3D Printing Using Material from Celestial Bodies

A Method to Circumvent the Non-Appropriation Principle?

Michael Chatzipanagiotis[*]

Abstract

Additive manufacturing or 3D printing enables manufacturing physical objects from three-dimensional digital models by laying down successive layers of material. Technology demonstrations have proved that such material could originate from a celestial body, such as an asteroid or the Moon. Thus, new objects could be manufactured using materials from celestial objects. Most legal orders provide that the manufacturer of a new object acquires original ownership thereon, while eventual property rights over the material used is lost. Such provision could qualify as a recognized general principle of law under Art. 38(1)(c) of the ICJ statute. Ownership through manufacturing might then be acquired, irrespective of the non-appropriation principle of Art. II Outer Space Treaty (OST). This paper examines whether the non-appropriation principle could be circumvented through manufacturing with celestial materials. It is submitted that the OST should prevail, if the non-appropriation principle covers exploitation of space resources. If the non-appropriation principle is inapplicable, then there is no point in examining whether it could be circumvented. In both scenaria, however, the practical question of the ownership of 3D-objects manufactured in space arises. It appears that the manufacturer would enjoy all elements of ownership, without being an owner according to international law. To solve the problem, it would be appropriate to establish an international organization under the UN auspices, at the example of the International Seabed Authority. Such organization would be the international administrator of the celestial resources and could grant tradable exploitation licenses to interested persons or entities against a fee. The fee could be a lump amount or a percentage of the net profits that the person/entity derives from exploitation of the resources. Ownership on the manufactured objects could then be legally recognized under international law, without affecting the non-appropriation principle.

* Legal Consultant, Aetherspace Consultants Ltd, Nicosia, Cyprus, Adjunct Lecturer, University of Cyprus – Legal Faculty, Nicosia, Cyprus, m.chatzipanagiotis@aetherspace-consultants.com.

1. Introduction

3D printing is a manufacturing technology that has great potential for use in outer space and over celestial bodies, for the construction of a wide variety of objects using materials found on site (*in situ*). In view of the principle of non-appropriation established in international space law, it worth examining whether there could be ownership rights over 3D printed objects using space resources.

2. 3D Printing in Space

3D printing or additive manufacturing is a manufacturing process, which transforms digital 3D objects into physical ones. After creating a 3D digital object with a Computer Aided Design (CAD) software or a digital 3D scanner, data is transmitted to special printers, which construct the physical object by laying down successive layers of material. Each of these layers can be seen as a thinly sliced about (0.1 mm) horizontal cross-section of the final object.[1]

3D printing has vast possibilities and applications across many industrial domains, ranging from medicine to aerospace manufacturing.

3D printing applications are also increasingly explored for outer space. Additive manufacturing experiments have been conducted in zero gravity on board the International Space Station (ISS).[2] Their objective is to use this technology to build in outer space or on celestial bodies various objects, such as transportation vehicles and components or even entire bases or settlements, by using *in situ* materials.[3] Further experiments are conducted in relation to asteroids, conducting 3D printing with asteroid materials,[4] not only to exploit valuable resources contained therein[5] but even to turn them

1 See for a brief explanation of 3d printing http://3dprinting.com/what-is-3d-printing/(last visited on 15 Dec. 2016); http://explainingthefuture.com/3dprinting.html (last visited on 15 Dec. 2016).

2 https://www.nasa.gov/content/international-space-station-s-3-d-printer (last visited on 15 Dec. 2016).

3 See e.g. https://3dprint.com/111799/nasa-3d-printed-rocket-engine/ (last visited on 15 Dec. 2016); http://www.esa.int/Our_Activities/Space_Engineering_Technology/Building_a_lunar_base_with_3D_printing (last visited on 15 Dec. 2016).

4 E.g. *Planetary Resources & 3D Systems Reveal First Ever 3D Printed Object from Asteroid Metals*, posted on 7 Jan. 2016 at http://www.planetaryresources.com/2016/01/planetary-resources-and-3d-systems-reveal-first-ever-3d-printed-object-from-asteroid-metals/ (last visited on 15 Dec. 2016).

5 http://www.asteroid.net/mining/mining-spaceships-with-3d-printing-by-2030/ (last visited on 15 Dec. 2016); *3D Printing in Space: Bringing Asteroid Mining One Step Closer to Reality*, posted on 3 Oct. 2016 by Esa Nummi at http://acceleratingscience.com/mining/3d-printing-in-space-bringing-asteroid-mining-one-step-closer-to-reality/, (last visited on 15 Dec. 2016).

into flying mining outposts by robotically 3D printing harvested materials and building mechanical propulsion systems.[6]

From a legal standpoint, many legal orders enable the manufacturer, under certain conditions, to obtain primary ownership over the manufactured object, overriding eventual ownership rights over the raw materials that other persons might had. Legal principles that are common across the majority of jurisdictions may qualify as "general principles of law recognized by civilized nations", which are a binding source of international law according to Art. 38(1)(c) of the Statute of the International Court of Justice (ICJ). So the question arises: Could 3D printing methods be used to circumvent the principle of non-appropriation of the Moon and other celestial bodies (non-appropriation principle), enshrined in Art. II Outer Space Treaty (OST),[7] by considering them a general principle of law?[8]

To answer this question, we should analyze the non-appropriation principle and, afterwards, the meaning and function of the general principles of law as a source of international law.

3. International Space Law and the Principle of Non-Appropriation

The principle of non-appropriation is laid down in Article II OST:

> "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by other means."

This principle is a fundamental rule of international space law.[9] It is considered a rule of international customary law. It has even been suggested[10] that it is a peremptory rule of international law in the meaning of Art. 53 of the Vienna Convention on the Law of Treaties.[11] Art. II OST prohibits the

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6 http://www.3ders.org/articles/20160608-nasa-funded-project-rama-could-transform-asteroids-into-mining-spaceships-with-3d-printing-by-2030-.html (last visited on 15 Dec. 2016).

7 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, signed at London, Moscow and Washington on 27 Jan. 1967, in force since 10 Oct. 1967.

8 On legal issues of 3D printing see also Mineiro, Michael/Lal, Bhavya, *Legal Uncertainties Related to Additive Manufacturing in Space*, Proceedings of the of the International Institute of Space Law 2014, Eleven International Publishing 2015, p. 233 et seq.

9 Lyall, Francis/Larsen, Paul B., *Space Law*, Ashgate 2009, p. 60; Freeland, Steven/Jakhu, Ram in: Hobe/Schmidt-Tedd/Schrogl (eds), *Cologne Commentary on Space Law I*, Carl Heynmanns Verlag 2009, Art. II OST, para. 1; Diederiks-Verschoor I.H.Ph./Kopal V., *An introduction to space law*, Wolters Kluwer 2008, p. 26.

10 Freeland/Jakhu (*supra* note 9), para. 45.

11 Article 53 of the Vienna Convention provides that "A treaty is void if, at the time of its conclusion, it conflicts with a peremptory norm of general international law. For

exercise of territorial sovereignty by any State over the outer space, the moon and other celestial bodies.
Art. II OST is combined with Art. I OST, which provides for the freedom of use and exploration of outer space:

> "The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.
> Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.
> There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation."

Moreover, Art. VI OST establishes the international responsibility of States for violations of the Outer Space Treaty and assimilates the acts of nationals of a State with the activities of the State itself:

> "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."

To the rest, Art. III OST clarifies that general international law applies to space activities:

> "States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding."

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the purposes of the present Convention, a peremptory norm of general international law is a norm accepted and recognized by the international community of States as a whole as a norm from which no derogation is permitted and which can be modified only by a subsequent norm of general international law having the same character."

Thus, States and their nationals are free to use outer space, the Moon and other celestial bodies, provided that the non-appropriation principle is respected. Otherwise, States will be held internationally responsible.
However, there is no unanimity as to whether the non-appropriation principle comprises the exploitation of natural resources.[12]
According to one view, the prohibition of appropriation is constructed widely and includes all celestial bodies and natural resources contained therein. Under the current legal regime, private property rights could not be recognized in any form.[13]
Pursuant to the opposite view, the non-appropriation principle applies only to territorial claims over outer space and celestial bodies as such, not to the resources contained therein, to which no mention whatsoever is made in the OST. Space resources are governed by the freedom to use outer space enshrined in Article I OST.[14]

4. The General Principles of Law as a Source of International Law

Art. 38 (1)(c) provides for the general principles of law as a source of international law:

> "The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:
> a. international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;

12 See in general Tronchetti, Fabio, *Legal aspects of space resource utilization*, in: von der Dunk/Tronchetti (eds) *Handbook of space law*, Edward Elgar 2015, p. 789 et seq.; Williams, Maureen, *The controversial rules of international law governing natural resources of the moon and other celestial bodies*, in: Proceedings of the International Institute of Space Law 2015, Eleven International Publishing 2016, *forthcoming;* Wolchover, Natalie, *Does Asteroid Mining Violate Space Law?*, posted on 23 April 2012 at http://www.livescience.com/33864-asteroid-mining-space-law.html (last visited on 15 Dec. 2016).

13 Lachs, Manfred, *The law of outer space*, originally published by A.W. Sijthoff in 1972, reissued by Martinus Nijhoff in 2010, pp. 42-43; Freeland/Jakhu (*supra* note 9), paras 42-44; Gorove, Stephen, *Limitations on freedom and use of outer space*, in: Proceedings of the Thirteenth Colloquium on the Law of Outer Space, AIAA 1971, p. 74.

14 Cheng, Bin, *La traité de 1967 sur l'espace*, 3 Jounal du Droit International (1968), p. 533 (574); Jenks, Wilfred, *Space Law*, Stevens 1965, p. 275; Williams, Maureen, The exploration and use of natural resources in the law of the sea and the law of outer space, in: Proceedings of the Twenty-Ninth Colloquium on the Law of Outer Space, AIAA 1987, p. 198. See also the *Position Paper on Space Resource Mining*, adopted by the Board of Directors of the International Institute of Space Law on 20 Dec. 2015, available at http://www.iislweb.org/docs/SpaceResourceMining.pdf (last visited on 15 Dec. 2016), para. II(2), which states that "in view of the absence of a clear prohibition of the taking of resources in the Outer Space Treaty one can conclude that the use of space resources is permitted".

b. international custom, as evidence of a general practice accepted as law;
c. the general principles of law recognized by civilized nations;
d. subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law."

The wording of the Article was taken from the statute of the Permanent Court of International Justice, the forerunner of the International Court of Justice – hence the parochial phrase "civilized nations", which is no longer used.[15]
The general principles of law is a complementary source of international law, laid down to avoid gaps in international law.[16] Gaps or *lacunae* indicate situations that, after applying international treaties and customs, remain unresolved – but not situations that are resolved unsatisfactorily.[17]
The exact meaning of Art. 38 (1)(c) is not absolutely clear. Although, in practice there can be a distinction between a legal "rule" and a "principle", the association "general" implies a wide-ranging legal norm.[18] The drafters of Art. 38 desired to denote general principles of domestic law (*in foro domestico*), including all branches of law.[19] The ICJ has applied this approach in several occasions.[20] However, there have been cases in which the ICJ applied general principles of law by reference exclusively to international law and not to any domestic legal orders.[21] To discover the general principles of law *in foro domestico*, one should look into the families or systems of law, the "legal systems", which are coherent enough to deduce general principles.[22] Particularly important can be general principles of private law,

15 Shaw, Malcolm, *International Law*, Cambridge University Press, 2008, p. 98; Pellet, Alain in: Zimmermann/Tomuschatt/Oehlers-Framm (eds), *The statute of the International Court of Justice*, Oxford University Press 2006, Art. 38, para. 256.
16 Shaw, *ibid*., Pellet, *supra* note 15, para. 245; Bogdan, Michael, *General principles of law and the problem of lacunae in the law of nations*, 46 Nordic Journal of International law (1977), p. 37.
17 Bogdan, *supra* note 16, pp. 38-39.
18 Pellet, *supra* note 15, para. 251.
19 Bogdan, *supra* note 16, p. 42; Pellet, *supra* note 15, para. 255 See also diss. op. of Judge Tanaka in the *South West Africa* case (Liberia v. South Africa), ICJ Reports 1966, p. 295, who states that the "general principles of law" refers to the fundamental concepts of each branch of law as well as to law in general.
20 E.g. *Effect of Awards of Compensation Made by the United Nations Administrative Tribunal* [Advisory Opinion], ICJ Reports, 1954, p. 47 (53); *Temple of Preah Vihear* (Cambodia v Thailand), [Judgment-Merits], ICJ Reports 1962, p. 6 (26); *Barcelona Traction* (Belgium v. Spain), ICJ Reports, 1970, p. 3 (37).
21 E.g. *Corfu Channel*, ICJ Reports 1949, p. 4 (22); *Western Sahara* (Advisory Opinion), ICJ Reports 1975, p. 12 (25, para. 59).
22 Pellet, *supra* note 15, para. 258; Bogdan, *supra* note 16, p. 46.

because they apply to individuals, who are equal to each other, just like States under Art. 2 UN Charter.[23]
Nevertheless, a general principle of law found in national legal orders is not automatically transferrable to international law; it must first be ascertained that such principle is compatible with the particularities of the international legal order.[24] As Sir Arnold McNair has famously explained:

> "The way in which international law borrows from this source is not by means of importing private law institutions "lock, stock and barrel", ready-made and fully equipped with a set of rules.... [T]he true view of the duty of international tribunals in this matter is to regard any features or terminology which are reminiscent of the rules and institutions of private law as an indication of policy and principles rather than as directly importing these rules and institutions."[25]

Although the wording of Art. 38 does not establish any formal hierarchy among the different sources of international law, it is accepted that the general principles of law are a subsidiary, albeit autonomous, source of international law: it is applied only if no solution can be found by examination of international treaties and customs.[26] Nevertheless, there is also the view that general principles of law do not have necessarily a subsidiary character and may influence the way that an international treaty or custom is applied.[27] If general principles of law enjoy equal status with treaties and customs, in case of a conflict the *lex specialis* will prevail.[28]

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23 Bogdan, *supra* note 16, p. 42, citing *Sørensen*, Max, *Les sources du droit international*, 1946, p. 136.

24 See PCIJ, *Status of Eastern Carelia*, Advisory Opinion, Series B, No. 5, p. 27, on the requirement of explicit consent to jurisdiction under international law, while in domestic legal rules such consent can be implicit; ICJ, *Temple of Preah Vihear* (Cambodia v. Thailand), Judgment-Preliminary Objections, ICJ Reports 1961, pp. 17 (31), in which the Court held that States may freely choose the form that applies to their transaction, contrary to domestic legal orders which require a specific form for certain transactions; Pellet, *supra* note 15, paras 262-264; Gaja, Giorgio, "*General Principles of Law*" in: Wolfrum, Rüdiger (ed.) *The Max Planck Encyclopedia of Public International Law*, Oxford University Press, 2007, para. 7.

25 Separate Opinion, *International Status of South-West Africa*, Advisory Opinion, ICJ Reports 1950, p. 128 (148).

26 Pellet, *supra* note 15, para. 289; Shaw, *supra* note 15, p. 123; Bogdan, *supra* note 16, p. 44. See also American Law Institute, *Restatement (Third) of Foreign Relations Law* (1987), § 102, comment l, where general principles of law are referred to as secondary sources of international law.

27 Gaja, *supra* note 24, para 21-22, who claims that a general principle may, in extreme cases, impinge on the application of a treaty rule; Panezi, Maria, *Sources of international law in transition: Re-visiting General Principles of International Law*, Ancilla Juris 2007, p. 66 (72).

28 See International Law Commission, Report of the 58th session, *Fragmentation of International Law: Difficulties arising from the Diversification and Expansion of*

Hence, the requirements for a general principle of law to exist are:

1) a gap in international treaties and customs (*lacuna*),
2) a legal rule, with identifiable content, found in many jurisdictions of different legal traditions,
3) this rule has wider importance for the legal systems it is found in,
4) the rule is transposable at the international level.[29]

5. Acquisition of Original Ownership through Accession in the Case of 3D Printing

5.1. Definition of Accession and Its Use Across Jurisdictions

Accession is a method of original acquisition of personal property, i.e. property that is not based on a consensual transaction between the old owner and the new owner. Accession can be defined as the right of ownership that persons acquire either as a result of their labor on or their improvement of an article, or by adding to or mixing with it something that they or another person owns.[30] Traditionally, accession has three main forms:[31]

(a) specification, which is the creation of a new product, through one's labor and skills, by an article initially belonged to someone else and used as a raw material, e.g. a cloth made into a dress;
(b) accession in strict sense or adjunction, which occurs when two or more distinguishable things are joined to create a new product that is identified with only one of the preexisting articles, e.g. foreign materials used to improve one's house;
(c) confusion, which is intermixing of two similar articles that cannot be distinguished, to create a new thing, same in kind as both intermixed articles, e.g. grain from two farmers is combined in a single container belonging to one of them.

The previous owners of the old item that has been processed/adjoined/confused might lose their ownership thereon, if the new item is of substantially greater value than the old. In that case, the old owners would be entitled to compensation by the new owner. There is also the possibility that co-ownership is established.

International Law, Yearbook of the International Law Commission 2006, Part II, Vol. II, p. 178.

29 See also Pellet, *supra* note 15, para. 249.

30 Arnold, Earl C., *The law of accession of personal property,* 22 Columbia Law Review (1922), p. 103.

31 See Arnold, *ibid*.; Merill, Thomas W., *Accession and original ownership*, (2009) Yale Law School Legal Scholarship Repository, Faculty Scholarship Series, Paper 4469, available at http://digitalcommons.law.yale.edu/fss_papers/4469 (last visited on 15 Dec. 2016), para. 19. Other forms of accession include offspring of animals, accretion, fixtures, crops etc., see *Merill,* paras 15 et seq.

Accession is a legal institution established already under Roman law and used ever since.[32] It can be found across numerous jurisdictions of both the common-law[33] and civil-law[34] tradition. Nevertheless, the exact legal effects vary across legal orders. There is no uniform regulation regarding crucial factors, such as the value threshold of the new item as to the old one that would justify full change of ownership, or whether the person that processed the old thing needs to have acted in good faith or not.[35]

5.2. 3D Printing and Accession

3D printing involves sophisticated manufacturing processes from other materials. The original materials are transformed into something completely new. Thus, the additive manufacturing process can be used to acquire original ownership over the manufactured object through accession.

6. Accession through 3D Printing as a General Principle of Law and International Space Law

Applying the requirements of Art. 38 (1)(c) ICJ Statute to the legal institution of succession, we conclude that accession cannot serve as a general principle of law.

6.1. Existence of a Gap in International Space Law

First of all, it is questionable whether there is a *lacuna* in international space law.

As mentioned above, there are two conflicting views on the scope of the non-appropriation principle: according to one view the non-appropriation principle covers exploitation of space resources, while the opposing view claims that exploitation of space resources is part of the freedom to use outer space.

If we follow the first view, then there is no gap in international law that could be filled by recourse to general principles of law. Even if we assumed

32 See Sohm, Rudolf, *The Institutes of Roman Law*, Stevens and Sons 1892, p. 244; Burdick, William Livesey *The Principles of Roman Law and Their Relation to Modern Law*, The Lawbook Exchange 2004, p. 336 et seq.

33 See Arnold, *supra* note 30 and Merill, supra note 31, both with extensive further references. See also for UK *Borden (UK) Ltd vs. Scottish Timber Products Ltd* [1981] 1 Ch 25; Scotland *International Banking Corp. vs Ferguson, Shaw and Sons* 1910 SC 182 (194), US UCC § 9-102(a)(1).

34 E.g. §§ 947 et seq. of the German Civil Code, Arts. 1336 and 1338 of the Portuguese Civil Code, Art. 192 Polish Civil Code, Art. 303 Spanish Civil Code, Art. 570 Belgian Civil Code, Art. 5:14 Dutch Civil Code, Arts 218 and 220 Russian Civil Code, Arts 243 Japanese Civil Code.

35 See e.g. the analysis of European legal orders conducted in Faber, Wolfgang / Luger, Brigitta (eds), *Acquisition and Loss of Ownership of Goods*, Sellier/Stämpfli, 2011, p. 1092 et seq.

that (a) the general principles of law to be on equal footing with international treaties and customs, and (b) accession is a general principle of law, then the non-appropriation principle (Art. II OST) would prevail as *lex specialis* in space law.
If we follow the second view, then there would be no need to examine whether the non-appropriation can be circumvented through sophisticated legal constructions. Nevertheless, in this case we would have a legal gap as to the establishment of property rights, which necessitates the examination of the rest of the requirements of Art. 38(1)(c) of the ICJ statute.

6.2. Legal Principle Common across Jurisdictions

Accession is widespread across many different jurisdictions of different legal families, as has already been mentioned above. Furthermore, it is a fundamental rule of acquiring original ownership. However, the deduction of a general legal principle is very difficult, because some important parameters of accession are not uniform across legal orders, such as the conditions of creating primary property rights on the new item instead of creating co-ownership or whether good faith of the person that processed the old item is required.

6.3. Compatibility with International Legal Order

In addition, accession would not be compatible with the established legal system of interstate legal relationships. Applying accession to justify acquisition of immovable property against another State would tantamount to violation of its territorial sovereignty. As to territories under the jurisdiction of no State, like the High Seas and Antarctica, they are governed by special international regimes that prohibit any (new) territorial claims.[36] In those cases, accession would violate existing international rules – notwithstanding that there is no *lacuna* in international law.
Accession as a method to justify creation of original ownership over movable property of another State would risk creating serious disputes, especially if the obtaining State acted in bad faith. Such State behanior would not promote international peace and security, and the friendly relations among States, contrary to Art. 1(1)-(2) UN Charter.

7. Conclusion

Additive manufacturing or 3D printing is a much promising technology for space exploration. From a legal standpoint, in many legal orders the principle of accession enables the persons/entities that manufacture objects with this

36 See Art. IV(2) of the *Antarctic Treaty*, signed at Washington on 1 Dec. 1959, in force since 23 June 1961; Art. 89 of the *UN Convention on the Law of the Sea*, signed at Montego Bay on 10 Dec. 1982, in force since 16 Nov. 1994.

method to obtain original ownership thereon, irrespective of any pre-existing ownership rights of other person/entities over the raw materials. Although accession is a legal institution known in many jurisdictions, the differences on the requirements and effects of its application among different legal orders do not enable the deduction of a general principle of law. Yet even if such deduction was possible, applying accession would not be compatible with the particularities of interstate legal relations. In any case, it is debatable whether the non-appropriation principle in international space law leaves a gap as to exploitation of space resources.

Nonetheless, the practical question of the ownership of 3D objects manufactured in space arises. It appears that the manufacturer would enjoy all elements of ownership, without being an owner according to international law. A temporary solution to the problem might be to use the principle of equity, foreseen in Art. 38(2) of the ICJ Statute. This provision could justify the establishment of a right of exclusive or privileged use, to enable limited exploitation of the manufactured item, such as use for own purposes or lease; but not sale, which entails ownership over the object.[37]

To solve the problem in the long term, it might be appropriate to establish an international organization under the UN auspices, at the example of the International Seabed Authority.[38] Such organization would be the international administrator of the celestial resources and could grant tradable exploitation licenses to interested persons or entities against a fee. The fee could be a lump amount or a percentage of the net profits that the person/entity derives from exploitation of the resources. Other methods to grant property and exploitation rights under international law would also be possible, yet the creation of an international legal regime on the exploitation of space resources would the most suitable solution to avoid international conflicts. Ownership on the manufactured objects could then be legally recognized under international law, without affecting the non-appropriation principle.

In the alternative, the creation of an international customary rule would be conceivable, in view of recent pieces of national legislation that enable exploration of space resources, provided that other States either establish similar rules or at least acquiescent to the new legal situation.

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37 Compare in this regard Kyriakopoulos, George, *Jurisdiction and control over facilities serving space tourism activities*, Proceedings of the International Institute of Space Law 2014, Eleven International Publishing 2015, p. 445 et seq., who suggests an evolutive interpretation of the Space Treaties, according to Art. 32 of the 1969 Vienna Convention, according to which acceptance of a "functional" jurisdiction over the surface occupied by installations constructed on the celestial bodies would be possible.

38 See Part XI of the *UN Convention on the Law of the Sea* and the *Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982*, which was adopted on 28 July 1994 and is in force since 28 July 1996.