver the spaceship in order to give the astronauts the best possible view of Earth and the blackness of space from vehicle's twelve large cabin windows.

After several minutes of weightlessness, our astronauts will return to their seats to prepare for re-entry. Personalized seats, custom-designed to safely

is processed. Virgin Galactic, Fly with us, <http://www.virgingalactic.com/human-spaceflight/fly-with-us/>.

⁷⁴ SpaceShipTwo is a reusable, winged spacecraft designed to carry repeatedly as many as eight people (including two pilots) into space — a larger total flight crew than any previous space mission except for NASA's 8-member STS-61-A mission in 1985. Everyone on board SpaceShipTwo will earn official astronaut status, just like the pilots who flew the X-15 space plane. A hybrid rocket motor—one that combines elements of solid rockets and liquid rocket engines by using a solid fuel source and a liquid oxidizer powers SpaceShipTwo. Hybrid rocket motors are not a new idea; they have been used in many other applications, including on SpaceShipOne. Although each type of rocket engine has important advantages for different applications (for example, LauncherOne uses liquid rocket engines), hybrids are particularly well suited for SpaceShipTwo because they can be shut down safely and quickly at any point during the flight, unlike solid motors, but do not require the cryogenic propellant tanks or complex plumbing needed by liquid rocket engines. Virgin Galactic, <http://www.virgingalactic.com/human-spaceflight/our-vehicles/>.

⁷⁵ WhiteKnightTwo is the mothership for SpaceShipTwo and is currently the world's largest commercial all composites aircraft. WhiteKnightTwo is a custom-built, four-engine, dual-fuselage jet aircraft. It is designed to carry SpaceShipTwo (or LauncherOne) up to an altitude of ~50,000 feet for air launch, a concept that was established by Chuck Yeager's supersonic Bell X-1, the X-15, and of course SpaceShipOne. WhiteKnightTwo's signature design features are its twin fuselage configuration; single-piece, carbon composite high main wing; and four jet engines. The twin boom configuration allows for a spacious central attachment area between the two fuselages for SpaceShipTwo or LauncherOne. WhiteKnightTwo's pilots fly the plane from its right fuselage. In the future, with the right regulatory approvals, research experiments or even customers preparing for their flights to space may sit in the cabin of either fuselage. The first WhiteKnightTwo, called Eve, has completed an extensive four-and-a-half year flight-test program. Virgin Galactic, <http://www.virgingalactic.com/human-spaceflight/our-vehicles/>.

⁷⁶ The first WK2, christened VMS Eve after Sir Richard Branson's mother, was revealed to the public for the first time in July 2008 and had its maiden flight in December 2008. The Spaceship Company, <http://www.thespaceshipcompany.com/vehicles/view/wk2>. see also the downloadable data sheet for WhiteKnightTwo at: http://www.thespaceshipcompany.com/images/uploads/documents/VG_Insert_v8_260612.pdf.

⁷⁷ Virgin America operates a spaceport in America, Spaceport America. Spaceport America is accommodating Virgin Galactic's WhiteKnightTwo and SpaceShipTwo. Also, SpaceX's Falcon 9R and host numerous other suborbital launches including those of UP Aerospace are operating their missions in the space port. Spaceport America is placed in 901 E. University Ave, Suite 965L, Las Cruces, NM 88001, United States with 18,000 acres and a 12,000-foot spaceway. Spaceport America, <http://spaceportamerica.com/>.

support each astronaut during every phase of flight, will provide cushioning as the spaceship rapidly decelerates upon re-entry. Once SpaceShipTwo has safely re-entered the atmosphere, the vehicle's wings will be returned to their normal configuration, and the spaceship will glide back to the original runway. Upon landing, the newly-official astronauts will join their family and friends to celebrate their spaceflight in true Virgin style.⁷⁸

Now Virgin Galactic is preparing to launch the new item with testing the flight process.⁷⁹ After the finish of the testing launches, the reserved customers would get serviced. Each customer will take part in three days of pre-flight preparation, bonding, and training onsite at Spaceport America, proceeding basic emergency response training and activities to aid familiarity with the spaceflight environment.⁸⁰

2.5 Possible risks in space tourism

Space tourism is a fascinating item in blue ocean as a few other companies provide the service. In addition, it seems many people on Earth have a desire to be out of the airspace. Less supply with more demand equals an increase of the price. For the entrepreneur, space tourism is the very business to expand.

However, proceeding a space travel, there are innumerable risks. Usually, the human spaceflight project are divided in three stage: launch, outer space, and reentry. Each state has the typical risk: physical problem of vehicle in the launch stage, space debris collisions in the outer space stage, and flow in of air in the reentry stage.

2.5.1 Risks during the launch

While the preceding statements assumed the use of liquid propellants, the problems associated with the use of solid propellants also deserve considerable attention. It is now said that a solid propellant, which normally will not detonate, might become detonated when a certain size is exceeded.⁸¹ The conclusion is that the transition from burning to detonation is a physical condition rather than the chemical make-up of the propellant. Thus, as in the case of liquid propellants, the standards of care in the use of solid propellants must be extremely high in order to avoid both the costly loss of equipment and danger to the lives of those involved.⁸² However, the technical and legal problems are still many and varied. Weather conditions must be checked thoroughly not only for the area of the launching site but also at the higher altitudes where the satellite-bearing missile will travel. If the wind velocity is too high, launching will be postponed.⁸³

⁷⁸ Virgin Galactic, Human Spaceflight, <http://www.virgingalactic.com/human-spaceflight/your-flight-to-space/>.

⁷⁹ Irene Klotz, Virgin Galactic Test Flights to Restart This Year, Discovery News, 2015, <http://news.discovery.com/space/private-spaceflight/virgin-galactic-test-flights-to-restart-this-year-150109.htm>.

⁸⁰ Virgin Galactic, Astronaut Training, <http://www.virgingalactic.com/human-spaceflight/training/>

⁸¹ McColloum 1959, at 294, citing Zaehring, Solid Fuels Vie for Propellant Lead, 4 Missiles and Rockets 28 (Aug. 11 1958)

⁸² *Ibid.* at 294.

⁸³ *Ibid.* at 294, citing Von Braun, The Story Behind the 'Explorers,' This Week Magazine, April 13 1958, p. 8.

A dangerous fuel leak could also halt the launching.⁸⁴ It is also possible that the rocket may become ignited prematurely with the result that one or more stages may take off and explode nearby starting brush fires,⁸⁵ or it may blow itself apart in flight due to the malfunction of a component such as the control system⁸⁶ or the fuel system⁸⁷ or other unknown causes.⁸⁸ Further- more, it may be necessary for a safety official to destroy the missile in flight if it veers off course.⁸⁹ In each of these instances the protection of lives and property must be a prime consideration.

2.5.2 Risks in outer space

More than 500,000 pieces of debris, or “space junk,” are tracked as they orbit the Earth. They all travel at speeds up to 17,500 mph, fast enough for a relatively small piece of orbital debris to damage a satellite or a spacecraft. The rising population of space debris increases the potential danger to all space vehicles, but especially to the International Space Station, space shuttles and other spacecraft with humans aboard.⁹⁰

NASA takes the threat of collisions with space debris seriously and has a long-standing set of guidelines on how to deal with each potential collision threat. These guidelines, part of a larger body of decision-making aids known as flight rules, specify when the expected proximity of a piece of debris increases the probability of a collision enough that evasive action or other precautions to ensure the safety of the crew are needed.⁹¹

Collision risks are divided into three categories depending upon size of threat. For objects 4 inches (10 centimeters) and larger, conjunction assessments and collision avoidance maneuvers are effective in countering objects which can be tracked by the Space Surveillance Network. Objects smaller than this usually are too small to track and too large to shield against. Debris shields can be effective in withstanding impacts of particles smaller than half an inch (1 centimeter).⁹²

The first accidental hypervelocity collision of two intact spacecraft occurred on 10 February, 2009, leaving two distinct debris clouds extending through much of low Earth orbit (LEO). Iridium 33, a U.S. operational communications satellite (International Designator 1997-051C, U.S. Satellite Number 24946), and Cosmos 2251, a Russian decommissioned communications satellite (International Designator 1993-036A, U.S. Satellite Number 22675), collided at 1656 GMT as the two vehicles passed over extreme

⁸⁴ *Ibid.* at 294, citing Von Braun, *supra*, not 28.

⁸⁵ *Ibid.* at 294, citing Cleveland Plain Dealer, October 16, 1958, p. 1.

⁸⁶ *Ibid.* at 294, citing 3 *Astronautics* 5 (March 1958).

⁸⁷ *Ibid.* at 294, citing 4 *Missiles and Rockets* 157 (June 1958).

⁸⁸ *Ibid.* at 294, citing Cleveland Plain Dealer, October 9, 1958, p. 1.

⁸⁹ *Ibid.* at 294, citing Cleveland News, November 5, 1958, p. 18.

⁹⁰ Mark Garcia, *Space Debris and Human Spacecraft*, NASA, 2013, http://www.nasa.gov/mission_pages/station/news/orbital_debris.html. In the past, however, NASA had different thought from Mark Garcia. The Thousands of manmade objects—95 % of them “space junk”— occupy low Earth orbit. Each black dot in this image shows either a functioning satellite, an inactive satellite, or a piece of debris. Although the space near Earth looks crowded, each dot is much larger than the satellite or debris it represents, and collisions are extremely rare. Holli Riebeek, *Catalog of Earth Satellite Orbits*, Earth Observatory, NASA, 2009, <http://earthobservatory.nasa.gov/Features/OrbitsCatalog/>.

⁹¹ *Ibid.*

⁹² *Ibid.*

northern Siberia at an altitude of 790 km. Both spacecraft were in nearly circular orbits high inclinations.⁹³

At the time of the collision, the two orbital planes intersected at a nearly right angle, resulting in a collision velocity of more than 11 km/s.⁹⁴ On 12 March the crew of the International Space Station (ISS) temporarily retreated into the safety of their Soyuz TMA-13 spacecraft when a small piece of orbital debris was belatedly projected to come close to the ISS. In the end, the interloping object (International Designator 1993-032D, U.S. Satellite Number 25090) passed ISS at a comfortable distance of almost 4 km.⁹⁵

2.5.3 Risks during the reentry

On Feb. 1, 2003, space shuttle Columbia broke up as it returned to Earth, killing the seven astronauts on board. NASA suspended space shuttle flights for more than two years as it investigated the disaster.⁹⁶ The disaster was caused by the risk during the reentry.

There is another spaceship-wreck which also occurred because of the problem in the process of reentry. While developing the space travel item, Virgin Galactic has tested fifty-five times the spaceship. At first, they expected the maiden flight in 2009. However, several occasions make the flight postponed and, finally, the crash accident surprises people in October 31, 2014.⁹⁷ One of the two pilots died.⁹⁸ Fortunately, it was only a test

⁹³ See, NASA, *Orbital* 2009 at 1.

⁹⁴ *Ibid.* at 1.

⁹⁵ *Ibid.* at 3.

⁹⁶ An investigation board determined that a large piece of foam fell from the shuttle's external tank and fatally breached the spacecraft wing. This problem with foam had been known for years, and NASA came under intense scrutiny in Congress and in the media for allowing the situation to continue. Columbia, on mission STS-107, left Earth for the last time on Jan. 16, 2003. At the time, the shuttle program was focused on building the International Space Station. However, STS-107 stood apart as it emphasized pure research. The seven-member crew — Rick Husband, commander; Michael Anderson, payload commander; David Brown, mission specialist; Kalpana Chawla, mission specialist; Laurel Clark, mission specialist; William McCool, pilot; Ilan Ramon, payload specialist from the Israeli Space Agency — spent 24 hours a day doing science experiments in two shifts. They performed around 80 experiments in life sciences, material sciences, fluid physics and other matters. On Feb. 1, 2003, the shuttle made its usual landing approach to the Kennedy Space Center. A television network was showing video of the shuttle breaking up in the sky. The shuttle's external tank was redesigned, and other safety measures implemented. In July 2005, STS-114 lifted off and tested a suite of new procedures, including one where astronauts used cameras and a robotic arm to scan the shuttle's belly for broken tiles. NASA also put more camera views on the shuttle during liftoff to better monitor foam shedding. Elizabeth Howell, *Columbia Disaster: What Happened, What NASA Learned*, Space, 2013, <http://www.space.com/19436-columbia-disaster.html>.

⁹⁷ On Oct. 31, 2014, the first SpaceShipTwo, called Enterprise, was lost during its 55th test flight. Virgin Galactic, <http://www.virgingalactic.com/human-spaceflight/our-vehicles/>. Although SpaceShipTwo had flown 54 previous test flights, all but three were unpowered tests in which it glided to the ground. This was the fourth time its motor was ignited. In the accident, it was the first powered by the new motor switching to the plastic-based fuel from the rubber-based one it had used. Kenneth Chang and John Schwartz, *Virgin Galactic's SpaceShipTwo Crashes in New Setback for Commercial Spaceflight*, *International New York Times*, 2014, http://www.nytimes.com/2014/11/01/science/virgin-galactics-spaceshiptwo-crashes-during-test-flight.html?_r=0.

⁹⁸ One pilot was able to parachute from the plane and was taken to a hospital with “moderate to major injuries,” said Ray Pruitt, the public information officer for the Kern County sheriff's office in California. The test was the first time. After the smaller plane was released, its motor ignited. The accident appeared to happen 60 to 90 seconds later, said Stuart Witt, the chief executive of Mojave Air and Space Port, where WhiteKnightTwo took off at 9:18 a.m. WhiteKnightTwo landed safely.

flight, so that there are no passengers. As people worry about, the space tourism is not perfectly safe.

2.6 Comparison between the risks of space travel and the risks of extreme sports

To recognize how dangerous space travel, it needs to concern the other dangerous activities, for example, extreme sports. Extreme sport is defined as recreational physical activity that carries a risk of serious physical injury or even death.⁹⁹ The extreme sport includes skydiving and BASE jumping.¹⁰⁰ In this article, to concern the risk of the space tourism, the fatality of sky diving is considered.

Sky diving can be regarded as a dangerous activity since 24 fatal skydiving accidents in the U.S. out of roughly 3.2 million jumps. In 2014, United States Parachute Association (USPA) members reported 729 skydiving injuries out of roughly 3.2 million jumps. That is roughly 2.3 injuries per 10,000 skydives.¹⁰¹ The risk in regular skydiving has been estimated to be around 5 deaths and 140-170 injuries per 100,000 parachute jump, and annually leading to 30 – 40 deaths in United States.¹⁰²

BASE-jumping is a more extreme and significantly more dangerous form of parachuting. There are many similarities between skydiving and BASE-jumping, but there are also distinct differences that force the BASE jumpers to deal with a greater spectrum of hazards. BASE-jumping is ranked among the most dangerous sports in the world.¹⁰³ A study of 20,850 BASE jumps from the same site reported 9 fatalities over the 11-year period from 1995 to 2005, or 1 in every 2,317 jumps.¹⁰⁴ The death rate can be calculated into 4.3 deaths per every 10,000 BASE jumps.

In the case of fatalities in space travel, it is worse than skydiving. As of September 2014, there have been 557 astronauts and cosmonauts who have flown in space since Yuri Gagarin became the first man in space. Of these 557 astronauts, 19 died while on a space mission and several others died during training.¹⁰⁵ That is about 341.1 deaths per

Kenneth Chang and John Schwartz, Virgin Galactic's SpaceShipTwo Crashes in New Setback for Commercial Spaceflight, International New York Times, 2014, <http://www.nytimes.com/2014/11/01/science/virgin-galactics-spaceshiptwo-crashes-during-test-flight.html? r=0>.

⁹⁹ Hetland, 2009, at 8, citing Willig, 2008.

¹⁰⁰ See, *ibid.* at 8, citing Slinger & Rudestam, 1997; Soreide, et al., 2007; Willig, 2008.

¹⁰¹ See, <http://www.uspa.org/AboutSkydiving/SkydivingSafety/tabid/526/Default.aspx>. See also, Risk of dying and sporting activities, <http://www.medicine.ox.ac.uk/bandolier/booth/risk/sports.html>.

¹⁰² Hetland, 2009, at 10, citing Soreide, et al., 2007

¹⁰³ Kockelman, 2009, at 10-11, citing Pedersen (1997).

¹⁰⁴ Delta Gear, Inc. BASE Fatality Risk Analysis, http://www.deltagearinc.com/FYI/Downloads/BASE_fatality_risk_analysis.pdf.

¹⁰⁵ As of September 2009, there have been 507 astronauts and cosmonauts who have flown in space since Yuri Gagarin became the first man in space Cf. Marsh 2010 at 438, citing <http://www.cbsnews.com/network/news/space/democurrent.html>. The list of space missions and their associated death toll is as follows: Soyuz 1 (one death), Soyuz 11 (three deaths), Challenger (seven deaths) and Columbia (seven deaths). Additionally, three other lives were lost during the training for the Apollo 1 mission. *Ibid.* Since the dawn of the space age, only 547 humans have traveled above the Earth's atmosphere and into space. It can be inferred that there were 40 more human spaceflights during the 6 years. According, Virgin Galactic, Human Spaceflight, 2015, <http://www.virgingalactic.com/human-spaceflight/>. However, on Oct. 31, 2014, there was an

10,000 space travels in history. Roughly comparing the death rates of space travel to the rates of skydiving and BASE jumping, the space travel is 682.2 times more dangerous activity than skydiving and 79.3 times more than BASE jumping.

3 Comparison with a Russian roulette game

The death rate of space tourism can be considered 3.4 per cent. In Russian roulette game, parties enjoy the game with a bullet in 6 cylinders. When the party can completely kill the other with no faults at a trigger, the death rate of Russian roulette can be calculated as 16.7 per cent. Now, if there is no qualitative difference between space travel and the game, the space travel can be considered as the another form of Russian roulette which has 17 bullets in 50 cylinders.

Therefore, when a person decides to participate in the program of Virgin Galactic, the person is planning to join the Russian roulette game with 17 bullets in 50 cylinders. A contract must have “enforceability” to be justified.¹⁰⁶ With the considerable death rate, the space travel and space tourism cannot avoid the criticisms on enforceability. As the society regulates the Russian roulette game as illegal activity, how can the society accept the space tourism?

Some, however, would criticize this theory that there is a difference which distinguish the space tourism from Russian roulette although the travel has high death rate. This article will argue that the space tourism is not acceptable by finding and highlighting the qualitative commons between space travel and Russian roulette in the view of contract law.

3.1 Space tourism as an illegal contract

Absolute liberty on the exercise of contracts can destroy the system of public policy since if a hit-man contract is accepted with the name of freedom of contract, the society accepts murder. When a society limits the exercise, the contract is called “illegal contract.”¹⁰⁷ If the parties perform the terms of the illegal contract, they become criminal. When one of the parties are damaged by the non-performance of the terms, the party cannot be protected by law and courts.¹⁰⁸ In sum, when the crime by the contract occurs, the contract becomes invalid and the performance does a crime.

additional death during the test flight of Virgin Galactic. *See also*, Kenneth Chang and John Schwartz, Virgin Galactic’s SpaceShipTwo Crashes in New Setback for Commercial Spaceflight, International New York Times, 2014, http://www.nytimes.com/2014/11/01/science/virgin-galactics-spaceshiptwo-crashes-during-test-flight.html?_r=0.

¹⁰⁶ *According*, Blum, 2013, at 2. A contract may be defined as an exchange relationship created by oral or written agreement between two or more persons, containing at least one promise, and recognized in law as enforceable. This definition reflects several essential elements: 1. An oral or written agreement between two or more persons; 2. An exchange relationship; 3. At least one promise; and 4. Enforceability. *Ibid*.

¹⁰⁷ *See, Ibid*, at 467. Even when the contract is a full and genuine exercise of both parties’ freedom of contract, it may break the law or so offend public policy that the court refuses to enforce it. *Ibid*. Some illegal contracts are such a serious violation of the law that performance of the contract is a criminal act. *See, Ibid*, at 469.

¹⁰⁸ *See, Ibid*, at 469. The basic rule is that a court will not enforce an illegal contract or term, even if it is clear that the parties entered the contract voluntarily and there was no improper bargaining. *Cf.*

3.2 Corporate homicide

Russian roulette is considered a contract before a bullet is fired. After the firing bullet, however, the game is regarded as a homicide crime since the United States bars a person kills human-being.¹⁰⁹

As the same logic, before the consumer of the space tourism is crashed, the contract on the space travel is legal and enforceable. Right after the crash, the contract is invalid and the crash is considered as a homicide.

The subject of the homicide can be Virgin Galactic as a corporation. Since there is no limitation that the subject of a homicide should be the human-being, a corporation can be the criminal for homicide. In the Great Briton, there is the law which acknowledges a corporation as a subject of homicide.¹¹⁰ According to the law, a corporation is guilty when it causes a person's death or amounts to a gross breach of a relevant duty of care owed by the organization to the deceased.¹¹¹

According to *In Pari Delicto* Rule, the parties in the space tourism contract cannot sue each other for the enforcement on the other party's performance.¹¹² Therefore, the contract becomes invalid because the illegal contract does not meet the standard that all the contract must be enforceable.

Therefore, the space tourism cannot be accepted in the society because of its illegality.

3.3 Assumption of risk

Although the providence of information about the risk of the activity, if the passengers of space travel consented to the contract and, at last, crashed, the families of the passengers will sue the corporation and try to be paid for the injuries. Then, the corporation will defend itself with "assumption of risk"¹¹³ by the passengers. *Volenti non fit injuria*.¹¹⁴ The defendant says that the victims voluntarily join the contract though the defendant

Parente v. Pirozzoli, 866 A.2d 629 (Conn. App. 2005); *Homani v. Iranzadi*, 211 Cal. App. 3d 1104 (1989)

Contract against public policy is not the target of this article. In weighing a public policy against enforcement of a term, account is taken of (a) the strength of that policy as manifested by legislation or judicial decisions, (b) the likelihood that a refusal to enforce the term will further that policy, (c) the seriousness of any misconduct involved and the extent to which it was deliberate, and (d) the directness of the connection between that misconduct and the term. Restatement 2d Contract section 178, (3)

¹⁰⁹ See, Model Penal Code (MPC) § 210.1. Criminal Homicide.

¹¹⁰ See, Corporate Manslaughter and Corporate Homicide Act 2007

¹¹¹ Corporate Manslaughter and Corporate Homicide Act 2007 1 (1) (a) and (b)

¹¹² When an illegal contracts occurs, the basic rule is that where the parties share the guilt of having entered an illegal contract, the court will keep aloof from the dispute and will not intervene to help either party. This is known as the *in pari delicto* rule, an abbreviation of the maxim *in pari delicto potior est condicio defendentis*. (When the parties are in equal guilt, the defendant's position is stronger.) Blum, 2013 at 472. The effect of applying the *in pari delicto* rule is that the court declines to award relief and leaves the parties as it finds them. The obvious effect of this is that the court will refuse to enforce the contract where on of the parties sues for enforcement. This is what happened in both *Parente* and *Homani*. *Ibid.* at 473.

¹¹³ Assumption of risk is a plaintiff's voluntary and knowing exposure to a particular risk. John L. Diamond (1995) at 718.

¹¹⁴ Latin, "to a willing person, injury is not done."

specifically and clearly notified the potential risks to the victims. Then, the restitution will be granted to the plaintiff with some reductions by the assumption of risk doctrine.

Enhanced by the assumption of risk doctrine, the freedom of people to make contracts is secured more. People can contract anything they want because, if the party is injured by the contract, the counterparty is no more liable for the party's damages.

In the case of Russian roulette, the participants of the game cannot be protected also by the assumption of risk rule as well as the illegal contract rule. Space tourism is the same as Russian roulette. The parties, Virgin Galactic and the consumers, cannot be covered by law when a crash occurs.

3.4 Imbalance of information between Virgin Galactic and the consumers

The point is that there must be the imbalance of information between Virgin Galactic and the consumers before the launch, so that the assumption of risk is not justified. The consumers, though they are trained for the travel, are laypeople who has less information of the risks on the tourism.

Promulgated in early 2007, the Human Space Flight Requirements set out the U.S. regulations for operators and participants in commercial suborbital flights, better known as space tourism. The regulations require "operator[s] . . . who [have] a space flight participant on board a vehicle" to ensure that each space flight participant gives written informed consent after being notified of the risks involved in space flight.¹¹⁵ This means that the operator must disclose, in writing, that there are risks known and unknown for this activity.

One of the major problems with "informed consent" under the Human Space Flight Requirements is that it is an ambiguous term. The regulations "[create] a duty to disclose risks and dangers material to a reasonable person in deciding upon a course of action."¹¹⁶

However, although there is the duty to disclose all the negative information of the space travel, the consumers who have intents to participate the travel can underestimate the significance of the risk. In this situation, the consent does not meaningful since the contract and the tourism industry increase the prices of society.

4 Conclusion

The space tourism is a result from the history of space industry. The momentum which tends to move the industry from public to private seems unstoppable. However, the space travelling is too risky to accept the private form of the space tourism.

Until the main problems are solved, the space tourism cannot be acceptable. The fatality rates should be decreased. Although the high-level technology is being developed, the frequency of fatality is too high to understand. At least, the rate should be decreased about the risk rate of BASE jumping which is known for the most dangerous extreme sport.

¹¹⁵ Blount 2008, at 3, citing 14 C.F.R. § 460.45(b) (2008)

¹¹⁶ *Ibid.*, at 4, citing Timothy Hughes & Esta Rosenberg, Space Travel Law (and Politics): The Evolution of the Commercial Space Launch Amendments Act, 31 J. SPACE L. 1, 53 (2005).

5 References

- Erik Cohen, A Phenomenology of Tourist Experiences, 13 *Sociology* 179 (1979)
- G. Candela and P. Figini, *The Economics of Tourism Destinations*, Springer Texts in Business and Economics, Springer (2012) DOI 10.1007/978-3-642-20874-4_2
- Boris Chertok, *Rockets and People*, The NASA History Series, National Aeronautics and Space Administration (2005)
- David Darling, *The Complete Book of Spaceflight From Apollo 1 to Zero Gravity*, John Wiley & Sons, Inc. (2003)
- Talcott Parsons, *THE SOCIAL SYSTEM*, 2nd edition, Routledge & Kegan Paul Ltd (1991)
- Partain, Roy Andrew, *The Legally Pluralistic Tourist* (June 22, 2014). Management-Culture-Interpretation, Forthcoming. Available at SSRN: <http://ssrn.com/abstract=2457675>
- David Darling, *The Complete Book of Spaceflight From Apollo 1 to Zero Gravity*, John Wiley & Sons, Inc. (2003)
- Rathuel L. McCollum, Tort Aspects of Space Technology, 8 *Clev.-Marshall L. Rev.* 292 (1959)
- Judith A. Rumerman, U.S. HUMAN SPACEFLIGHT: A RECORD OF ACHIEVEMENT, MONOGRAPH IN AEROSPACE HISTORY No.41, 1961-2006, SP-2007-4511, NASA History Division (2007)
- Nandasiri Jasentuliyana, *SPACE LAW: DEVELOPMENT AND SCOPE*, Greenwood Pub Group (1992)
- NASA, SpaceX CRS-1 Mission Press Kit: First Cargo Resupply Services Mission, (2012)
- Dennis R. Jenkins, X-15: EXTENDING THE FRONTIERS OF FLIGHT, NASA (2012). Available at NASA: http://www.nasa.gov/connect/ebooks/aero_x15_detail.html
- Wendell H. Stillwell, X-15: RESEARCH RESULTS WITH A SELECTED BIBLIOGRAPHY, Scientific and Technical Information Division, NASA (1965)
- Dennis R. Jenkins, *HYPERSONICS BEFORE THE SHUTTLE: A CONCISE HISTORY OF THE X-15 RESEARCH AIRPLANE*, NASA Publication SP-2000-4518, NASA (2000)
- James Andrew Lewis, *Hard Choices for Manned Spaceflight: America as Icarus*, Strategic Technologies Program, Center for Strategic & International Studies (2014)
- NASA, *Orbital Debris Quarterly News*, Volume 13, Issue 2, The NASA Orbital Debris Program Office (2009)
- Inter-Agency Space Debris Coordination Committee (IADC), *IADC Space Debris Mitigation Guidelines*, IADC Action Item Number 22.4, IADC-02-01 (2007)
- Thomas Pedersen, *Copenhagen Suborbitals Flight report HEAT-1X / Tycho Brahe* (2011). Available at Copenhagen Suborbitals: http://copenhagensuborbitals.com/wp_blog/wp_content/uploads/2013/11/HEAT1X_flight.pdf
- Federal Aviation Administration, *Launches*, 2014, http://www.faa.gov/data_research/commercial_space_data/launches/?type=license
- Terry L. Hardy, *Models and Simulations: Risks and Lessons Learned*, *Journal of 1 Space Safety Engineering* (1), 3, 2014

Paul D. Wilde, Chris Draper, and Aircraft Protection Standards and Implementation Guide-lines for Range Safety, 48th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition, 2010

Elizabeth A.Z. Gonzales and Daniel P. Murray, FAA's Approach to Ground and NAS Separation Distances for Commercial Rocket Launches, 48th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition, 2010

Federal Aviation Administration (FAA) Associate Administrator for Commercial Space Transportation, Commercial Human Spaceflight Crew Training Survey, HQ-080204, 2008

FAA, Associate Administrator for Commercial Space Transportation, Flight Safety Analysis Handbook, (2011). Available at FAA Reports & Studies Library:

https://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/

FAA, Study on Informed Consent for Spaceflight Participants, APT-CFA-230-0001-02F. (2008). Available at FAA Reports & Studies Library:

https://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/

Paul Alp, Limitations On Liability As To Space Tourists, Aviation and Space Law Committee, (2011). Available at FAA Reports & Studies Library:

https://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/

Melvin S. Marsh, Ethical Issues Regarding Informed Consent for Minors for Space Tourism, American Institute of Physics, 438, (2010). Available at FAA Reports & Studies Library:

https://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/

Daniel P. Murray and Andre Weil, The FAA's Approach to Quality Assurance in the Flight Safety Analysis of Launch and Reentry Vehicles, (2010). Available at FAA Reports & Studies Library:

https://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/

Steven Millard, Risk Considerations for the Random Reentry of Space Debris, 48th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition (2010)

FAA, Report of the Commercial Human Spaceflight Workshop, Office of Commercial Space Transportation Federal Aviation Administration (2010)

Frans G. von der Dunk, Sun, Sea, Sand ... and Space: Launching Tourists into Outer Space from the Dutch Caribbean, pace and Telecommunications Law Program Faculty Publications, 62, (2011) Available at Digital commons@ University of Nebraska - Lincoln: <http://digitalcommons.unl.edu/spacelaw/62>

Christopher M. Hearsey, A Review of Challenges to Corporate Expansion into Outer Space, AIAA SPACE 2008 Conference & Exposition, AIAA 2008-7816 (2008)

Jeff Foust, Weighing the risks of human spaceflight, The Space Review (2003) Available at The Space Review: www.thespacereview.com/article/36/2

U.S. Human Spaceflight Plans Committee, Seeking a Human Spaceflight Program Worthy of a Great Nation, Review of U.S. Human Spaceflight Plans Committee (2009)

Audun Hetland, Feeling the extreme: An exploratory study of experienced emotions during extreme sport, Master thesis in Psychology, University of Tromsø (2009)

R.A. Buckley, ILLEGALITY AND PUBLIC POLICY, 2nd Edition, Contract Law Library, Sweet & Maxwell (2009)

Brian A. Blum, *EXAMPLES & EXPLANATIONS CONTRACTS*, 6th Edition, Wolters Kluwer Law & Business (2013)

P.S. Atiyah, *The Rise and Fall of Freedom of Contract*, Oxford (2003)

Anton Westman, *Fatalities in Skydiving*, Karolinska Institutet (2014)

Juliet P. Kostritsky, *Illegal Contracts and Efficient Deterrence: A Study in Modern Contract Theory*, 74 *Iowa Law Review*, 115 (1988) Available at SSRN: <http://ssrn.com/abstract=923577>

John L. Diamond, *Assumption of Risk After Comparative Negligence: Integrating Contract Theory into Tort Doctrine*, 52 *Ohio St. LJ*, 717 (1991)

Melvin Aron Eisenberg, *The limits of cognition and the limits of contract*, *Stanford Law Review*, 211(1995)

Stephen D. Sugarman, *Assumption of Risk*, *Val. UL Rev.*, Vol. 31, 833 (1996)

David Horton, *Extreme Sports and Assumption of Risk: A Blueprint*, 38 *University of San Francisco Law Review*, 599 (2004). Available at SSRN: <http://ssrn.com/abstract=1585408>

Timothy S. Kaye, *Law and Risk: An Introduction*, *RISK AND THE LAW*, Gordon Woodman & Diethelm Klippel, eds., 3 (2008) Available at SSRN: <http://ssrn.com/abstract=1263472>

Timothy S. Kaye, *Risk and Predictability in English Common Law*, *RISK AND THE LAW*, Gordon Woodman & Diethelm Klippel, eds., 95 (2008) Available at SSRN: <http://ssrn.com/abstract=1263481>

Melvin A. Eisenberg, *Impossibility, Impracticability, and Frustration*, 1(1) *The Journal of Legal Analysis*, 207 (2009) Available at SSRN: <http://ssrn.com/abstract=1349482>

Aristides N. Hatzis, *STANDARD CONTRACT TERMS IN EUROPE: A BASIS FOR AND A CHALLENGE TO EUROPEAN CONTRACT LAW*, Hugh Collins, ed. Wolters Kluwer Law & Business, *Private Law in European Context Series*, 43 (2008) Available at SSRN: <http://ssrn.com/abstract=899008>

Robert W. McGee, *Suicide is a Property Right; Assisted Suicide is a Contract Right*, *Commentaries on Law & Public Policy*, 36 (1997) Available at SSRN: <http://ssrn.com/abstract=845813>

Harold S. Davis, *The Plaintiff's Illegal Act as a Defense in Actions of Tort*, *Harvard Law Review* 18(7) (1905)

P.J. Blount, *Informed Consent V. Itar: Regulatory Conflicts that Could Constrain Commercial Human Space Flight*, *National Center for Remote Sensing, Air, and Space Law*, University of Mississippi School of Law (2008) Available at SSRN: <http://ssrn.com/abstract=1364261>