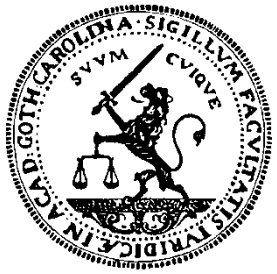

FACULTY OF LAW

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Satelliability

A study of the intersection between international responsibility and international liability for private satellite launches

JURM02 Graduate Thesis

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Contents

Summary

In this thesis I study international space law's rules on international responsibility and international liability for private satellite launches. I have used a legal dogmatic method to interpret these rules, before subjecting them to an economic analysis on how they will affect the behaviour of private actors and States. Finally I propose solutions to increase the economic efficiency of three different situations that involve private satellite launches' meeting with international space law.

This is done in the following way. Chapter two presents the main framework for private satellite launches within international space law, which consists of the *Outer Space Treaty* (OST), the *Liability Convention* (LC) and the *Registration Convention* (REG) and how these correlate. In short a State party to the OST has international responsibility over private space activities it has jurisdiction over. According to the LC, which is lex specialis to the OST, the international liability is borne by a launching State. A State is qualified as a launching State if it launches or procures the launch of a space object, e.g. a satellite, or if a space object is launched from its territory or facility. There can be multiple launching States which are jointly liable under the provisions of the LC. One of the launching States must register the satellite in their national register and with the UN, thus making it possible for others to know of the satellites existence and legal status. A private satellite launch will as a general rule always have a launching State, that will be liable if the satellite crashes and causes damage, but in chapter four I present some exceptions to this rule.

In chapter three I present how the end of the cold war and the economic and political development of the world has introduced new actors in space activities. These are private companies and developing nations that want to take part of the many benefits of space. Chapter four presents three different situations that have sprung from the entrance of private enterprise into the realm of space law. Finally, in chapter five I analyse these situations and the regulatory framework covering them with the method of law and economics. My proposed solution to the uncertainties of space law that can cause economic inefficiency is to adopt national space law and establishing a mandatory insurance regime. By harmonizing national space law and establishing an insurance regime for all private satellite launches, it is possible to attribute the liability for a private activity from a launching State back to the company performing it, while still enabling the existence of private space enterprises.

Sammanfattning

I denna uppsats studerar jag internationell rymdrätts regler om internationellt ansvar och internationellt skadeståndsansvar för privata satellituppskjutningar. Jag har använt mig av en rättsdogmatisk metod för att tolka dessa regler och sedan utför jag en rättsekonomisk analys av hur de kommer att påverka agerandet hos privata aktörer och stater. Slutligen föreslår jag lösningar för att öka den ekonomiska effektiviteten i tre olika situationer som involverar privata satellituppskjutningars möte med internationell rymdrätt.

Detta görs på följande sätt. I kapitel två presenteras huvudramen för regleringen av privata satellituppskjutningars inom internationell rymdrätt, som består av *Rymdfördraget* (OST), *Ansvarskonventionen* (LC) och *Registreringskonventionen* (REG) och hur dessa korrelerar. Kort sagt har en stat som är part till OST internationellt ansvar för privata rymdverksamheter som den har jurisdiktion över. Enligt LC, lex specialis i förhållande till OST, bärs det internationella skadeståndsansvaret av en uppskjutsstat. En stat kvalificeras som en uppskjutsstat om den skjuter upp eller inhandlar uppskjutningen av ett rymdobjekt, ex. en satellit, eller om ett rymdobjekt skjuts upp från dess territorium eller anläggning. Det kan finnas flera uppskjutsstater parallellt och dessa är då solidariskt skadeståndsansvariga enligt bestämmelserna i LC. En av uppskjutsstaterna måste registrera satelliten i sitt nationella register och med FN, vilket möjliggör för andra att känna till satellitens existens och rättsliga status. En privat satellituppskjutning kommer som huvudregel alltid att ha en skadeståndsansvarig uppskjutsstat, men undantag finns vilket visas i kap. 4.

I kapitel tre presenterar jag hur slutet av det kalla kriget samt den ekonomiska och politiska utvecklingen i världen har introducerat nya rymdaktörer. Dessa är privata företag och utvecklingsländer som vill ta del av dem många fördelarna rymden medför. Kapitel fyra presenterar tre olika situationer som har uppstått i samband med privata aktörers inträde på rymdrättsscenen. Slutligen analyserar jag dessa situationer och regelverket bakom med en rättsekonomisk metod i kapitel fem. Min föreslagna lösning på osäkerheterna i rymdrätten som kan orsaka ekonomisk ineffektivitet ligger i nationell rymdrätt. Genom att harmonisera den nationella rymdrätten och införa ett försäkringskrav för alla privata satellituppskjutningar, är det möjligt att återföra skadeståndsansvaret för en privat rymdverksamhet tillbaka från en uppskjutsstat till företaget som utför det, medan man samtidigt möjliggör existensen av privata rymdföretag.

Foreword

During the semesters first two weeks I found myself in a Kafkaesque situation. I was bounced around between the different divisions of the faculty of law, since space law was an unfamiliar subject. I'm therefore very grateful to Moa for accepting to be my supervisor. Thank you Moa for valuable discussions and comments that have greatly improved my thesis. As usual, any faults or errors in the text are solely my own.

Now I will switch to my first language, Swedish, since I feel I can more freely express the combination of humor and sentimentality that will follow below. If you have read this far without understanding Swedish then I applaud you for your dedication to space law.

I en galax inte så långt bort, för inte särskilt lång tid sen började jag juristprogrammet. Vid denna tidpunkt fasade jag den dagen jag skulle behöva skriva ett helt examensarbete då det verkade omöjligt att ro hem en sådan bedrift. I skrivande stund vet jag inte om mitt yngre jag hade rätt eller ej, men jag hoppas att denna känsla berodde på min ännu ej fullt utvecklade hjärna. Denna ska tydligen bli färdig hos män först i 25-års åldern, vilket är lägligt med tanke på att jag fyllde 26 för två veckor sen.

Tiden i Lund hade inte varit densamma utan Hallands Nation där jag lärt känna många vänner och haft otroligt kul. Här fick jag både boende och så småningom arbete, då jag fick möjligheten att skjuta upp examen och den kommande uppsatsen kring satelituppskjutningar för att få vara med och leda nationen på heltid under 2015. Ett extra tack till alla som var med och gjorde det året till mitt hittills roligaste, svåraste, mest lärorika och ohälsosammaste år. Om någon har hittat Chrilles laddare som kom bort på bussen till förmannaresan ht-15 får ni gärna lämna den till återvinning då jag förmodar[1] att han bytt telefonmodell sen dess.

Tack till HG, framförallt för första halvan av juristprogrammet då vi sågs frekvent, nu infaller ju radio- och tv-avgiften oftare än våra träffar.

Tack till nätkursavdelningen där jag haft nöjet att arbeta som amanuens och få fri tillgång till kaffe på fjärde våningen. Tack även till uppsatsgänget som gjorde skrivandet mindre ensamt och mycket roligare, om än något transcendentalt. Superstort tack till min mamma Anna för villkorslöst stöd genom allt och till min bror Fabian som jag alltid har nära till skratt med.

Ett tack ska även riktas till den examinator som läser detta, med reservation för att tacket kan komma att dras tillbaks vid utebliven examen.

[1] Chrille bekräftade den 4 januari 2018 att han bytt modell.

Abbreviations

Outer Space Treaty	OST
Liability Convention	LC
Registry Convention	REG
Committee on the peaceful uses of outer space	Copuos
International Space Station	ISS
European Space Agency	ESA

1 Introduction

1.1 Background

Space law emerged in the middle of the cold war following the ongoing "space race" between the US and USSR, which started with the Soviet launch of the satellite Sputnik into orbit on 4 October 1957. This development triggered a discussion within the international community about the necessity to create international regulations on space activities and an ad-hoc Committee on the Peaceful Uses of Outer Space (Copuos) was established the next year by the General Assembly of the United Nations. The committee was made permanent the following year and has played a central role for the development of international space law ever since.[2] It is within the auspices of the committee that the currently existing five space treaties have been discussed and drafted.[3]

The latest treaty, the *Moon Agreement*, has not been ratified by any of the major space nations and it is therefore considered by many to be a failure. One reason why this convention's capabilities to attract States are weak seems to be connected to how it conceives of the moon and other celestial bodies as being the common heritage of mankind and to the adjoined provisions that postulate an equitable distribution of resources extracted from these celestial bodies.[4] These provisions are seen as hindering for private exploitation of resources in outer space.[5]

[2]Jankowitsch, Peter, 'The background and history of space law', (pp. 1–28) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 2–3, 10–11.
[3] http://www.unoosa.org/oosa/en/ourwork/copuos/history.html.
[4] René Lefeber, 'Relaunching The Moon Agreement', *41 Air & Space Law* pp. 42-42, and Articles I and XI of the Moon Agreement.
[5]Landry, Benjamin, 'A Tragedy of the Anticommons: The Economic Inefficiencies of Space Law', *38:2 Brook J Int'l L*, p. 535.

In recent years, the private sector has had an increasing importance regarding space projects. This affects the development of space law, which traditionally centres on States and their activities in outer space.[6]

The drafters of the original space treaty, *"Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies"*, (*Outer Space Treaty, hereinafter OST*) were foresighted enough to envision private actors within the field of use and exploration of outer space. This was asserted through Article VI of the *OST* in which non-governmental entities are mentioned and are made subject to authorization and continued supervision by the appropriate State party when conducting activities in outer space.[7] Furthermore, the same provision states that a State party to the treaty bears international responsibility for national activities in space, regardless if these are conducted by governmental or non-governmental entities.[8] In subsequent sections, I will return to the implications of this article on private actors in outer space.

However, during the first two decades of the so-called space age, private actors were only involved with the space activities of the western countries and their roles were merely as contractors in State projects.[9] Because of the governing socialist ideologies in the Soviet Union and the eastern bloc, there were no private enterprises involved within their space activities.[10]

[6]Hobe, Stephan, 'Historical Background', (pp. 1–17) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), pp. 14–15.
[7]Kerrest, Armel and Smith, Lesley Jane, 'Article VII', (pp. 125–145) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 138.
[8]Kosmo, Fredl 'The Commercialization of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility', *61 S. Cal. L. Rev.*pp. 1068-1069.
[9]See for example Kosmo, Fred, 'The Commercialization of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility', *61 S. Cal. L. Rev*. p. 1055.
[10]Smolkin-Rothrock, Victoria 'The contested skies', (pp. 57–78) in *Soviet Space Culture; Cosmic Enthusiasm in Socialist Societies*, Maurer, Eva et. al. (eds.), pp. 59-60.

Apart from Article VI, another important principle set forth in the *OST* is Article VII, which establishes the principle on international liability. In this Article a State party is assigned international liability for an object that it has participated in launching into outer space.[11]

For example, if a private satellite is launched from the territory of a State party to the *OST*, then that State is liable for damage caused by the satellite even though it is privately owned. The State will therefore indirectly act as a warranty for private space operations.

Since Article VII of the *Outer Space Treaty* establishes general principles, there was a need for further elaboration of what international liability should encompass. Therefore, this Article was further elaborated into the *Liability Convention (LC)*[12], which entered into force in 1972 and contains a number of provisions on liability. This subsequent treaty has the status of *lex specialis* in relation to the *Outer Space Treaty* on matters regarding liability[13].

In the first Article of the *Liability Convention*, the concepts of *launching State* and *space object* are defined. These concepts are reoccurring and important within the body of international space law and will therefore play an important role for the purpose of this thesis, and as will be shown later on, these concepts can become problematic when put in contact with activities performed by private enterprise in outer space. This thesis will show how *launching State* and *space object*, which are linked to the attribution of liability, can be interpreted in a variety of ways. Certain interpretations of these concepts can result in outcomes where private

[11]Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (the "Outer Space Treaty"), Article VII, 610 U.N.T.S. (entered into force 10 October 1967).
Hence referred to as the "*Outer Space Treaty*" in the footnotes.

[12] Convention on the international liability for damage caused by space objects (the "*Liability Convention*"), 961 U.N.T.S. (entered into force 1 September 1972).
Hence referred to as the *Liability Convention* in the footnotes.

[13]Kerrest, Armel and Smith, Lesley Jane, 'Article II (Absolute Liability)', (pp. 116–130) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.) p. 125.

activities will not be covered by international liability, thus weakening the possibilities of an injured party to obtain compensation.

Recently, the expansion of the interest taken by the private sector in space and space activities has increased exponentially. There have been new initiatives such as launching privately owned satellites, space tourism and far-reaching plans of establishing inhabited colonies.[14]
Because these kinds of activities at the time of adopting OST and LC probably sounded like mere science fiction, they were not taken into direct account when drafting either of them. This means that today, there are gaps and uncertainties when applying the conventional body of international space law, formed during the sixties and seventies, on our new technology infused and growth driven world where private actors have an important role.

1.2 Scope and purpose

In this thesis I will examine how new developments in space activities have affected and may affect the body of international space law. With new developments, I refer to the private commercialisation of outer space that I briefly outlined upon in the previous section.

The focus of this thesis is set on the principles of *international responsibility for national activities in outer space* and *international liability* established through the *Outer Space Treaty* and the *Liability Convention* (see Articles VI-VII *OST* and Articles I-II *LC*). The intention with incorporating the aforementioned principles into the two mentioned international conventions on space law was to ensure a safe use of space and compensation to those who could suffer damages from a space object, for

[14]See for example the company "Rocket Lab" regarding private launches of satellites at *https://www.rocketlabusa.com/about-us/*,
the company "Space Adventures" on the matter of space tourism at *http://www.spaceadventures.com/about-us/*,
and the companies "Space X" and "Mars One" about their respective plans on colonization of Mars at *http://www.spacex.com/mars* and *https://www.mars-one.com/about-mars-one*.

example the passengers of an airplane damaged by a satellite on its way into orbit.[15] When the treaties on space law were established in the beginning of the space age, States were the only subjects able to perform activities in outer space.[16] It was thus natural to attribute international responsibility and liability only to States. Consequentially the process of attributing these concepts was relatively simple as every launch of a space object, e.g. a satellite, was handled from start to finish by a determined State.

The principles presented above are being challenged by the entry of private enterprises onto the scene of space activities. The existence of private enterprises might lead to launching companies "license shopping"[17] to circumvent Art VI of the *OST* from which international responsibility emerges. Such license shopping can be conducted through legal constructions, through which, the international responsibility and adjoined licencing is attributed to the State that is most "favourable" for the enterprise. An example of this is the case of "Sea Launch", an enterprise specialized in launching space objects from platforms at sea. Sea Launch started as a company incorporated in the Cayman Islands (but by means of a substantial American ownership fell under authorization by the US) and later reorganized its corporation to Switzerland, before finally transferring its ownership to a Russian holding company. By purposively changing the nationality of the juridical person, Sea Launch could theoretically circumvent the well-established licensing body of US space law and thus alleviate its regulatory burden when performing launches. However, it continues to obtain licensing from the US.[18] This illustrates how the private

[15]Kerrest, Armel and Smith, Lesley Jane, 'Historical Background and Context LIAB', (pp. 94–99) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.), pp. 96–98.
[16]Jankowitsch, Peter,'The background and history of space law', (pp. 1–28) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 5–6.
[17]See Palkovits, Neta, 'Space Entrepreneurship and Space Law – Future Challenges and Potential Solutions', (pp. 61–72) in *Proceedings of the International institute of space law 2013*, Corinne Jorgenson (ed.), pp. 66–67. and Masson-Zwaan, Tanja 'Article VI of the Outer Space Treaty and Private Human Access to Space', republished in https://openaccess.leidenuniv.nl/handle/1887/14303, section 7.
[18] Fenema, Peter Van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 389–390.

sector's entry into the space industry poses new challenges in interpretation and application of traditional space law.

Further on in this thesis I will examine the relationship between international responsibility stemming from the *Outer Space Treaty* and how this concept correlates to the international liability found in the *Liability Convention*. However, for now it suffices to highlight merely the fact that gaps exist in so far as, for example, one State can authorize a space venture and thus carry bear international responsibility for this privately conducted space activity while not having international liability for said activity, which instead is placed on the launching States.

As mentioned above, the purpose of this thesis is to study what impacts the entrance of private entities into the field of space activities (such as the example of Sea Launch), specifically satellite launches, has had on the applicability of the principles of international responsibility and liability set forth in articles VI-VII of the O*uter Space Treaty*. International liability will be further studied trough an analysis of the relevant provisions of the *Liability Convention*, which is an expansion of Article VII of the *Outer Space Treaty.*

The following questions will be addressed to accomplish said purpose:

1. How does the emergence of private actors in access to outer space affect the applicability of international space law, considering its traditional State-oriented provisions?
   1.1 To answer this question, it is necessary to study in what ways do the concepts of "appropriate State" and launching State correlate with each other, regarding the question of attributing international responsibility and liability for a space object launched either by a State or a private entity.

2. Until now, how has the international community handled the issue of private satellite launches in the light of the established legal regulation of international responsibility and liability and how can these issues be tackled from an economic perspective? Answering this question will lead to a normative discussion on how the development on space law shall take these experiences into account in a de lege ferenda perspective while making use of a law and economics method.

1.3 Delimitations

This thesis will focus on international space law and national legislation will be included sparsely to exemplify some factual cases. Even though there are a number of interesting questions arising from the current privatization of outer space, due to limitations of time and space I have narrowed down the scope of the thesis to satellite launches. I will focus my discussions on private satellite launches and how the method in which a satellite is launched affects which State is internationally responsible and/or liable if this satellite would cause damage, either on Earth or in outer space. Launches performed by international organizations will not be studied. Space traffic management and satellite navigation are related to questions of liability but the thesis would become too broad in its scope if I would to include these developing regulatory framework. Neither will the International Telecommunication Union framework on satellite communications be discussed, since it would move the direction of the thesis from private enterprises to international organizations.
Questions regarding the registration of space objects will be included to the extent that they help clarify the questions of assigning international responsibility and international liability. However, the material aspects of such registration will not be further discussed.

For the purposes of the present thesis, the *Rescue Agreement* and *Moon Agreement* have little or no relevance as they do not regulate issues regarding satellite launches nor responsibility or liability for such activities.

1.4 Method, theories and perspective

In this thesis I use a legal dogmatic method which consist of studying the sources of international law such as they are presented in article 38 (1) of the statute of the ICJ. These sources are international treaties, international customary law, general principles of law, judicial decisions and legal scholarship.[19] Due to the idiosyncratic nature of space law, seeing to the fact that there are many rules that have yet to be applied since many envisioned space activities have not yet been realized, the main sources for a study like the present are the "space treaties" and legal scholarship. Because understanding any kind of expression of law requires a method of interpretation, I have adopted the method of treaty interpretation put forth in the *"Vienna Convention on the Law of Treaties"*[20] Articles 31-33.

In the Chapters where I look forward on how the development of space law should take form, I apply theories of law and economics. In short, this is a method that consists of using economic theories on legal rules to analyse either how they are or how they should be in order to achieve desirable economic goals. Law and economics is a legal method that consists of applying theories and concepts from the discipline of political economy onto legal rules. The application of law and economics on given legal problems can be divided into two branches: a descriptive and a prescriptive branch. The descriptive, or positive, branch of law and economics consists of analysing how a certain rule affects the economic aspects of society.[21]

[19]See Thirlway, Hugh, 'The Sources of International Law', (pp. 95–121) in *International Law*, Evans. D, Malcolm (ed.) p. 98.
[20]*Vienna Convention on the Law of Treaties*, 1155 U.N.T.S. (entered into force 27 January 1980).
[21] Polinsky, Mitchell A., *An introduction to law and economics*, pp. xiv–xv.

The prescriptive, or normative, branch centres on using economic theories in order to propose how legal rules should be formulated in order to better achieve economic efficiency.[22]
In Chapter Five I further elaborate on which variation of law and economics I have used and what the method consists of. Then I use the concepts presented by conducting first a descriptive and then a prescriptive analysis of three different situations.

A theory that I use in this thesis when considering space law is the functionalist theory. This theory has emerged as a response to the fact that there does not exist an international agreed upon limit on where outer space begins. Due to this fact there exist differing opinions for when the applicability of air law ends and space law begins. The functionalists resolve this issue by determining which set of rules shall be applied based on the function of the vehicle/object that is performing an activity. For example, a rocket that has the capacity to reach outer space and is launched with the intention to enter space falls under the scope of space law even when it is moving through the air space. The contrasting view are the spatialist that argue that space, and space law, begins around 100 km up from the surface of the Earth. [23] I find the functionalist theory as the most reasonable theory on space law's reach, due to the fact that space operations have their largest impact on Earth before entering outer space and should therefore be regulated by space law from launch to finish.

1.5 Material

In order to present the body of space law applicable to my research questions I have used international treaties, resolutions from the United Nations and legal doctrine. To give a broader view of how political and economic developments of the world has affected the actors involved with

[22] Miceli, Thomas. J, 'Economic Models of Law', (pp. 9–28) in *The Oxford Handbook of Law and Economics; Volume I: Methodology and Concepts*, Parisi, Francesco (ed.), p. 13.
[23] Dunk, Frans G. von der, 'International Space Law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 87.

space projects I have also used scientific texts from the fields of political science and economy. When making use of the method of law and economics to conduct my analysis in chapter five I use doctrine from this field.

1.6 Research Standing

International responsibility and international liability's relation has been studied by space commentators such as Bin Cheng[24], Frans von der Dunk[25] and Paul Stephen Dempsey[26]. They have also studied how these concepts can be applied on private space activities, but they have not subjected these concepts and situations to a law and economics analysis. There exist some other studies of satellites with a law and economics perspective, but these focus on damages in orbit and space debris.[27] I focus mainly on damages caused by a satellite that is no longer in outer space, which further separates my thesis from the other economic studies.

1.7 Disposition

In Chapter Two, I present how the international body of space law is constructed and discuss the relevant provisions on international responsibility and liability. In Chapter Three, I describe how changing political and economic structures have enabled further access to space through the entrance of private actors to the space scene. Then in Chapter Four I discuss three problematic situations emerging from the changed conditions presented in the previous chapter. Finally, in Chapter Five, while

[24] Cheng, Bin, 'International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-governmental Entities' in *Studies in International Space Law*, pp. 621–633.
[25] Dunk, Frans G. von der,' Liability versus Responsibility in Space Law: Misconception or Misconstruction?', in *Space, Cyber, and Telecommunications Law Program Faculty Publication,* 21, pp. 363–370.
[26] Dempsey, Paul Stephen, 'Liability for Damage Caused by Space Objects under International and National Law', *37Annals Air & Space L*, pp. 333–368.
[27]Salter, Alexander William, 'Space Debris: A Law and Economics Analysis of the Orbital Commons', in *19 Stan. Tech. L. Rev. 221*, pp. 221–238.
Nodir Adilov, Peter J. Alexander & Brendan M. Cunningham, 'An Economic Analysis of Earth Orbit Pollution', 60 ENVTL. & RESOURCE ECON 81 (2015), pp. 81–98.

making use of theories on law & economics I analyse the three situations and how they affect international responsibility and international liability. Question 1 will be answered in chap. 2-3 while question 2 will be answered in chap. 4-5.

2 Foundations of Space law

2.1 The origin of space law

Space law, as a branch of public international law, emerged in the advent of the space era. As mentioned earlier, the space era began with the launching of the first artificial satellite into orbit by the Soviet Union. The satellite was named Sputnik, and its launch took place in 1957 with the ongoing cold war as the political backdrop.[28]

The two superpowers, the U.S and the U.S.S.R, both realized the urgent need to regulate space activities since neither wanted to risk that the other should gain an unprecedented advantage over a new potential battlefield. Since these two actors were at the centre stage of global politics, their commitment to regulating the use of outer space was crucial since other States would then follow suit. [29]

Discussions in the UN lead to the establishment of an ad hoc committee for the peaceful uses of outer space in 1958. The Soviet Union initially boycotted the committee since it thought it lacked representation of more countries and wanted that the committee should adopt its decisions through consensus, which the US opposed seeing that they preferred majority rule. Concessions were made by the western bloc which expanded the number of members and split the chairmanship of the subcommittees between western

[28] See Freeland, Steven, "There's a Satellite in My Backyard - Mir and the Convention on International Liability for Damage Caused by Space Objects" *University Of New South Wales Law Journal*, 2001, no. 2, p. 465.
[29]Dunk, Frans G. von der, 'International Space Law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 34–37.

and eastern States.[30] Through the efforts of this committee, international space law would come to be.[31]

2.1.1 Copuos

The ad hoc committee, called Copuos[32], was made permanent in 1959 and initially consisted of 24 members. The committee is split into two subcommittees, the legal and the technical subcommittee. During the committee's first years, the main discussions revolved around the question of which legal principles should govern the use of outer space. These discussions eventually resulted in the "Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space"[33] called the *Principles Resolution*, which was adopted by the United Nations General Assembly (UNGA) in 1963.

This resolution fomented that States' use of outer space should be for peaceful purposes and it encouraged international cooperation.[34] However, concerns were raised in both blocks about the risk of the other side gaining an unsurmountable strategic advantage (both military and economically) if they would gain control of outer space. Therefore, Copuos was put to work on a treaty laying down central and binding principles for the utilization of outer space.[35] This was an important step forward from the somewhat vague *Principles Resolution* that, due to its status as resolution of

[30]Jankowitsch, Peter, 'The background and history of space law', (pp. 1–28) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 10-12.
[31] Dunk, Frans G. von der, 'International Space Law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 39–41.
[32] The Committee on the Peaceful Uses of Outer Space.
[33] "Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space", General Assembly resolution 1962 (XVIII) of 13 December 1963.
[34] See Freeland, Steven, "There's a Satellite in My Backyard - Mir and the Convention on International Liability for Damage Caused by Space Objects" *University Of New South Wales Law Journal*, 2001, no. 2, p. 466.
[35] Dunk, Frans G. von der, 'International Space Law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 34–37.

the General Assembly, was not considered to constitute binding international law.[36]

2.2 The space treaties

In the following subsections I will discuss some central provisions of the *Outer Space Treaty* (OST), the *Liability Convention* (LC) and the *Registry Convention* (REG) in that order. The reason for discussing these treaties are that they in conjunction form a framework for how a private satellite launch is regulated in international space law. International responsibility is attributed to a State through the OST, liability through the LC and the State that shall register the space object with the United Nations is determined through the REG.

2.2.1 The Outer Space Treaty

Legal scholars sometimes refer to the *Outer Space Treaty* as the "magna carta" of space law.[37] This is a reasonable approach given that said treaty contains several core principles, which reoccur in most subsequent instruments of space law.[38] The legal principles that have the largest impact on the activities of private enterprises in outer space are found in articles VI and VII of the *Outer Space Treaty*.[39] These two principles are important since they decide which State bears international responsibility and liability for a private enterprise, thus binding these private actors to States' legal norms when performing space activities.

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[36] Stanton Hardenstein, Taylor, "In Space, No One Can Hear You Contest Jurisdiction: Establishing Criminal Jurisdiction On The Outer Space Colonies Of Tomorrow" Journal of Air Law and Commerce, Spring, 2016, pp. 261-262.
[37] Hobe, Stephan, 'Historical Background', (pp. 1–17) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 14.
[38] See Marboe, Irmgard, 'National space law', (pp. 127–204) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 169, 180–181.
[39] Antoni, Ntorina and Bergamasco, Federico, 'To Orbit and Beyond: Present Risks and Liability Issues from the Launching of Small Satellites', (pp. 75–92) in *Proceedings of the International institute of space law 2014*, Moro-Aguilar, Rafael, Blount, P.J., & Masson-Zwaan, Tanja (eds.), pp. 86–87.

2.2.1.1 Article VI and International responsibility

Article VI of the outer space treaty introduces the concept of international responsibility for national space activities. This responsibility encompasses activities performed by governmental agencies as well as non-governmental activities i.e. a private activity.

The Article reads:

> *States Parties* to the Treaty shall bear *international responsibility* for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by *non-governmental entities*, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. *The activities of non-governmental entities in outer space*, including the Moon and other celestial bodies, *shall require authorization and continuing supervision by the appropriate State Party to the Treaty*. When activities are carried on in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.[40]

This article is therefore essential for the assessment of a new space enterprise, because such an enterprise will fall under the international responsibility of the "appropriate State" due to its activities and will therefore need authorisation and supervision from this State in order to proceed with their space plans. Onwards I will interpret "activities" broadly under the functionalist approach, which means that all activities with the capacity and intent of reaching outer space are space activities which includes satellite launches regardless if they are successful or not.[41]

[40] The "Outer Space Treaty" Article VI, 610 U.N.T.S. (entered into force 10 October 1967). *Emphasis added.*

[41] Gerhard, Michael, 'Article VI', (pp. 103–125) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe &

But before discussing which State is considered to be the appropriate State for an activity, I will outline what international responsibility means.

International responsibility, also called State responsibility, is a concept that exists within the general body of international law and has come to be through international customary law. Subsequently the concept has been made subject to an attempted codification, and progression, through the workings of the International Law Commission in the treaty *Articles on the Responsibility of States for Internationally Wrongful Acts (Arsiwa)*.[42] The general concept of international responsibility means that a State is responsible for internationally wrongful acts towards another State, when these acts are attributable to the first State.[43] If a State is attributed an international wrongful act, firstly it must cease the act that constitutes a breach and offer appropriate guarantees that the act will not be repeated, which follows from Article 30 of *Arsiwa*. Thereafter, it must make full reparation for the injury caused, which is stated in Article 31 of *Arsiwa.* The different forms of how to make reparations are listed in Article 34 *Arsiwa*.[44]

The forms of reparations are restitution, compensation and satisfaction. Restitution means undoing or restoring the wrongdoing, for example restoring a building that has been destroyed by a crashed satellite. Compensation is an alternative when restitution is not possible or appropriate, and is typically made through monetary means where the wrongful act is valued to an amount that is paid to the wronged State. Satisfaction is the third form of reparation which comes into play when the two former forms are not possible, and can take the form of an official

Goh, Gérardine Meishan (eds.), pp. 107–109. See also my presentation of the functionalist theory in section 1.4.

[42] Crawford, James and Olleson, Simon, 'The Nature and Forms of International Responsibility', (pp. 441–471) in *International Law*, Evans. D, Malcom (ed.) pp. 446–447. *Articles on the Responsibility of States for Internationally Wrongful Acts*, adopted by the IC on 10 August 2001.

[43] Dunk, Frans G. von der,' Liability versus Responsibility in Space Law: Misconception or Misconstruction?', (pp. 363–370) in *Space, Cyber, and Telecommunications Law Program Faculty Publication,* 21, pp. 363–364.

[44] *Arsiwa* Articles 31, 34.

acknowledgment of the breach, a formal apology or other similar and appropriate means.[45]

The international responsibility for space activities under the *Outer Space Treaty* is based on the same principles as the general international responsibility but some differences exists. The main differences are regarding the attributability of a wrongful act to a State which has been performed by a private party.[46] The principal rule for attributing general international responsibility is that the wrongful act has been performed by representative of the State, for example its armed forces, and attributing acts of private parties to their State of nationality is an exception that is applicable only if the State has lacked in taking due care to prevent these acts, for example by not exercising control over a factory located at the boarder that pollutes the territory of a neighboring country.[47] The international responsibility in the *Outer Space Treaty* covers all private activities, regardless if the State has tried to prevent the wrongful acts or not. This means that even though a State has performed its due care by, as part of its responsibility under Article VI, authorizing and supervising a private space activity it will still bear international responsibility for a breach made by this activity. [48] Such a breach can for example consist of violating the territorial sovereignty of a country by flying a rocket through their airspace without their permission.

[45] Crawford, James and Olleson, Simon, 'The Nature and Forms of International Responsibility', (pp. 441–471) in *International Law,* Evans. D, Malcom (ed.) pp. 464–466.
[46] Dunk, Frans G. von der,' Liability versus Responsibility in Space Law: Misconception or Misconstruction?', (pp. 363–370) in *Space, Cyber, and Telecommunications Law Program Faculty Publication,* 21, p. 366–367.
[47] Cheng, Bin, 'International Responsibility and Liability for Launch Activities', (pp. 598–614) in *Studies in International Space Law* p. 601.
[48] Dunk, Frans G. von der,' Liability versus Responsibility in Space Law: Misconception or Misconstruction?', (pp. 363–370) in *Space, Cyber, and Telecommunications Law Program Faculty Publication,* 21, p. 367 and Cheng, Bin, 'International Responsibility and Liability for Launch Activities', (pp. 598–614)) in *Studies in International Space Law*, pp. 605–606.

As discussed above, when attributing international responsibility for a private activity in outer space the appropriate State must be identified. The interpretation of which State is considered the appropriate State in a certain situation has been interpreted by scholars not as a separate concept, but as a reference to the first section of Article VI where a State is made subject to international responsibility for national activities. The appropriate State is therefore the State that bears international responsibility for an activity. Following this interpretation, a State must have jurisdiction of the space activity performed by a private entity to bear international responsibility for it, since this is how international responsibility is mainly attributed to a State. [49]

Space law commentator Michael Gerhard, who has given a comprehensive overview of the main interpretations of Article VI in the Cologne Commentary on Space Law series, favours the interpretation presented above.[50] Gerhard begins by clarifying that the different interpretations he presents of Article VI all share a lowest common denominator. This is that only the State that has jurisdiction over a space activity can bear international responsibility, thus making it the appropriate State. The different strings of interpretation are separated by which methods used to attribute this jurisdiction, which I will not dwell into.

Gerhard argues for attributing State jurisdiction based on general principles of international law.[51] His arguments are based on the premise that it is in accordance with the purpose of the OST to attribute international responsibility by the principle of territorial sovereignty[52] and the active

[49] See Dunk, Frans G. von der,'International space law' and Marboe, Irmgard, 'National space law', (pp. 127–204) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 54 and p. 134.
[50] Gerhard, Michael, 'Article VI', (pp. 103–125) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), pp. 110–113.
[51] Gerhard, Michael, 'Article VI', (pp. 103–125) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 112.
[52] This concept will be explained below.

personality principle[53] which he derives from the fact that the drafters of OST did not intend to derive from the general concepts of international law. Furthermore, he presents state practice supporting this view. The Swedish space act applies territorial jurisdiction and the active personality principle, as well as the Norwegian space act that recognizes territorial jurisdiction but personal jurisdiction only in cases when the activity is performed from a territory not under the sovereignty of any State.[54]
The presented view, that the appropriate State corresponds with the State that has jurisdiction over a space activity, is supported by other prominent space commentators. [55]

The process of assigning an "appropriate State" can therefore be resolved through national space legislation in the sense of establishing jurisdiction for an activity. An example of this is the American Commercial Space Launch Act, which regulates when a private entity that wish to engage in space activities falls under US jurisdiction and therefore must comply with the supervision of the FAA Office of Commercial Space Transportation (FAA/AST). Under this supervision, foreign private entities are included if a substantial ownership of them is held by an American natural or legal person.[56] In this way, the United States have interpreted Article VI through its national space legislation, but if such national legislation would be insufficient, or if it is completely absent - as it happens to be in many cases - then assignation must be done based on Article VI of the Outer Space Treaty and its concept of appropriate State which, as showed above, is made through general principles of international law on State jurisdiction.

[53] This concept will also be explained below.
[54] Gerhard, Michael, 'Article VI', (pp. 103–125) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), pp. 113–114.
[55] Dunk, Frans G. von der,' Liability versus Responsibility in Space Law: Misconception or Misconstruction?', (pp. 363–370) in *Space, Cyber, and Telecommunications Law Program Faculty Publication*, 21, pp. 364, 366-367 and Cheng, Bin, 'International Responsibility and Liability of States for National Activities in Outer Space, Especially by Non-governmental Entities', (pp. 621–633) in *Studies in International Space Law*, p. 621.
[56] Fenema, Peter van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 387.

In conjunction to the conclusion above, I found it adequate to give a brief presentation on different grounds for basing State jurisdiction under the principles of international law concerning international responsibility under the OST. I will present three principles, the territorial(ity) principle(1), the personality principle(2) and the universality principle (3).[57]

The territoriality principle signifies that a State has jurisdiction to decide what is allowed or prohibited within its territory. This principle is dived into two sub-branches, a subjective and an objective one. The subjective branch consists of jurisdiction for a State over incidents initiated within its territory but completed outside of it. The objective branch mirrors the subjective one by establishing jurisdiction for a State over incidents completed within its territory but initiated abroad. [58]The subjective territoriality principle is for example applicable on a State that passes space legislation on how a space launch from its territory shall be conducted and which authority shall oversee space launches, since the space launch will result in an activity that is completed outside the boarders of the State.

The personality principle is divided into two parts, the active and the passive one. Active personality means that a State can prescribe rules on how its nationals, both juridical and personal, shall conduct themselves even when they are not operating within their State of nationality. This principle is commonly used by States to prevent their nationals from performing serious offenses abroad. The passive personality principle is more controversial since it gives a State jurisdiction over activities of non-nationals by prohibiting certain actions being performed against its nationals, more simply put by asserting jurisdiction to the State over a crime committed against one of its nationals abroad.[59]

[57] Lowe, Vaughan and Staker, Christopher, 'Jurisdiction', (pp. 313–339) in *International Law*, Evans. D, Malcom (ed.) pp. 315–316.
[58] Lowe, Vaughan and Staker, Christopher, 'Jurisdiction', (pp. 313–339) in *International Law*, Evans. D, Malcom (ed.) pp. 321–322.
[59] Lowe, Vaughan and Staker, Christopher, 'Jurisdiction', (pp. 313–339) in *International Law*, Evans. D, Malcom (ed.) pp. 330.

Within the context of space law the active personality principle is applied to regulate how a State's nationals perform space activities abroad, since in this way the State of nationality can try to prevent the activity from constituting an internationally wrongful act which would be attributable to the State through the provisions of Article VI of the *Outer Space Treaty*. The passive personality principle cannot trigger international responsibility for space activities due to the nature of its scope that would case the injured State to be responsible for the wrongful act that their national has suffered.

Universal jurisdiction is applied to certain types of crimes that either are so awful that any State should be able to invoke jurisdiction over them, or crimes that are serious and would otherwise go unpunished if not subject to universal jurisdiction. The most common example of this is piracy on the high seas.[60] Therefore this principle is not likely to be applicable for attributing international responsibility under the provisions of the *Outer Space Treaty* anytime soon, since hopefully space pirates will not become a reality in the near future.

2.2.1.2 Article VII "International Liability"

In Article VII of the *Outer Space Treaty*, international liability is assigned to a State party for damage caused by an object whose launch into outer space said party has participated in. This participation is determined based on four alternative criteria. Below, I will further describe these criteria and how the subsequent *Liability Convention*, enlisting these criteria along with a number of new provisions, is regarded as an expansion of the *Outer Space Treaty's* Article VII.[61]

The above mentioned article reads:

> Each State Party to the Treaty that *launches* or *procures* the launching of an object into outer space, including the Moon

[60] Lowe, Vaughan and Staker, Christopher, 'Jurisdiction', (pp. 313–339) in *International Law*, Evans. D, Malcom (ed.) p. 326.
[61] See Kerrest, Armel and Smith, Lesley Jane, 'Article I (Definitions) LIAB', (pp. 104–115) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan, Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 102.

> and other celestial bodies, and each State Party from whose *territory* or *facility* an object is launched, is *internationally liable for damage* to another State Party to the Treaty or to its *natural* or *juridical persons* by such object or its component parts on the *Earth, in air space or in outer space, including the Moon and other celestial bodies*.[62]

Before shifting the focus from the *Outer Space Treaty,* however, I will discuss further some of the more interesting aspects of the international liability in Article VII. This liability principle is explicitly only applicable to other State parties. This means that if a State Party to the *Other Space Treaty* would launch an object that crashes on the territory of a State that is not a party to this treaty, the liability rule embodied in Article VII is not applicable.[63] The injured State could instead claim compensation based on Article VI on the basis that the launching State has international responsibility for the object under international space law, alternatively based on general principles of international responsibility within international law. Furthermore, the kind of liability that emerges from Article VII is not clearly defined by the convention and it is not clear from the wording of the Article in what way the damage should be compensated.

2.3 The Liability Convention

The Liability Convention was opened for signature on March 29 in 1972 and entered into force on September 1 the same year. Today, the treaty has been ratified by 95 states.[64] This treaty is victim oriented, which is declared in its preamble, and focuses on the idea that restoration shall be given to

[62] *Outer Space Treaty* Article VI. *Emphasis added*.
[63] Kerrest, Armel and Smith, Lesley Jane, 'Article VII', (pp. 125–145) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 134.
[64] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-sixth session Vienna, 27 March-7 April 2017, Item 5 of the provisional agenda* Status and application of the five United Nations treaties on outer space, p. 11.

those who suffer damage on earth due to space activities.[65] Articles I, II, (III) and V of the convention together define who shall bear international liability for a space object and to what extent. These Articles are therefore of special importance to the present thesis, which I will present below.

2.3.1 Article I "launching State"

In the Liability Convention Article I, the concept of launching State is introduced. This is a central concept since international liability is always attached to a launching State, which follows from Article II of the same convention.

Article I reads as follows:

> For the purposes of this Convention:
> (a) The term "*damage*" means loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations;
> (b) The term "launching" includes attempted launching;
> (c) The term *"launching State"* means:
>
> (i) A State which *launches* or *procures* the *launching* of a *space object*;
>
> (ii) A State *from whose territory* or *facility a space object* is launched;
>
> (d) The term "*space object*" includes component parts of a space object as well as its launch vehicle and parts thereof."[66]

A State qualifies as a launching State if it *launches* or *procures* a launch of a space object, or if a space object is launched from its *territory* or *facility*. Each of the four criteria is sufficient in itself.

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[65] Jakhu S., Ram et. al. 'Legal Aspects of Solar Power Satellites', (pp. 17–51) in *Private Law, Public Law, Metalaw and Public Policy in Space:A Liber Amicorum in Honor of Ernst Fasan*, Sterns, Patricia M. and Tennen, Leslie I. (eds.), p. 31.
[66] *Liability Convention* Article I.

I will now present how these criteria have been interpreted within the legal community of space law.

2.3.1.1 Launches

The concept of a State launching a space object is interpreted as when a State through its own efforts, or to the largest part, is in charge of the complete operation of performing or attempting a launch.[67] This is commonly done through a governmental space agency, as when NASA launched the Explorer satellites on behalf of the United States.[68]

2.3.1.2 Procures

To procure something is understood in a literal sense as purchasing services or goods. This is a starting point when interpreting this concept within the context of the *Liability Convention*. When a State, normally through a government agency dedicated to space related issues, buys a launch service from a launch provider, be it a private entity or a governmental agency of another State, then it is clear that the State has procured a launch.[69]

It has been discussed if a State can be qualified as a launching State when one of its nationals procures a launch. The launching activity is attributable to a State by the provision in Article VI OST, stating international responsibility for a State or space activities performed by its nationals.[70] Procuring the launch of a space object falls within the scope of the concept space activity. Therefore, a State has international responsibility for a private procurement performed by one of its nationals and must continually authorize and supervise this space activity. Based on this interpretation, to secure that the international responsibility is taken seriously by States these should also carry international liability for activities they have responsibility

[67] Kerrest, Armel and Smith, Lesley Jane, 'Article I (Definitions) LIAB', (pp. 104–115) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan, Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), pp. 113–114.
[68] See https://www.nasa.gov/topics/history/features/explorer1.html.
[69] Kerrest, Armel and Smith, Lesley Jane, 'Article I (Definitions) LIAB', (pp. 104–115) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan, Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 114.
[70] Kerrest, Armel and Smith, Lesley Jane, 'Article VII', (pp. 125–145) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), p. 128.

over, since this would create incentives for States to model suitable conditions for space activities in order to avoid international liability.[71]

Contrary to this stance is the wording of Article II of the *Liability Convention* that only mentions that a State qualifies as launching State if it procures a launch. Interpreting that the concept of State in this Article would encompass also natural or juridical citizens of a given State is too far reached from its traditional meaning. This line of reasoning is supported by State practice, namely by the Netherland's space law were the State does not consider itself as a launching State for launches procured by its nationals when these are conducted abroad.[72]

2.3.1.3 Territory

Determining if a satellite has been launched from a certain State's territory is normally uncontroversial when the launching vehicle takes off from a territory with clear and acknowledged State jurisdiction and sovereignty. An example is when satellites are launched from Cape Canaveral in Florida, which undisputedly is the territory of the United States, thus qualifying it as the United States a launching State. Possible complications could be if a launch is initiated from a territory that is contested by different States. This could become reality in the South China Sea where a number of States claim territorial sovereignty over the same areas. [73] If China, which has an ambitious space program[74], would launch a space object from this territory they could theoretically provoke another State to bear international liability for this space object.

[71] Kerrest, Armel and Smith, Lesley Jane, 'Article VII', (pp. 125–145) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), pp. 144–145.
[72] Marboe, Irmgard and Traunmuller, Karin, 'Small Satellites and Small States: New Incentives for National Space Legislation', in *Journal of Space Law, issue 2 (2012)*, p. 309.
[73] Pace, Scott, 'Space cooperation among order-building powers', in *Space Policy 36 (2016)*, p. 25.
[74] Solomone, Stacey, 'How is China Going into Space?', in *China's Strategy in Space*, pp. 17–18.

2.3.1.4 Facility

A facility can fall under the control of one State while at the same time being located within the territory of another State, therefore it is included as a separate criterion. This is the case of the space port 'Baikonur Cosmodrome' which is located in Kazakhstan but is leased by the Russian Space Agency.[75] Thus, in this scenario both Russia and Kazakhstan are qualified as launching States.

2.3.2 Article II

International liability is attributed to a launching State for damage caused by its space object. When the damage occurs on the surface of the Earth or to aircraft in flight, the launching State is absolutely liable to pay compensation.[76] Absolute liability means that compensation shall be payed regardless of fault by the launching State. This liability cannot be exonerated by force majeure. [77]

If the damage occurs elsewhere. i.e. outer space, then the launching State is liable depending on fault, which is stated in Article III. Both forms of liability in the LC are not applicable towards nationals of the launching State nor foreigners participating in the launch, which is established in Article VII.

Article II puts no limit to liability in terms of value and establishes that all damage shall be compensated by way of pecuniary means. However, the Article does not define "damage". Among scholars, the accepted interpretation of "damage" is that it includes all direct but not all indirect damages, thus placing the importance in the fact that the damages have a

[75] Dunk, Frans G. von der, 'International space law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 117-118.
[76] *Liability Convention* Article II.
[77] Kerrest, Armel and Smith, Lesley Jane, 'Article II (Absolute Liability)', (pp. 116–130) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.) pp. 124–125.

close causation to the space object.[78] Direct damage are damages resulting as a direct consequence of an action derived from the space object.[79] This could include a satellite crashing into a building, all damage caused to the building stemming from the crash as well as to objects and people inside would qualify as damage under Article II of the *Liability Convention*.

2.3.3 Article V

Article V, sec. 1, of the *Liability Convention* states that when a space object is jointly launched then these launching States shall jointly bear the international liability for caused damage. Furthermore, sec. 2 of the same Article establishes that if one of the launching States pays compensation for damage, then it has the right to present claims against the other liable launching States in order to be indemnified. These joint launching States may agree internally on how to distribute the financial burdens following from their liability, but this does not affect the right of a State that has sustained damage to seek full compensation from any of the involved launching States.[80] Finally, in the Article's section 3, it is explicitly stated that a State from whose territory or facility a space object has been launched is considered to have participated in a joint launching.

2.3.4 Claims made under the framework of the Liability Convention

As the *Liability Convention* centres on States, its framework for pursuing claims reflects this perspective. However, there are also aspects of the *Liability Convention* that gives individuals more acknowledgement as

[78] Kerrest, Armel and Smith, Lesley Jane, 'Article II (Absolute Liability), pp. 116–130) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.) pp. 111–112.
[79] Kerrest, Armel and Smith, Lesley Jane, 'Article II (Absolute Liability)', pp. 116–130) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.) pp. 126–127.
[80] Kerrest, Armel and Smith, Lesley Jane, 'Article V (Joint Launch/Joint and Several Liability) LIAB', (pp. 141–147) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.), p. 145.

subjects of law than what is common in international law.[81] Therefore, I will give a brief overview of how certain claims should be handled according to this convention.

Article VIII presents three alternate ways for a State to have the right to put forward a claim for compensation for damages to a launching State. Section 1 of the aforementioned article links the right to compensation for damage suffered to a State that has been damaged, alternately to a State whose natural or juridical persons have suffered damage. Section 2 of the Article confers the right to claim compensation onto the State in whose territory the damage has occurred to a national or juridical person, when their State of nationality has not presented a claim. Finally, section 3 comes into effect when neither the State of nationality nor the State with territorial jurisdiction has presented claims. In that situation, another State where the person who has suffered damage has permanent residence may put forward claims for compensation.[82]

It is important to note that, unlike other mechanism for resolving international disputes, claims can be made under the LC without exhausting local remedies beforehand which is stated in Article XI. Claims shall be presented through diplomatic channels on behalf of a State and if possible settled through diplomatic negotiations, which follows from Article IX and XIV respectively. The claims can be presented to any of the involved launching States, disregarding their potential internal agreements on distribution of liability.[83]

[81] Freeland, Steven, "There's a Satellite in My Backyard - Mir and the Convention on International Liability for Damage Caused by Space Objects" *University Of New South Wales Law Journal*, 2001, no. 2 pp. 478-479.
[82] Freeland, Steven, "There's a Satellite in My Backyard - Mir and the Convention on International Liability for Damage Caused by Space Objects" *University Of New South Wales Law Journal*, 2001, no. 2 pp. 474-475.
[83] Kerrest, Armel and Smith, Lesley Jane, 'Article V (Joint Launch/Joint and Several Liability) LIAB', (pp. 141–147) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.), p. 144.

If the negotiations do not lead to a settlement, then either party (i.e., the claimant State or the launching State) may request that the parties establish a Claims Commission, whose decision is only binding if agreed to by the parties. Therefore, the institution of a Claims Commission may have a larger role as a way to make the involved parties discuss and settle in good faith than as a legal arbitrational institution.[84] This is supported by the fact that no actual case exists of when a Claims Commission has been established, the only time that it could have happened was when a Soviet satellite crashed on Canadian territory which resulted in a settlement through diplomatic negotiations without directly applying the provisions of the LC.[85]

2.4 The Registry Convention

The *Registry Convention* has its origin in Article VIII of the *Outer Space Treaty* where it is established that States maintain jurisdiction over space objects they carry on their register.[86] Thus, said Article implies that States have a duty to carry a register of their space objects. This implied duty was then formalized with the drafting and adopting of the *Registry Convention,* which contains provisions on registering space objects.[87] Registration shall be done regardless if the space object is privately or governmentally owned. This Treaty enables States and individuals to find out which space objects exists and to whom they belong, therefore it is of relevance when attributing international responsibility and liability if a satellite crashes.

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[84] Freeland, Steven, "There's a Satellite in My Backyard - Mir and the Convention on International Liability for Damage Caused by Space Objects" *University Of New South Wales Law Journal*, 2001, no. 2 p. 483.
[85] Williams, Maureen 'Dispute resolution regarding space activities', (pp. 995–1046) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 1011-1012.
[86] Schmidt-Tedd, Bernhard and Tennen, Leslie I., 'Historical Background and Context REG', (pp. 234–240) in *Cologne commentary on space law: in three volumes, volume II* Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.), p. 239.
[87] Schmidt-Tedd et. al 'Article II (National Registries/Registration Obligation) REG', (pp. 249–299) in *Cologne commentary on space law: in three volumes, volume II*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe (eds.) & Stubbe, Peter (ass. ed.), p. 250–251.

2.4.1 Articles I and II "State of registry"

For the sake of this thesis, Articles I and II of the *Registry Convention* are of main importance in so far as the general provisions on who shall register a space object and how are enshrined in these articles.

In the *Registry Convention* Article I, three concepts are defined for the purpose of the convention. These three concepts are launching State, space object and State of registry. Launching State and space object are defined in the same way as in the *Liability Convention*, which is a logical order seeing to the fact that these two conventions correlate. The third concept, State of registry, is defined as the "launching State on whose registry a space object is carried in accordance with article II"[88]. Therefore, the State who registers the space object is a launching State and therefore liable for this object.[89] Read together with Article VIII OST it is also clears that the State of registry maintains jurisdiction over the space object, which means that it bears international responsibility over it according to Article VI OST.

2.5 Relationship between international responsibility and liability

Here follows a summary of the relationship between international responsibility and liability for a privately conducted satellite launch. The responsibility is carried by the State(s) that have jurisdiction over the enterprise conducting the launch. This responsibility requires that the State authorizes and continues to supervise the satellite launch, which stretches out during the entire lifecycle of the satellite as long as the State has jurisdiction over it. If the satellite would for example fly through the airspace of a State without permission, then this international wrongful act will be attributed to the appropriate State even though no material or personal damage has occurred. This is the main difference between

[88] *Registry Convention* Article I, section c.
[89] Together with other launching States if there are multiple.

responsibility and liability, that responsibility does not require damage to be activated in contrast to liability.

Liability is attributed to the launching State(s) and requires damage to occur. According to the wording of the LC, the status as launching State is permanent. This stretches out liability indefinitely for a launching State, but international responsibility can be limited in time if the responsible State ceases its jurisdiction over the space object, e.g a satellite. This is possible since the OST in combination with the REG places jurisdiction over a space object on the State of registry, which is one of the objects' launching States. In this way, a State that before the launch of the Satellite has jurisdiction over it, for example through the active personality principle when the entity launching the satellite is one of its nationals, but is not qualified as a launching State will escape continued responsibility once the satellite reaches outer space and is registered onto one of the launching States.

2.6 An example of a traditionally performed space activity

The following example will illustrate how the legal body presented above works when applied to a traditional satellite launch when it is performed wholly by a State that is party to the OST, LC and REG.

2.6.1 International responsibility

The Space Agency of State A assembles a satellite and then performs a launch of this satellite into outer space from a facility under its control in its territory. This object is put into orbit in a position without risks of collision. In this way State A has maintained control over the satellite from its creation to its placement in orbit, and has taken precautions to avoid collisions with other States' space objects. By performing the launch in this way State A is compliant with its obligations under Article VI of OST. The state is qualified as a launching State under three of the four criteria of the LC Article II, since the launch is made from its facility in its territory.

2.6.2 Registration

State A has registered the satellite in both its national register and with the UN. The registration meets the requirements of the REG and Article VIII of OST and State A is therefore the State of registry for the satellite.

2.6.3 Liability

Unexpectedly the satellite loses communication with the control centre and crashes down to earth, onto the territory of State B where it destroys a warehouse and kills several people. State A is now absolutely liable for these damages under the provisions of the LC. The injured State can consult the registry of space objects to verify which State has registered the satellite, which is a launching State subject to international liability for the damages caused by the crash.[90]

[90] See Article II in REG and Articles II-III in LIAB.

3 New developments in space activities

My intentions with this chapter is to give the reader a considered understanding of how economic and political events in the later parts of the 20th century have affected the type of actors involved in space activities.

3.1 The end of the cold war

The period between the end of the Second World War and the dissolution of the Soviet Union is usually denominated as the Cold War. This period is characterized by the far-reaching impact on overall global politics by the two competing super powers, the United States and the Soviet Union. The United States promoted a free market based on a capitalist system while the Soviet Union stood for a socialist ideology with a strict governmental control over the market. These two colliding worldviews took many different expressions, such as proxy-warfare, supporting or usurping governments in other nations based on their ideological beliefs, escalation of military capacities and even a race to outer space.[91]

What divide the United States and the Soviet Union in terms of ideology obviously affected the non-governmental entities involved in their respective space program. The United States contracted American companies at an early stage, such as Lockheed Martin and Boeing, while the Soviet Union handled their space program within the confines of governmental entities.[92] The Soviet space program was also used as propaganda for the Soviet worldview, as it could be portrayed as an

[91] Brown, Trevor, 'The American and Soviet Cold War Space Programs', in *Comparative Strategy*, pp. 177–178.
[92] Fenema, Peter van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 392–393.

intellectual conquering of the celestial sphere that had previously been considered reachable only through religion.[93]

The space race was initiated with the launch of Sputnik and arguably the Soviet Union was at the forefront for the first years. They did not only successfully launch the first man-made satellite into orbit, both also the first human which was the Cosmonaut Yuri Gagarin.[94] This spurred the US to increase its investments in their space program which resulted in them landing the first humans on the moon, which took place on 20th July 1969.[95] Developments in space technology during these years lead to many military and civilian benefits, such as the GPS that today is an integrated part of daily life.[96]

The Soviet Union came crumbling down in the beginning of the 90's which resulted in both new independent countries, for example the Czech Republic and Slovakia, and renewed independence for countries that had been subjugated under Soviet rule, such as Ukraine and Kazakhstan. Following the dissolution of the union based on a socialist rule, a liberal market based system was adopted by the former unified countries.[97] This opened up for the entry of private entities in a number of sectors that had previously been governmentally run, which included outer space activities.

3.2 Privatisation

Since the West and its liberal market ideology had won the cold war and perforated the former Soviet countries, the 90's marked a new era of the space sector. The Soviet space program was in most parts transferred to the

[93] Smolkin-Rothrock,Victoria 'The contested skies', (pp. 57–78) in *Soviet Space Culture; Cosmic Enthusiasm in Socialist Societies*, Maurer, Eva, et al (eds.), pp. 59–60.
[94] Brown, Trevor, 'The American and Soviet Cold War Space Programs', in *Comparative Strategy*, pp. 178–179.
[95] Dunk, Frans G. von der, 'Legal aspects of private manned spaceflight', (pp. 662–716) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 662.
[96] Tronchetti, Fabio, 'Legal aspects of satellite remote sensing', (pp. 501–553) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 506–507.
[97] Malysheva, Natalia R. & Stelmakh, Olga S., 'Recent Developments in Space-Related Law and Policy within the Post-Soviet Area', (pp. 507–515) in *Proceedings of the International institute of space law 2013*, Jorgenson, Corinne (ed.), pp. 507–509.

new Russian state, which would come to allow private actors.[98] Meanwhile, budget restrictions in the United States shrunk the National Space Agency's (NASA) operating capacities, which lead to an increase in the use of the private sector for performing space activities. In the 80's the US president Ronald Reagan encouraged further involvement by the private sector in governmental space projects, which lead to an increased cooperation with the American private sector. [99]

Meanwhile in Europe, Arianespace was founded by a group of European countries in 1980 as the world's first commercial space transport company offering its services initially to States.[100]

3.3 Commercialisation

With the term commercialisation I refer to the fact when an entity, be it governmental or non-governmental, performs an activity with the main purpose of making a profit of said activity. Defined this way, it can be argued that the first step of commercializing outer space was the launching of satellites for broadcasting television- and radio transmissions, which began in the 60's, and included privately owned satellites.[101]

As time progressed, new ways to commercialise outer space emerged. In 2001 Dennis Tito became the world's first space tourist when he paid around 20 million dollars to visit the International Space Station, which was arranged by the company Space Adventures in collaboration with the Russian Space Agency and Rocket and Space Corporation Energia. Since

[98] Dunk, Frans G. von der, 'International space law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 117-118.
[99] Sharpe, Carla and Tronchetti, Fabio 'Legal aspects of public manned spaceflight and space station operations', (pp. 618–661) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 622–623.
[100] Fenema, Peter van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 391 and http://www.arianespace.com/about-us/.
[101] Scimemi, Sam, 'An Emerging Marketplace: Low Earth Orbit and the International Space Station', (pp. 337–343) in *Proceedings of the International institute of space law 2014*, Moro-Aguilar, Rafael, Blount, P.J, & Masson-Zwaan, Tanja, (eds.), p. 339.

this first journey, a small number of people have followed in his footsteps.[102]

The importance of satellites for the private sector has increased during the beginning of the 21th century due to the various functions they can perform. Facebook has started a program to launch satellites into orbit with the purpose of transmitting internet to areas with low internet penetration, presumably to increase its user base.[103] There are a number of launching companies emerging to meet the demand for operating private satellites.[104] Rocket Lab is one of these new launch service operators and specializes in launching small satellites along with larger payloads, in a concept they call "rideshare" with the intention to lower launching costs.[105]
Other proposed ways of commercializing outer space by private entities are mining operations conducted on asteroids and the idea of establishing a permanent colony on Mars.[106]

3.4 Globalization

Another development of the political and economic environment that has affected space law is the current trend of globalization. This is a multifaceted concept but to simplify it has to do with the world's increased trade and interchange between countries of different levels of economic development.[107] It is common to perform research and development in

[102]Sharpe, Carla and Tronchetti, Fabio, 'Legal aspects of public manned spaceflight and space station operations', (pp. 618–661) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.), pp. 646-647.
[103] See https://www.theguardian.com/commentisfree/2016/sep/05/facebook-satellite-developing-world-mark-zuckerberg-internet.
[104] Fenema, Peter van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.), pp. 386–387.
[105] See https://www.rocketlabusa.com/launch/rideshare/.
[106] See for example "Deep Space Industries" o their plans on asteroid mining at http://deepspaceindustries.com/mining/ and the companies "Space X" and "Mars One" about their respective plans on colonization of Mars at *http://www.spacex.com/mars* and *https://www.mars-one.com/about-mars-one*.
[107] Urban, Jennifer Ann, 'Soft Law: The Key to Security in a Globalized Outer Space', in *Transportation Law Journal 43, no. 1*, p. 36.

countries with high standards of living and education, while outsourcing the manufacturing to countries with less developed economies but with large quantities of low wage workers.[108] The former division of the world in a western and eastern bloc is now described by scholars as replaced with a division of the world in north and south. This division is based on the geographical placement of developed countries, mainly located on the northern hemisphere, and developing countries, that are mainly located on the southern hemisphere. However, which group a country belongs to is dependent on its status as developing or developed and not its geographical placement. The North consists of developed countries, for example the United States, Germany and Japan while the South is made up by developing countries such as the Philippines, Guatemala and Nigeria. [109]

The importance of space technology such as weather or broadcasting satellites has increased for the Earth as a whole, leading developing countries to acquire their own satellites. Among the possible uses of a satellite for a developing country is the ability to better predict the weather and thus securing more stable crops, reducing the risk of food shortage, or being able to at an earlier stage evacuate an area in risk of flooding. Since space activities are costly, a satellite can hundreds of millions of dollars to produce and launch, not all States can afford these without cooperation with other States or private actors.[110]

[108]Loibl, Gerhard, 'International Economic Law', (pp. 722–751) in *International Law*, Evans. D, Malcom (ed.) pp. 743–746.
[109] Arrighi, Giovanni, Beverly J. Silver, and Benjamin D. Brewer 'Industrial Convergence, Globalization, and the Persistence of the North-South Divide', in *Studies in Comparative International Development*, Spring 2003, Vol. 38, No. 1, pp. 3–4, 13.
[110] Sundahl, Mark, 'Financing Space Ventures', (pp. 874–909) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.), pp. 874, 877.

3.5 Current trends in space law

The last international treaty on outer space was the *Moon Agreement* that entered into force in 1984, but it suffers from a low level of ratification.[111] In today's political climate, it is difficult to reach agreements on international issues through large treaties, instead regional agreements and soft law have increasingly important roles. This is true for general issues such as how to deal with climate change but also for specific issues on how to regulate access to outer space in new ways.[112] Therefore, the European Space Agency has had a growing impact on regional space law in recent years. It is an organization created by European countries with the aim strengthen European cooperation in space. ESA has been inferred with a legal capacity and sub sequentially it has concluded a number of agreement with European governments on how to conduct space activities together, which contributes to establishing a clearer framework for space operations in Europe. [113] This agency is not a part of the EU but they have an established cooperation.[114]
EU has also had an impact on making space law more coherent, especially through its proposed international Code of Conduct for Outer Space Activities.[115]

Another example of international cooperation in outer space is the International Space Station and its international agreement between the

[111] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-sixth session Vienna, 27 March-7 April 2017, Item 5 of the provisional agenda* Status and application of the five United Nations treaties on outer space, pp. 1-2.
[112]Sykes, Alan and Guzman, Andrew, 'Economics of international law' (pp. 465–481) in *The Oxford Handbook of Law and Economics; Volume III: Public Law and Legal Institutions*, Parisi, Francesco (ed.), pp. 444–446, 454–456.
[113] Jankowitsch, Peter, 'The background and history of space law', (pp. 1–28) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 22.
[114] http://www.esa.int/About_Us/Welcome_to_ESA/ESA_and_the_EU.
[115] Jankowitsch, Peter, 'The background and history of space law', (pp. 1–28) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 22–23.

participant States and organizations, which among other things regulates intellectual property rights for inventions made on orbit.[116]

3.6 An example of a modern space activity

The following example will illustrate how the legal body presented in chapter two works when applied to a non-traditional private satellite launch when it is performed with multiple actors.

3.6.1 International responsibility

The Company X, incorporated in State A, is interested in acquiring a communications satellite that can be used to transmit access to the internet in remote locations. They therefore procure the construction of a satellite with the desired qualities from the Company Z located in State B. Once the construction of the satellite is finalized Company X purchases launching services from Company Y incorporated in State C. The launch will take place from a facility in State D, but which is in turn leased by State E that operates the facility. Depending on which of the States that are parties to the OST the attribution of international responsibility varies. Assuming that all the mentioned States are parties to the treaty the responsibility will be attributed as presented below:

State A bears international responsibility for the satellite launch, through the active personality principle giving them jurisdiction over Company X which procures the launch and therefore performs an activity in outer space. This is depending on that State A's national space law does not exclude their jurisdiction for this situation.

[116] Dunk, Frans G. von der, 'International space law', (pp. 29–126) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) pp. 113–114.

State B does not bear international responsibility for the satellite launch since Company Z merely built the satellite, which falls under the scope of the concept activities in outer space.

State C bears international responsibility on the same grounds as State A but applied to Company Y.

State D bears international responsibility through the territoriality principle, even though they lease the facility to State E they maintain jurisdiction over it. This can be compared to how a foreign embassy is under the control of the foreign State but under the territorial jurisdiction of the State where it is located.

State E does bear international responsibility since it has jurisdiction over the facility.

3.6.2 Registration

It is up to one of the launching States to register the space object, therefore they must agree between them which one will be the State of registry. Which of the States A-E are qualified as launching States, and thus can be a State of Registry, follows below.

3.6.3 Liability

Liability is attached to the concept of launching State. Therefore I will present which of the presented States are qualified as launching States and therefore liable for the satellite:

Depending on the interpretation of *procures* in Article I LC State A can both be considered as a launching State and not. In my opinion the wording of the Article does not give room for a wide interpretation where a State can be qualified as a launching State because one of its nationals procures a launch, therefore I do not consider State A to be liable for the satellite.

State B is not internationally liable for the satellite launch since Company Z merely built the satellite, which does not fall under the scope of the four criteria to qualify as a launching State.

State C is not internationally liable on similar grounds as to why State A is not liable. Company Y is its national and performs a launch, but the wording of Article I LC only mentions States. Therefore, State C is not a launching State for the Satellite.

State D is a launching State since the satellite is launched from its territory, which is one of the links qualifying a launching State according to Article I LC.

State E is also a launching State since the satellite is launched from its facility, which is one of the links qualifying a launching State according to Article I LC.

4 Problematic situations

So far in this thesis, I have presented the main body of international space law such as this in general regulates the launching of space objects, and satellite launches specifically. Below I will elaborate on different situations that are problematic regarding assignment of international responsibility and international liability, with special dedication to private space activities. I will also comment on some of the distinguishing factors of international law in general and how this affects space law in this context.

4.1 Multiple launching States

As I discussed in Chapter Two there can be multiple launching States for the same space object. This follows from the fact that the criteria for qualifying as a launching State in Article II of the *Liability Convention* are alternate. An example of when multiple launching States are involved is the case when a private entity launches a satellite on behalf of State X, from the launching facility of State Y, which is located on the territory of State Z. If one, in this case, interprets the concept of *launches* in Article I of the *Liability Convention* broadly, the private entity's nationality may also be considered a criterion for launching State. In this scenario, then, there are four potential launching States which all can be internationally liable for the same space object.

If no damage occurs then the fact that there are multiple launching States does not pose a problem. But, if a situation would arise were the abovementioned satellite crashes into the territory of a State that is not a launching State and causes damage to persons and objects, then there will be a problem on how to distribute the liability to compensate these damages. A claim based on the *Liability Convention* is done on behalf of the State who is attributed the damage. This State shall present its claims through diplomatic channels and lastly, if no settlement is reached through

diplomatic negotiations, a claims commission shall be set up together with the State that is liable. Here the claiming State can freely choose between the launching States to present its claims, but it can be difficult to decide which States are liable or not based on the unclear scope of the launching criterion *procures*. To avoid uncertainty the Claiming State can consult the register of space objects to see which launching State is registered for the satellite, since this registration is proof that the State of registry acknowledges its status as launching State with its joined liability. Internally the launching States may have agreed on how to assign liability between them, as was the case for the joint satellite launch by China and the United Kingdom. This agreement was interesting since China bore liability for damages caused by the United Kingdom, even though this was not the case for the averse situation.[117] This illustrates how more experienced space faring States may take advantage of States with less experience. A conclusion I draw from this example is that the nationality of a private space enterprise could affect weather its State of nationality will bear liability for it or not, since a more experienced State could agree with a less experienced State that they shall bear the sole international liability for the private enterprise.

Another aspect when multiple State are involved is the fact that the private entity may require authorization for its activity by more than one State. Ideally these States will coordinate their licensing process, but this may be difficult to achieve which could result in them demanding different levels of documentation, security measures etc. making it difficult for a private entity to predict what will be required to obtain a license. This could hinder space projects, since difficulties in attracting financing should occur when there is uncertainty if the plan is deemed legal or not.[118]

[117] Cheng, Bin, 'International Responsibility and Liability for Launch Activities', *Studies in International Space Law* p. 606.
[118] Compare, Kosmo, Fredl 'The Commercialization of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility', *61 S. Cal. L. Rev.*pp. 1055–56.

As discussed in chapter two, a launching State never lose its status as such. Instead it must absolve itself from liability through agreements with the other launching States. If a satellite is bought when in orbit, then the buying State will not obtain status as launching State. This means that if the satellite would cause damage, either in outer space or on the face of the earth, the new owners cannot be held liable through the LC.

4.2 Small satellites

None of the space treaties discussed in this thesis mentions or defines so-called small satellites. The concept of small satellites has developed in practice as a result of technological progress which has led to the possibility of producing smaller satellites than before. Space law commentator Ingrid Marboe presents a proposed classification of small satellites into different subcategories made by the International Academy of Astronautics. According to this classification small satellites are satellites weighing less than 1000 kg. Satellites weighing less than 500 kg are called mini satellites. If weighing less than 100 kg then it is a micro satellite, below 10 kg it is called a nano satellite. The two smallest categories are pico satellites that weigh under 1 kg and femto satellites that weigh below 100 g.[119] There is a subset of nano satellites called CubeSat, which is a cube formed satellite that can be combined together with other CubeSats to enable more functions.[120] CubeSats are therefore a flexible alternative that can be adapted to the specific intended project.

[119] Marboe, Ingrid, 'Small Is Beautiful? Legal Challenges of Small Satellites', (pp. 1–16) in *Private Law, Public Law, Metalaw and Public Policy in Space:A Liber Amicorum in Honor of Ernst Fasan*, Sterns, Patricia M. and Tennen, Leslie I. (eds.), pp. 3–4..
[120] Antoni, Ntorina and Bergamasco, Federico, 'To Orbit and Beyond: Present Risks and Liability Issues from the Launching of Small Satellites', (pp. 75–92) in *Proceedings of the International institute of space law 2014*, Moro-Aguilar, R, Blount, P, & Masson-Zwaan (eds.), p. 76.

Some commentators argue that cube satellites do not fall under the concept "space object" established in the *Liability Convention's* Article I, seeing to the fact that they are so small that they lack manoeuvrability. Following this line of interpretation would result in that a lot of the small satellites presented above would not be considered as space objects. This view is disputed by other commentators that mean that it is sufficient that an object is launched into space for it to become a space object.[121] I agree with the latter group, even though that "space object" has a unclear definition in the LIAB it does not mention anything on manoeuvrability, which indicates that the location of the object is the determinant factor. Thus once a small satellite, regardless of its size, is launched into outer space and reaches orbit it is a space object.

However, due to that CubeSats are too small to operate effectively they may become space debris, leaving them orbiting earth for a long period of time. Space debris is commonly defined as space objects or parts of space objects that are located in outer space and are no longer in use.[122]

If large swaths of CubeSats satellites accumulate they could cause damage directly, by impeding the path of other space objects, or indirectly by causing other space objects to manoeuvre around them and possibly causing a collision with another space object. Another problematic aspect of small satellites is that some States do not register these as space objects, based that they do not consider themselves launching States for small satellites that have been privately procured.[123] This makes it harder to know how many small satellites are in orbit and in case of a crash it would be difficult to identify a responsible and liable State. The interest of identifying which

[121]Antoni, Ntorina and Bergamasco, Federico, 'To Orbit and Beyond: Present Risks and Liability Issues from the Launching of Small Satellites', (pp. 75–92) in *Proceedings of the International institute of space law 2014*, Moro-Aguilar, Rafael, Blount, P.J., & Masson-Zwaan, Tanja (eds.), p. 87.
[122] Salter, Alexander William, 'Space Debris: A Law and Economics Analysis of the Orbital Commons', in *19 Stan. Tech. L. Rev.*, pp. 224–226.
[123] Marboe, Ingrid, 'Small Is Beautiful? Legal Challenges of Small Satellites', (pp. 1–16) in *Private Law, Public Law, Metalaw and Public Policy in Space:A Liber Amicorum in Honor of Ernst Fasan*, Sterns, Patricia M. and Tennen, Leslie I. (eds.), pp. 10–11.

State is liable and/or responsible is two-folded, one aspect is to obtain compensation for the ones injured by the crash (liability) and the other is to prevent similar scenarios in the future by pressuring the responsible State to impose stricter authorization and supervision for private space activities. Furthermore, some of these satellites are launched by universities or non-profit organizations that are unaware of their need for authorization by a State for such activities.[124] In these situations a State may not know that there is a satellite in orbit that it is responsible for and that it should register in accordance with the REG.

4.3 Creative launches

As I mentioned in the opening chapter of the thesis there are private entities that perform space launches in ways intended to select favourable space regulations or completely circumvent them. One example is Sea Launch which performs its launches from a platform located in the high seas, which is not subject to jurisdiction of any country according to the law of the sea. The platform is under the flag of Liberia, which is not a State party to the outer space treaty.[125] Another way of trying to opt out of international responsibility and liability is by placing a satellite on an airplane which is then flown over the high seas and to launch the satellite into outer space from the plane.[126] This case is easier to handle under the conventional concepts of responsibility and liability since the launch, in form of the take-off of the airplane, is initiated from a certain territory or facility which therefore will qualify a launching State. It differs from launching a satellite from a platform at sea, which is fixed on a certain location during the launch and therefore in a clearer way is separated from the last State the platform

[124] Palkovits, Neta, 'Space Entrepreneurship and Space Law – Future Challenges and Potential Solutions', (pp. 61–72) in *Proceedings of the International institute of space law 2013,* Corinne Jorgenson (ed.), pp. 65–66
[125] Fenema, Peter van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.), p. 401.
[126] Takaya-Umeharea, Yuri et. al., 'State Responsibility and Liability for Air-Launch over the High Seas', (pp. 669–678) in *Proceedings of the International Institute of Space Law 2013*, Corinne Jorgenson (ed.), pp. 669–670.

docked in. However, if the launch begins from a State that is not a party to neither the OST nor the LC, then, problems of application arise. What would happen if the satellite crashed on Earth? Would the private entity be solely responsible or would there be ways of assigning international responsibility to a State?

Some argue that some of the principles in the OST has transcended into the status of international customary law, thus making them binding on all States regardless if they have ratified the treaty or not.[127] If these commentators are correct, then there would be no issues with the examples above with regards to assigning responsibility and liability. These concepts would be assigned by the general principles of international law, which would qualify the State under which flag the aircraft or launching platform is registered as responsible through the active personality principle of jurisdiction. However, the problem with international customary law is that it develops slowly and is dependent on State practise and opinio juris.[128] Since to this point no privately owned satellite has crashed on earth it is possible for the States involved with a launch that is not covered by the space treaties to refute their status as international customary law. Some space commentators argue that space law due to its specific nature can create "instant customary law" by just performing one act that is received with affirmation by other States.[129]
Regardless if this is true or not, which again is dependent on State practice and opinio juris, the problem of how to enforce international law remains.

State sovereignty is central within the sphere of international law, which prevents a "world police" and limits the scope of the international court of

[127] See, Freeland, Steven and Jakhu, Ram, 'Article II', (pp. 44–63) in *Cologne commentary on space law: in three volumes, volume I*, Hobe, Stephan., Schmidt-Tedd, Bernhard, Schrogl, Kai-Uwe & Goh, Gérardine Meishan (eds.), pp. 55–57.
[128] Thirlway, Hugh, 'The Sources of International Law', (pp. 95–121) in *International Law*, Evans. D, Malcolm (ed.) pp. 101–104.
[129] Cheng, Bin, 'United Nations Resolutions on Outer Space: 'Instant' International Customary Law?', (pp. 125–149) in *Studies in International Space Law*, pp. 136–137.

justice to certain areas of law.[130] Paul B. Stephan, active within the field of international law and economics, presents two different ways States informally can enforce international law. These two ways are called reputation and retaliation. [131]

Reputation consist of that States will follow their international obligations since if they breach them they will get a reputation of being unreliable. This can lead to that other States will abstain from entering into agreements or transaction with the State that historically shows tendencies to not keep its promises. In this way, international law is not enforced by directly reacting to a breach but by in future scenarios treat the breaching State with skepticism, making it harder for it to conduct trade etc.[132]

Retaliation, a form of countermeasure, is a more direct way of enforcing international law and consist of responding to a breach with another breach.[133]
For example if two States have agreed to deposit money in a fund to purchase a satellite that they intend to operate jointly, but one State does not fulfill this obligation then the other State will retaliate by not depositing its part either. As shown in this case both States lose on the breach, since no satellite will be purchased.

[130] Koskenniemi, Martti, 'What is international law for?', (pp. 32–57) in *International Law,* Evans. D, Malcom (ed.) pp. 36–38.
[131] Stephan, Paul B., 'Enforcement of International Law', (pp. 465–481) in *The Oxford Handbook of Law and Economics; Volume III: Public law & legal instutions*, Parisi, Francesco (ed.), pp. 471–472.
[132] Stephan, Paul B., 'Enforcement of International Law', (pp. 465–481) in *The Oxford Handbook of Law and Economics; Volume III: Public law & legal instutions*, Parisi, Francesco (ed.), pp. 471–472.
[133] White, Nigel and Abass, Ademola, 'Countermeasures and Sanctions' (pp. 531–558) in *International Law,* Evans. D, Malcom (ed.) pp. 534–536.

5 Space law and economics

In this chapter, I will begin by giving a brief description of the legal methodology called law and economics. Thereafter I will use this method by applying a selection of economic theories on the aspects, principles and problems of international space law discussed in the thesis' previous chapters. Specifically, I will analyse how private satellite launches affect the allocation of international liability when there are multiple launching States; how small satellites increases the probability of collisions occurring in outer space; and how there, in certain cases, can be gaps between international responsibility and liability for a launch when it is performed through unconventional methods. I divide each of these analyses in a descriptive and normative part.

5.1 Law and economics

Law and economics is a legal method that consists of applying theories and concepts from the discipline of political economy onto legal rules. The application of law and economics on given legal problems can be divided into two branches: a descriptive and a normative branch.
The descriptive, or positive, branch of law and economics consists of analysing how a certain rule affects the economic aspects of society.[134]
A descriptive economic analysis of legal rules is when one studies the regulation on risk allocation between parties to a transaction, or how the rules of tort law assign liability for damages.

The normative, or prescriptive, branch of legal economics centres on using economic theories in order to propose how legal rules should be formulated in order to better achieve economic efficiency, a concept that I will further

[134] Polinsky, Mitchell A., *An introduction to law and economics*, pp. xiv–xv.

explain below.[135] An example of a normative analysis is to propose, in the process of drafting new legislation regarding dangerous activities, that the risk shall be placed on the subject with the best conditions to manage this risk as this is desirable from an economic point of view because this is the most efficient allocation.

As presented above the concept of efficiency is central within the field of law and economics. There are two central definitions of efficiency, which are called Pareto-efficiency and kaldor-hicks efficiency. Pareto-efficiency is obtained when an optimal repartition of rights or resources is reached. This optimum is achieved when the rights or resources are assigned in such a way that no change can be made without leaving someone worse off than before.[136]

Kaldor-hicks-efficiency is an elaboration of Pareto-efficiency and according to this concept, a transaction is efficient if the benefits gained are larger than the negative consequences following from this transaction. Then theoretically the "losers" of the transaction could be compensated by the "winners", while these still would be better off than before. [137]

The reason for striving after efficient outcomes is that in this way we increase the prosperity of society more than we would with inefficient outcomes. Law and economics however does not take a stance in how prosperity should be distributed, but the goal is to maximise it regardless of which group/individual that reaps the largest benefit.[138] When conducting my analysis in the following sections I will refer to Pareto-efficiency when I write about efficiency and all Pareto-efficient transactions are also Kaldor-hicks-efficient per its definition.

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[135] Miceli, Thomas. J, 'Economic Models of Law', (pp. 9–28) in *The Oxford Handbook of Law and Economics; Volume I: Methodology and Concepts*, Parisi, Francesco (ed.), p. 13.
[136] Samuels, Warren. J, 'Welfare Economics, Power, and Property', (pp. 9–75) in *Law and Economics; An Institutional Perspective*, Samuels, Warren. J and Schmid. A. Allan (eds.), pp. 16–19.
[137]Rajagopalan, Shruti and Rizzo, Mario J., 'Austrian Perspectives in Law and Economics', (pp. 268–287) in *The Oxford Handbook of Law and Economics; Volume I: Methodology and Concepts*, Parisi, Francesco (ed.), pp. 277–279.
[138] Cooter, Robert and Ulen, Thomas, *Law & Economics*, pp. 110–112-

Broadly speaking, economical theory is composed of theories and models to predict future events and explaining the outcomes of past events. These theories and models depend, in turn, on certain assumptions at their root level on how the market/individuals/firms act. Which assumptions that are applied vary in relation to the branch of economics that is at hand.[139]
The branch of law and economics that I will use when analysing private enterprises behaviour is rooted in neoclassical economics. According to economic scholar Elliot Roy Weintraub, this particular tradition of thought is based on three central assumptions which one has to make when analysing economic effects of events: "1. People have rational preferences among outcomes. 2. Individuals maximize utility and firms maximize profits. 3. People act independently on the basis of full and relevant information."[140]

Since the rules I analyse are set in an international context I will also use theories from the institutional branch of international law and economics when analysing the behaviour of States. This school of thought involves legal institutions and how they operate when analysing the law, which differs from the neoclassical approach where the focus is set on the behaviour of private actors and the market.[141] One of the central assumption in international law and economics is that States act rationally.
By applying this I can better explain the different considerations taken by States when operating within the body of international law, such as negotiations in the UN.

[139]Miceli, Thomas. J, 'Economic Models of Law', (pp. 9–28) in *The Oxford Handbook of Law and Economics; Volume I: Methodology and Concepts*, Parisi, Francesco (ed.), pp. 10-11.
[140] Weintraub,E. Roy, 'Neoclassical Economics', in *The Concise Encyclopedia of Economics*.
[141]Coase, Ronald, 'The New Institutional Economics', reprinted (pp. 45–48) in *The Economics of Contracts: Theories and Applications*, Brousseau, Eric and Glachant, Jean-Michel (eds.), pp. 45–47.

5.1.1 Microeconomics and Market equilibrium

Within the neoclassical approach to law and economics microeconomics play a vital role. This is often defined as the study of the allocation of scarce resources between competing ends. Since rational actors strive to maximise their utility or profits they will have to evaluate different activities and then choose the one that accomplishes maximisation.
When individuals and firms strive to maximise their utility and profit they will meet on the market to exchange goods and services. [142] The demand for a certain product in relation to the supply of this product will affect its price, along with its costs of production. Different products will compete and under the assumption that there is access to full and relevant information, interchangeable products will have to compete with their pricing in order to attract consumers. The production of a product is efficient once supply meets demand in equilibrium, which is the case when the price equals the cost of production.[143]

In order for the pricing to be correct all costs of producing something must be accounted for. When this is not the case, the producer will not bear all its cost but these will instead be borne by society which is called externalities. An example of this is a factory that pollutes its surrounding environment without having to pay for the clean up. It will then be able to sell its products for a lower price than it really costs to produce, which will result in an overproduction which means that the market is not in equilibrium. To avoid this the externalities must be internalized into the cost of production, since then the producer will correctly price its products and adjust its production accordingly. This can be done for example through tort law.[144]

[142] Cooter, Robert and Ulen, Thomas, *Law & Economics,* pp. 10–11.
[143] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 88–90.
[144] Cooter, Robert and Ulen, Thomas, *Law & Economics,* pp. 40–42, 154-155,

5.1.2 Risk and risk management

An important component of neoclassical economics is the attribution of risk in society. I will here operate under the assumption that different persons (natural or juridical) have different attitudes towards risk. There are three possible attitudes a person can have in relation to risk; risk aversive, risk indifferent and risk preferring. If you are risk aversive you will prefer a certain outcome instead of an uncertain one, even if both have the same expected value. A common example is having to choose between receiving 10 $ or flipping a coin with the possibility of winning 20 $ if it lands on heads. The expected value of both alternatives is the same, namely 10 $ since this value is calculated through multiplying the probability for a certain outcome with the value this outcome would have. A risk aversive person would opt for the 10 $ instead of playing the game.
A risk indifferent person would regard both alternatives as equally attractive based on that they have the same expected value. A risk preferring person would, when confronted with two options with equivalent expected value, opt for the one with the most risk. [145]

Due to these different attitudes towards risk it is possible to make efficient transactions that reassigns risk from a risk aversive entity, for example an individual person, to a risk indifferent entity, such as an insurance company, which results in that the risk is borne by the party with the best means of handling it. The risk aversive party will therefore pay a premium to the insurer in order to liberate itself from a certain risk. The insurer has calculated the premium based on the probability of the risk being realized and how many equivalent risks they can insure, thus portioning out the cost of risk management on a collective of insured.[146]

[145]Polinsky, Mitchell A., *An introduction to law and economics*, pp. 53–54.
[146] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 56–58.

5.1.3 Coase's theorem

Ronald Coase is a central figure in forming law and economics. One of his central theories is on the subject of how the efficient amount of a certain activity can be reached, which has been named Coase's theorem.[147] According to Coase, in a world where there are no transaction costs[148] the parties affected by negative externalities of an activity will reach an agreement with the one performing the activity to reach an efficient outcome. The example Polinsky uses when describing Coase's theorem is a factory that through its smoke causes damages to laundry hung to dry by five neighbouring houses. The smoke causes 75 $ in damages to each neighbour if corrective actions are absent, totalling a cost of 375 $. One solution is that the neighbours dry their clothes indoors, but then they each need to buy an electric drier that costs 50 $ per unit. The combined costs of the neighbours would then be 250 $. The other solution is that the factory instead installs a filter that clears its smoke, for a cost of 150 $. Therefore, the second option is better in terms of efficiency since it reduces the costs of society with 225 $ while the first only reduces them with 125 $. In this case, were no transaction costs exists, the neighbours could pool their resources and buy a filter for the factory, which the factory owner should accept since it is free. Coase's theorem reaches the conclusion that the most efficient solution will be found regardless who has the original right to the use of the air, but that the difference lies in which party will carry the costs. The neighbours will carry the costs of the corrective action if the factory owner is entitled to let out smoke from his chimney, while the factory owner will carry the costs if the neighbours have a right to claim compensation for the polluting smoke.[149]

[147] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 11–14.
[148] Transaction cost will be explained in the following page.
[149] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 11–14.

For the theorem to work there can be no transaction costs, which in the real world are nearly always present.[150] Transaction cost are the costs associated for performing a transaction and are normally divided into three categories:

1. Cost of *contact*, which in the example presented above would be the costs for the neighbours to come into contact with each other and the factory owner.
2. Cost of *contract*, the costs associated with negotiating an agreement, for example involving a lawyer to draw up legal documents or a technician to identify which kind of filter is needed to prevent damaging smoke.
3. Cost of *control*, the costs for controlling that the other party follows the agreement and for example does not remove the filter unexpectedly. [151]

So, according to Coase, to formulate economically efficient rules one shall try to replicate a world without transaction costs. In order to achieve this, a clear attribution of rights to do something or prevent someone else from doing something is needed. These rights shall be placed with the party that will result in the lowest transaction cost, since then the parties will find an efficient solution between them. If the factory owner is given the right to pollute, this will result in an inefficient outcome compared to if the right to clean air is assigned to the neighbours. This is true since the factory owner has less transaction costs in finding a filter than what the neighbours would have since they would have costs to get in touch with each other atop of finding a filter, or otherwise opt for the electrical driers that are inefficient compare to installing a filter.[152]

[150] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 12–14.
[151] Cooter, Robert and Ulen, Thomas, *Law & Economics*, pp. 88–90.
[152] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 13-14.

5.1.4 Tragedy of the commons

A tragedy of the commons occurs when an individual reaps the benefits of exploiting a common area while sharing the negative costs with the other stakeholders of the area. In this way, negative externalities will slowly decompose the benefits from the area but at the same time it will be rational for everyone to exploit it, until one day it is no longer useful and no one can gain any benefits from it at all.[153]

5.1.5 Asymetrical information & Moral hazard

Asymmetrical information means that to parties to a transaction have different access to information, for example a seller of a car will now more about how it runs than what a presumptive buyer will. There are a number of situations were asymmetry in information occurs between the actors involved.[154] This can be utilized by the actor with the informational advantage to gain a larger part of the benefits of the transaction, for example by selling a car for the prize of an unused model while knowing that the meter has been fiddled with. Such a behaviour is seen as opportunistic and leads to an inefficient transaction since the car is overpriced. Another problem that can occur when asymmetrical information is at hand is moral hazard.

A moral hazard occurs when the existence of a provision intended to handle a risk creates incentives to the one closest to the risk to not take precautions. This is commonly associated with the insurance market, where the insurer has less information about the insured about its level of risk-taking. Having an insurance that replaces any damages caused by a fire may lead a person

[153] Hardin, Garret, 'The Tragedy of the Commons', *Science, New Series, Vol. 169 (1968): 1243–1248.*
[154] Wu, Tim 'Law and Economics of Information', (pp. 239–255) in *The Oxford Handbook of Law and Economics; Volume II: Private and Commercial Law*, Parisi, Francesco (ed.), pp. 246-248.

covered by this insurance to take less precautions than before signing the insurance, since now it has less risk of loss than before.[155]

5.2 Multiple launching States

5.2.1 Descriptive analysis

Under the assumption that individuals, in this case private enterprises, act rationally when assessing from which launch site they shall launch a satellite, they will factor in the different conditions that will affect the economic outcome of the operation and thereafter choose the most efficient alternative. Among these factors is the launch site's location, both in relation to the private enterprises location and to outer space, since different degrees of inclination of the globe affects the complexity of launching a satellite into orbit.[156]

Another factor is the cost of compliance. Because different States set different standards for authorizing space ventures, and the cost of compliance for a space actor therefore varies depending on under which State's authorization they are subject to, then the actor will choose the State that causes the lowest compliance costs when choosing between two otherwise equivalent alternatives.[157] This could therefore lead to a "race to the bottom" where States compete in attracting the space industry by lowering their safety standards and therefore augmenting the risk of the launches resulting in damages. A developing State could see this as a rational decision, since by attracting space enterprises it can gain a part of their income in exchange for carrying part of their risk in form of international liability. This can be a beneficial trade of as long as that no

[155] Polinsky, Mitchell A., *An introduction to law and economics*, pp. 56–57.
[156] Fenema, Peter Van, 'Legal aspects of launch services and space transportation', (pp. 382–455) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 402.
[157] On the different levels of complexity of national space law see Marboe, Irmgard, 'National space law', (pp. 127–204) in *Handbook of Space law*, Dunk, Frans G. von der & Tronchetti, Fabio, (eds.) p. 139.

satellite crashes occur, but could result in a massive cost for a State with a limited budget.

Another aspect of the existence of multiple launching States is the division of the cost of damages between these States. The LC makes it clear that the injured State can make claims against any of the involved launching States, regardless of their internal agreements on division of liability. A claimant State will therefore put forward it claims towards the State which will be most inclined to pay, presumably a State that cares about its international reputation and has the financial capacities to compensate the arisen damages. However, this State has a right of recourse against the other launching States according to the LC, if not agreed otherwise. It is possible to envision a smaller State with good launching conditions to be pressured into assuming a larger amount of the liability, since it is in a position where attracting space industry is valued highly while underestimating its potentially large liability.

5.2.2 Prescriptive

Private satellite launches are desirable as long as they are economically efficient. To find the optimal level of private satellite launches we must imitate a world without transaction costs.

Since the liability for a space activity is place on the launching State(s) one can say that the right to an accident free space lies with the potential victims of a satellite crash. If damage occurs they will therefore turn to the launching State for compensation. This State must then perform diplomatic negotiations with the Claimant State in order to reach an agreement on the amount of compensation etc. Such negotiations means large transaction costs for both States, possibly larger than what the compensation for damages would result in. Therefore its more efficient to reassign the liability from the launching State(s) to the private satellite company in form of mandatory insurance.

Some of the space faring States have already enacted legislation that requires space activity operators to get insurance coverage for their planned operations.[158] A State can combine an obligatory insurance for a private space activity, with a right of recourse against the actor conducting the space activity in case that the insurance does not cover all the damages. In this way, the State can allocate the risk linked to the international liability on to the actual subject carrying out the potentially harming activity. This solution combines State enforcement with the markets free pricing on insurance, which should result in an efficient repartition of risk between the parties. In this way transaction costs for potential claims under the LC are eliminated since the Claimant State can be compensated directly by the satellite enterprise's insurance company.

The relationship between the insurance company and the satellite company may result in a moral hazard situation, but this can be avoided through a close cooperation between these companies in the process of developing the insurance contract. This is how the space insurance sector operates today since space enterprises have a better technological understanding of their projects which the insurance company needs to understand to correctly asses the risk, therefore the parties act more like partners in the process of assessing the risk than adversaries.[159]

[158]For example France and USA, see Malinowska, Katarzyna, 'Risk Assessment in Insuring Space Endeavours: A Legal Approach', *in Air & Space Law 42, no. 3 (2017)* pp. 337–339.
[159] Malinowska, Katarzyna, 'Risk Assessment in Insuring Space Endeavours: A Legal Approach', *in Air & Space Law 42, no. 3 (2017)* pp. 331–333.

5.3 Small Satellites

5.3.1 Descriptive analysis

Small satellites are gaining popularity partly on the basis that they are very cost efficient compared to traditional satellites. Small satellites are cheaper to launch since they can "piggyback" on launches of other payloads and they are also cheaper to produce due to their sizes and limited functions. Their limits in functions can be compensated by linking multiple small satellites together in outer space and by then operating them in the form of a swarm where each satellite has a specific function that it combines with the others.[160] From an economic perspective of an individual actor, it is rational to increase the use of these small satellites since it lowers its cost for performing space operations. Meanwhile, from the perspective of the Earth in whole and the global human community, such an increase of small satellites may lead to a "tragedy of the commons" kind of situation, where ultimately our surrounding space is so full with small satellites that we cannot leave our planet without serious risk of collisions.[161]

5.3.2 Prescriptive analysis

To avoid the situation where our orbital lanes and surrounding space becomes cluttered with small satellites causing a tragedy of the commons, there is need of clarification that small satellites are space objects according to the OST and the LC. In this way the small satellites have to be registered with the UN and this enables the world as a whole to get an overview of how many small satellites exist and therefore better assess the potential gravity of the situation. A way to then limit the risk that our orbital lanes become cluttered is to impose regulations that all small satellite must either

[160] Marboe, Ingrid, 'Small Is Beautiful? Legal Challenges of Small Satellites', (pp. 1–16) in *Private Law, Public Law, Metalaw and Public Policy in Space:A Liber Amicorum in Honor of Ernst Fasan*, Sterns, Patricia M. and Tennen, Leslie I. (eds.), pp. 4–5.
[161] Salter, Alexander William, 'Space Debris: A Law and Economics Analysis of the Orbital Commons', in *19 Stan. Tech. L. Rev.*, p. 226.

have the capacity to deorbit (and burning up in the atmosphere without harm for anyone on Earth) or be removed by its launching State(s) after a certain period of time, thus enabling other satellites to take its place. Voluntary guidelines for space debris mitigation has been proposed by the UN through Copuos.[162] It would be desirable to form these guidelines into a treaty but since such negotiations involve multiple States for an extended period of time this would cause large transaction costs. The solution can come from States adopting national space legislation about small satellites and their removal from orbit, which could cause a bandwagon effect where other States follow since it is seen as a positive step that they also want to take for terms of a better international reputation.[163]

5.4 Creative Launches

5.4.1 Descriptive analysis

The rules on State responsibility and liability exist in order to increase the incentives of States to regulate space activities under their control so as to avoid potential damages. When a satellite is launched with only one State involved, that State solely bears both the international responsibility and liability. In this case it is possible to coordinate the required security measurements for a satellite launch in relation to the potential costs of the satellite crashing. Security measures that cost less than what they reduce in potential costs for a crash are economically efficient and should be imposed on the launch. For example, if an estimation of a crash would amount to 200 million in damages and the probability for its occurrence is 1 %, the expected cost for a launch under those conditions are 200 million $ (the cost if the crash occurs)/100 (the probability of it occurring, one in a hundred) =

[162] Committee on the Peaceful Uses of Outer Space: Scientific and Technical Subcommittee: Fortieth session, Vienna, 17-28 February 2003, Item 10 of the provisional agenda* A/AC.105/ C.1/L.260. Annex.
[163]On the bandwagon effect see Zorc, Martina, 'How to Foster the Development of Space Commerce Through Law and Economics', (pp. 121–126) in *Proceedings of the International institute of space law 2012,* Jorgenson, Corinne (ed.), pp. 125–126.

2 million $. If a security measure can lower the probability of the crash by half then the expected cost would also be halved and amount 1 million $. In order for this measure to be economically efficient to perform by the launching party it must cost less than 1 million $. The launching party should therefore voluntary adopt the measure in this situation under the assumption that they act rationally.

International space law, however, places the liability on the launching States and not the private actor, which can cause a moral hazard were the private actor has incentives to not adopt a measure that reduces the risk of liability. If no international liability would exist then an injured party would present it claims directly to the private actor, which would cause them to take more precautions to avoid liability. Since there now always is a launching State that is liable, the injured parties should opt to present its claims to the launching State instead of the private actor due to the fact that the former typically has deeper pockets. This situation could occur if the national space law of the launching State does not impose the private actor to absorb the liability carried by the State.

If a private actor instead goes through the efforts to avoid the international body of space law then it will probably not be made subject to a regulation as strict as it would if operating under the provisions of the space treaties. This could be achieved by incorporating its company in a State not member to either of the space treaties, thus lowering its total costs for the operation due to lower compliance cost.

But, this requires that the launch also takes place from the territory of a State that is not party to the aforementioned treaties, since otherwise this State would have incentives to impose restrictions in order to reduce its liability since it would carry both international responsibility and liability, seeing to the fact that the space activity started from its territory. An alternate way for a State to avoid qualifying as a launching State is to perform the launch from the high seas or from international airspace. This

would mean that there is no launching State that would be liable for the launched space object. From the perspective of the private actor they could lower their compliance costs of launching a satellite, but this would likely increase the risk of damages occurring compared to if the satellite would have a launching State. This since the private actor has better knowledge of its operation than what the launching State would have, that would then possibly impose excessively strict security measures. If damage occurs then the private actor will be sued for damages by those injured, but if these costs are too large to bear then the actor, presumably operating its space activities in the form of a limited liability corporation, will declare bankruptcy/dissolve the company. In that scenario, the ones injured by the crashed satellite will never be able to receive full compensation for the damages caused by the private actor. That would result in a situation where the external cost of the activity would not be carried by the ones performing it, which is undesirable from an economic point of view since the costs of the society would not match the cost of the space enterprise. The reason for this being undesirable is that then the activities would not be in equilibrium with the market since they are not considering all their costs, which could lead to an overproduction of these more risk taking satellite launches compared to other satellite launches that have internalized their costs.

5.4.2 Prescriptive analysis

To avoid the negative externalities presented above a clear definition of rights is needed, much like the situation with the multiple launching States. By this I mean that there is a need to always assign an appropriate State for each private space operation, since this State will have to authorise and supervise the space activity. The same is the case with always assigning a launching State. If there always exists an appropriate State/launching State then there is possible to impose mandatory insurance on the space enterprise to internalize its costs. In order to achieve this all of the world's States must ratify the OST and the LC, since then there is no way for a private enterprise to forum shop, as well as adopting national space legislation. This might be difficult to achieve due to the fact that there are many States that have no

space capacities and that State sovereignty is central in international law, meaning that you cannot force a State to ratify a treaty against its will. If argued that the OST constitutes international customary law then States can be encouraged to follow its provisions on international responsibility and international liability by the forms of reputation. For example States that incorporates a licensing regime for space enterprises can be award through increased international trade, causing others to follow their footsteps. If a State allows itself to be subject by license shopping by private space enterprises then other States can condemn this behaviour and avoid entering into international agreements with it in the foreseeable future in order for it to follow the provisions of the OST.

5.5 Concluding remarks

In chapters two and three I presented how international space law's rules on international responsibility and liability are applied to governmental and non-governmental space activities. In these chapters I presented the difficulties that can occur when there are multiple private entities involved as well as multiple appropriate- and launching States. Since there is no clear customary international law on how to view the procurement of a satellite launch abroad by a private entity in relation to its State of nationality being considered a launching State or not, there is a need for clarification.

In chapters four and five I presented problematic situations that have sprung from the entrance of private enterprise in space law. In addition to presenting these situations I proposed some ways to tackle these issues with the help of law and economics. Primarily the harmonization of national space law can help establish an obligatory insurance regime for all private satellite launching, which will assure that all liability cost will be carried by the actors in the satellite industry in form of paying insurance premiums. Combined with a right of recourse from the satellites launching States, triggered if the insurance does not cover the damages caused, the externalities created will be internalized in the private space enterprise.

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