Lunar Exploration: New Challenges for Export Control Compliance

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Abstract

Space exploration missions on celestial bodies bring new challenges for export control, notably due to the fact that diverse actors will be involved, including commercial entities; and new technologies will be developed and used, as lunar surface power, in situ resource utilization, surface excavation and construction. Such scenarios raise many legal issues, especially with reference to export control regime. Insofar as lunar exploration will imply the exchange of technologies as well as information and data between the participants to the mission, possessing different nationalities, these activities would need to be properly licensed and authorized by the competent authority. The paper examines the export control systems in the United States and at European level, considering also the mechanism set up within the International Space Station's agreements, and the Artemis Accords in order to put forwards the key elements to limit potential risks of export control violations in the case of space exploration programs.

Keywords: space exploration, international cooperation, export control, regulations, compliance

1. Introduction – Space Exploration: New Challenges for Export Control Regime

Since the last decade, there is a rising interest to return to the Moon. In fact, new missions of space exploration are being developed in close cooperation with States, space agencies and private entities involving both robotic and human activities.[1] There are projects for orbital and landing missions on the

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1 NASA Publishes Artemis Plan to Land First Woman, Next Man on Moon in 2024, September 2020: https://www.nasa.gov/press-release/nasa-publishes-artemis-plan-to-land-first-woman-next-man-on-moon-in-2024; NASA Names Companies to Develop Human Landers for Artemis Moon Mission, April 2020: https://www.nasa.gov/press-release/nasa-names-companies-to-develop-human-landers-for-artemis-moon-missions; European Space Agency, Third European Service Module for Mission to Land

Moon to establish scientific out posts that will later enable permanent human settlement on celestial bodies. Future space exploration implies the use of robots, machine learning and artificial intelligence technology[2] to carry out new kind of activities.[3] In this context, the Artemis program,[4] developed by the National Aeronautics and Space Administration (NASA), represents the first step in the next era of human space exploration. The project plans to establish a sustainable presence on the Moon, and to prepare for deep space exploration, with the ultimate objective Mars, together with commercial and international partners, including the European Space Agency, Canada and Japan. With this in mind, the Artemis Accords – *Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets and Asteroids* – signed on 13 October 2020 by 13 States so far,[5] establish some principles for a safe, peaceful and prosperous future of space exploration. The Accords take into account the fact that numerous countries and private actors aim to conduct missions and operations in cislunar space. New science investigations and technology experiments are leading the return to the Moon by 2024. The Artemis program aims to build sustainable elements on and around the Moon in order to allow robots and astronauts to explore further and conduct scientific experiences, as well as space mining activities with *in-situ* resource initial research (e.g. using lunar ice for sustainment and fuel).[6]

Exploration innovative initiatives, as lunar surface power, high performance spacefligh computing, precision landing, lunar dust mitigation, *in situ* resource utilization, solar electric propulsion, surface excavation and construction,[7] as well as space launch system,[8] lunar outpost,[9] lunar landers

Astronauts on the Moon, September 2020: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Third_European_Service_Module_for_mission_to_land_astronauts_on_the_Moon.

2 A.S. Martin, S. Freeland, *The Advent of Artificial Intelligence in Space Activities: New Legal Challenges*, 55, Space Policy, 2021, 1-10; A.S. Martin, S. Freeland, *Artificial Intelligence – A Challenging Realm for Regulating Space Activities*, Annals of Air and Space Law, XLV, 2020, 275-306.

3 How Humanity Will Return to the Moon: the Future of Lunar Exploration, Science Focus, June 2021: https://www.sciencefocus.com/space/future-of-moon-exploration/.

4 NASA, Artemis Program: https://www.nasa.gov/artemisprogram; *see also* https://www.nasa.gov/specials/artemis/.

5 NASA, *The Artemis Accords*: https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf; *see also* NASA, *The Artemis Accords*: https://www.nasa.gov/specials/artemis-accords/index.html.

6 Artemis Plan, NASA's Lunar Exploration Program Overview, September 2020: https://www.nasa.gov/sites/default/files/atoms/files/artemis_plan-20200921.pdf.

7 D. Flynn, *Managing Export Compliance and Lunar Exploration*, Bureau of Industry and Security, 2019 Conference, NASA Headquarters.

8 NASA, Orion Spacecraft: https://www.nasa.gov/exploration/systems/orion/index.html.

9 European Space Agency, Lunar Gateway: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Exploration/Gateway; NASA, Gateway: https://www.nasa.gov/gateway.

for deep space habitat concept,[10] are shaping new legal scenarios where space players will have to exchange data, information and technology.
Thus, new activities on celestial bodies will imply the transfer of technologies and the exchange of information and data which therefore represent significant challenges for export control rules.[11] In general tems, export control encompasses the rules restricting the transfer of goods and technology to and the performance of services to a "foreign person" or foreign destination by any means, anywhere, anytyime.[12] As a matter of fact, compliance with the rules will be of utmost importance in the attainment of lunar exploration activities involving international partners.
Novel lunar exploration activities spur numerous legal questions, in particular, whether the existing legal regime and export control procedures are appropriate and adequate to enable the realisation of these missions. The challenge is to coordinate common approach and implement common regulation in the field of export control.

2. The United States Approach

First of all, it is necessary to mention the Space Policy Directives (SPD) 1 and 2 which are particularly relevant in the context of space exploration and export control rules from the United States (US) perspective. Indeed, the Space Policy Directive 1 of 11 December 2017 relating to "Reinvigorating America's Human Space Exploration Program"[13] underscores the need to lead an innovative and sustainable program of exploration with commercial and international partners in order to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. The SPD emphasizes the role of the US as leader for the return of humans to the Moon, followed by human missions to Mars and other destinations. Subsequently, the Space Policy Directive – 2 of 24 May 2018 relating to

10 NASA Outlines Lunar Surface Sustainability Concept, April 2020: https://www.nasa.gov/feature/nasa-outlines-lunar-surface-sustainability-concept; NASA, Deep Space Habitation: https://www.nasa.gov/content/deep-space-habitation; D. Flynn, *Managing Export Compliance and Lunar Exploration... op.cit*.

11 S. Aoki, *Law and Military Uses of Outer Space*, in R.S. Jakhu, P.S. Dempsey (eds), *Routledge Handbook of Space Law*, Routledge, 2017, 217-220.

12 Export controls: A Brief Definition: https://research.charlotte.edu/departments/office-research-protections-and-integrity-orpi/export-control/export-controls-basic; *see also* the US Code of Federal Regulations, 22 CFR § 120.17 and 15 CFR § 734.2(b); A. M. Dula, *Export Controls Affecting Space Operations*, Journal of Air Law and Commerce, 51(4), 1986, 927-950; *See generally* Y. Aubin, A. Idiart (eds), *Export Control Law and Regulations Handbook: a Practical Guide to Military and Dual-Use Goods Trade Restrictions and Compliance*, Wolters Kluwer, 2016; D. Tamada, P. Achilleas (eds), *Theory and Practice of Export Control*, Springer, 2017.

13 Space Policy Directive 1 of 11 December 2017 relating to "Reinvigorating America's Human Space Exploration Program": https://fas.org/irp/offdocs/nspm/spd-1.pdf.

"Streamlining Regulations on Commercial Use of Space"[14] precises in Sec.6 the review of Export Licensing Regulations. The Executive Secretary of the National Space Council, in coordination with the members of the National Space Council shall "initiate a review of export licensing regulations affecting commercial space flight activity".

With this in mind, it became necessary to reshape the export control regime with the purpose to simplifly the procedures in order to enhance and to strenghten commercial partnerships in space exploration.[15] Indeed, export control is a particularly sensitive topic in the US,[16] especially in the context of the wide and strict 'International Traffic in Arms Regulations' (ITAR),[17] and considering also the extraterritoriality application of the regime (the laws and regulations continue to apply to the technical data and goods transferred abroad).[18] Due to the important constraints imposed by the system, it has been necessary to adapt the mechanism of control in the case where there are limited or no defense and security implications. In fact, the regime should be different when the program deals only with civil exploration.

As a consequence, NASA, in collaboration with the Department of State and the Department of Commerce, has initiated a reform of the procedures. The objective is to broaden the exceptions to the U.S. Munitions List (USML) within the Commerce Control List (CCL), as foreseen for the International Space Station (ISS) to explicitly include the Lunar Gateway, commercial habitats, NASA-led missions, and private sector systems.[19] This scenario will avoid some issues with export control procedures linked to civil missions, as

14 Space Policy Directive – 2 of 24 May 2018 relating to "Streamlining Regulations on Commercial Use of Space": https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-2-streamlining-regulations-commercial-use-space/.

15 *Introduction to U.S. Export Controls for the Commercial Space Industry*, November 2017; *see also* E. Goetz, J. Snyder, *What next for US space export controls?*, WorldECR, Nov. 2020, 32-33; US Department of Commerce, *US Space Industry "Deep Dive" Assessment: Impact of US Export Controls on the Space Industrial Base*, February 2014: https://www.bis.doc.gov/index.php/documents/technology-evaluation/898-space-export-control-report/file; National Defense Industrial Association, Export Control Reform: https://www.ndia.org/policy/international/export-control-reform; J. Hoffner, *The Myth of "ITAR-Free"*, Aerospace security, May 2020: https://aerospace.csis.org/the-myth-of-itar-free/.

16 M.J. Noble, *Export Controls and United States Space Power*, Astropolitics, 6(3), 2008, 251-312.

17 P.J. Blount, *The ITAR Treaty and its Implications for US Space Exploration Policy and the Commercial Space Industry*, Journal of Air Law and Commerce, 73(3), 2008, 705-722.

18 K.W. Abbott, *Defining the Extraterritorial Reach of American Export Controls: Congress as Catalyst*, Cornell International Law Journal, 17(1), 1984, 79-158.

19 NASA Advisory Council Recommendation. Export Control Reform – Extending International Space Station Export Control Relief, 1st March 2018 (RPC-01).

well as it will boost investment and ensure the safe operation of future space missions.

NASA aims to facilitate export control treatment provided by the ISS to other civil space-based systems with the purpose to align export control restrictions associated with Space Policy Directive 2.[20] In particular, a number of technologies and sensors used to current and future NASA missions, as well as future commercial activities in space, are not significant from a national security perspective, and consequently need less export control restrictions.[21] Therefore, it appears relevant to simplify existing rules and to ensure the interoperability of the technologies as well as to guarantee a greatest cooperation with international partners, implementing a sort of "open technology",[22] given the importance of sharing innovative technology and data. The idea is to develop space exploration missions where export control information might be shared more easily by taking into account:[23] (i) the role of commercial partners; (ii) the dynamic regulatory environment; (iii) the necessity to require licenses in advance for international partners; (iv) the rapid pace of design, and technologies.

To conclude, an adaptation of the US export control regulations is essential in order to make a collaborative lunar exploration possible with international partners. The regime has also to be examined from the European perspective as Europe constitutes a major partner in space exploration.

3. The European Vision

The European Union (EU) is supranational while the European Space Agency (ESA) is an intergovernmental organisation. Both institutions have different competences and member States. They are also managed by diverse rules and procedures. Nevertheless, the EU and ESA share a common purpose: strengthening space in Europe.[24]

20 NASA Export Control Program Operations Manual, 30 September 2021: https://nodis3.gsfc.nasa.gov/OPD_docs/NAII_2190_1H_.pdf.

21 NASA Advisory Council Recommendation. Export Control Reform..., *op.cit.*

22 D. Flynn, *Managing Export Compliance and Lunar Exploration... op.cit.*; C. Johnson, *The Space Law Context of the Artemis Accords*, SpaceWatch Global, May 2020: https://spacewatch.global/2020/05/spacewatchgl-feature-the-space-law-context-of-the-artemis-accords-part-1/.

23 D. Flynn, *Managing Export Compliance and Lunar Exploration... op.cit.*

24 F.G. von der Dunk, *Europe and Security Issues in Space: The Institutional Setting*, Space, Cyber and Telecommunications Law Program Faculty Publications, 2010, 71-99.

3.1. The European Union

From the EU perspective, there is also a will to simplify, to streamline and to modernise the export control system.[25] Indeed, export control rules need to be regularly updated given the evolving security risks and threats, rapid developments in science and technology, and changes in world trade. In this context, the European Parliament and the Council adopted, on 20 May 2021, the Regulation (EU) 2021/821 which sets up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items.[26] The new Regulation upgrades and strengthens the EU's export control mechanism to respond effectively to evolving security risks and emerging technologies, and allows the EU to protect its interests and values in an appropriate way.

The Regulation considers: (i) common export control rules, including a common set of assessment criteria and common types of authorisations (individual, global and general authorisations); (ii) a common EU list of dual-use items; (iii) common provisions for end-use controls on non-listed items; (iv) controls on brokering and technical assistance relating to dual-use items and their transit through the EU; (v) specific control measures and compliance to be introduced by exporters, such as record-keeping and registers, and; (vi) provisions setting up a network of competent authorities supporting the exchange of information and the consistent implementation and enforcement of controls throughout the EU.

In certain cases, EU Member States may introduce additional controls on non-listed dual-use items due to public security or human rights considerations. Moreover, additional EU restrictive measures may apply to dual-use exports (e.g. sanctions). Dual-use items may be exported freely within the EU, except for some particularly sensitive items, whose transfer within the EU remains subject to prior authorisation pursuant to Annex IV of the Regulation. In addition, while the regulation is directly applicable throughout the EU, member States need to take national measures to implement some of its provisions (e.g. enforcement and penalties).[27]

The Regulation deals with space launch vehicles, aerospace infrastructure/applications and spacecraft (Part XI – Category 9). So, it contains some relevant elements related to export control procedures of data, good and technology in the case of lunar exploration missions, including: (i)

25 F.G. von der Dunk, *A European "Equivalent" to United States Export Controls: European Law on the Control of International Trade in Dual-Use Space Technologies*, Astropolitics, 7(2), May 2009, 101-134.

26 Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items : https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0821&from=EN.

27 R. Rosanelli, *Seeking Harmonisation: European Space Export Control at the Crossroads*, ESPI Perspectives 54, November 2011, 1-6.

harmonization of licensing conditions and requirements in order to avoid imbalance of competition and to ensure the consistent and effective application of controls; (ii) introduction of additional general export authorisations in order to reduce administrative procedures on private entities, and authorities, while ensuring an appropriate level of control on the items to the relevant destinations.

With the adoption of this Regulation, the EU demonstrates its commitment to maintain robust legal requirements with regard to dual-use items, as well as to strengthen the exchange of relevant information and technology with greater transparency in the field of space activities involving international partners.

3.2. The European Space Agency's Rules and Procedures related to Export Control

The European Space Agency represents an important partner for lunar exploration.[28] In fact, the Agency is preparing to put satellites in orbit around the Moon in order to facilitate future missions.[29] In this context, technological interoperability and common approach in export control procedure are necessary in order to avoid any failure of compliance with rules. These considerations are particularly important in the framework of cooperation between NASA and ESA for the Artemis Gateway Partnership, and the European Service Modules (ESMs) for NASA's Orion spacecraft.[30]

From ESA perspective, rules and procedures concerning export-control issues can be found in Article XI.5(j) of the ESA Convention,[31] stating that

> "*Council shall adopt, by a two-thirds majority of all Member States, rules under which authorisation will be given, bearing in mind the peaceful purposes of ESA, for the transfer outside the territories of the Member States of technology and products developed through the activities of ESA or with its assistance*".

This provision is implemented by Chapter IV – Transfer outside the Member States of Technology and Products – of the Rules on Information, Data and Intellectual Property, adopted on 19 December 2001 by Council.[32]

28 Ambitious joint missions for ESA: https://www.theguardian.com/science/2020/oct/10/european-space-agency-finalises-plans-to-explore-the-moon-properly.

29 One Giant Leap: ESA wants satellites around the Moon to make manned missions easier, Euronews, August 2021: https://www.euronews.com/next/2021/05/21/esa-wants-satellites-around-the-moon-to-create-lunar-telecoms-and-navigation-system.

30 NASA, European Space Agency Formalize Artemis Gateway Partnership, October 2020: https://www.nasa.gov/press-release/nasa-european-space-agency-formalize-artemis-gateway-partnership.

31 ESA Convention: https://esamultimedia.esa.int/multimedia/publications/SP-1337/SP-1337_EN.pdf.

These rules underscore a clear distinction between technology and products owned by ESA, and those owned by Contractors.[33] The transfer of technology or products owned by ESA implies the authorisation of the Agency's Technology Transfer Board (TTB), while the transfer of technology or products owned by Contractors needs to be recommended by the TTB.[34] The TTB's authorisations or recommendations represent an additional step and it is not an alternative to the national-level authorisation mechanism.[35] The TTB's authorisations and recommendations take into consideration diverse elements,[36] such as: (i) the objectives of the ESA Convention; (ii) the competitiveness of European industry; (iii) the compliance with export controls in force in the Member States and, in particular, in the Member State under the jurisdiction of which the proposed transfer would be performed; (iv) any reciprocity for ESA and the Member States which may be appropriate; (v) any requirements on re-exports; and (vi) any relevant technology-transfer agreements. In any case, export control remains a national competence, governed by the national laws and regulations of the member States.

International cooperation is a core element in the realisation of ambitious space exploration projects. Thus, cooperative project imply that Parties take into account many legal issues, in particular export control rules. Moreover, the compliance with export control regulations at European level is of utmost importance to improve the competitiveness of its industry, and to continue being a key partner in the conduct of space exploration program. Therefore, the development of common standards and procedures in export control is needed in order to ensure a successful achievement in lunar exploration missions.

4. Lessons Learnt from the International Space Station

The International Space Station represents the major collaboration project undertaken at international level. The ISS is governed by two main levels of agreements: (i) the Intergovernmental Agreement (IGA) signed in 1998,[37] and

32 European Space Agency, Rules on Information, Data and Intellectual Property (ESA/REG/008), 23 April 2014: https://esamultimedia.esa.int/docs/LEX-L/Contracts/ESA-REG-008-EN.pdf.

33 C. Hansen, *Export Control and ESA Programmes*, 2016: http://www.law.kobe-u.ac.jp/GMAP/ingeer2016/presentation_files/D2_3_3_Hansen.pdf.

34 ESA Rules on Information, Data and Intellectual Property, Chapter IV.2.

35 A. Farand, U. Bohlmann, *ESA's Cooperation with International Partners – Export Control Issues*, ESA Bulletin 118, May 2004, 49-53.

36 ESA Rules on Information, Data and Intellectual Property, Chapter IV.3.

37 The ISS has been built and operated by Canada, member States of the European Space Agency (ESA), Japan, Russia and the US. *Agreement among the Government of Canada, Member States of the European Space Agency, the Government of Japan,*

(ii) 4 MoU signed in 1998 between NASA and four cooperating Agencies including ESA, Canada, Japan and Russia.[38] Furthermore, diverse Implementing Arrangements were concluded when the need arise between NASA and other cooperating Agency. In particular, the export control mechanisms implemented in the realisation of the ISS mission[39] highlight some relevant elements to consider in the case of future lunar exploration scenarios.

In the framework of the IGA, it is necessary to take into account Article 19 'Exchange of Data and Goods' and Article 20 'Treatment of Data and Goods'. While in the MoU signed signed between NASA and each of the other four cooperating Agencies (ESA, JAXA, Roscosmos, Canada), Article 8 – Management Aspects of the Space Station Program Primarily Related to Operations and Utilization, Article 9 – Responsibilities for Operations Costs and Activities and Article 15 – Exchange of Data and Goods, Treatment of Data and Goods in Transit are of particular relevance. The Agreements simplify the exchange and transit of technical data and goods necessary to implement the ISS cooperation. They provide appropriate procedure for the treatment of technical data and goods protected for export control and proprietary rights purposes. Indeed, these protected data and goods should be marked with a notice, or specifically identified; otherwise it means that they can be freely used for any purposes.[40] Data and goods can be used only by partners to fulfil responsibility requirements under IGA/MoUs, and used only by the receiving Cooperating Agency and its contractors and subcontractors.[41] Furthermore, Partners are not required to transfer any technical data and goods if it is inconsistent with their national laws or regulations.[42] They have only to exchange protected data and goods for the achievement of the mission.

In that respect, the IGA and the four MOUs have been drafted with flexible provisions in order to provide an appropriate legal framework for the realisation of the program with international partners.[43] In addition, export control rules have played an important role in the context of the ISS

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the Government of the Russian Federation, and the Government of the United States of America Concerning the Cooperation on the Civil International Space Station, signed 28 January 1998, entered into force 27 March 2001. TIAS 12927.

38 ESA, International Space Station Legal Framework: https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station/International_Space_Station_legal_framework.

39 United States General Accounting Office, *Export Controls – International Space Station Technology Transfers... op.cit.*

40 Articles 19.3 and 19.4 ISS IGA.

41 Article 19.1 ISS IGA.

42 *Ibid.*

43 The Legal Framework for the International Space Station, Presentation UNCOPUOS, 17 April 2013: https://www.unoosa.org/pdf/pres/lsc2013/tech-05E.pdf.

program, especially the clauses related to the exchange of technical data and goods, which can serve as a model for future agreements covering lunar exploration. Indeed, the ISS Partners have notably agreed that:[44] (a) partner's obligation to transfer technical data and goods to another Partner is limited to the data and products necessary to fulfil the Partner's responsibilities under the agreement; (b) everything must be done to facilitate transfers at every level (industries, cooperating agencies); and (c) to prevent unauthorised transfers to third parties.

However, some Partners may proceed inappropriately with the 'over-tagging' of data and goods normally freely available.[45] In that respect, the following sentence has been added in the IGA at article 19.3 in order to avoid this practice:

> "*The transfer of technical data for the purposes of discharging the Partners' responsibilities with regard to interfacing, integration and safety shall normally be made without the restrictions set forth in this paragraph.*"

It is obvious that it is difficult to foresee all possible scenarios in the field of export control, and for this reason, it is necessary to conclude additional agreements between partners taking into account all the hypothesis and specific cases in future lunar exploration missions. In addition, partners involved in a transfer during lunar exploration program, will most likely follow a careful approach, to avoid any possibility of non-compliance with export control rules.

Lastly, it is worth to mention the ISS Code of Conduct for the Space Station Crew.[46] Some provisions, in particular the Part V on Physical and Information Security Guidelines, constrain astronauts to protect, to mark and to identify goods and data produced during the performance of their duties, especially scientific experiments, carried out onboard the Station. Indeed, the fact that astronauts from different nationalities, work together onboard the ISS, is perceived as an export situation.

Thus, the establishment of a future 'Code of conduct for lunar exploration' including specific provisions relating to the exchange of information, technology and results from experiments (e.g. over the course of on-orbit activities or *in-situ* resource utilization) seems particularly relevant.

5. An Analysis of the Artemis Accords from an Export Control Perspective

Some provisions of the Artemis Accords are of particular interest to respond to the export control challenges.

44 A. Farand, U. Bohlmann, *ESA's Cooperation with International Partners... op.cit.*

45 *Ibid.*

46 Code of conduct for the Space Station crew. Code of conduct for the international space station crew: https://www.law.cornell.edu/cfr/text/14/1214.403.

Firstly, Section 5 on 'Interoperability' states that

> "*The Signatories recognize that the development of interoperable and common exploration infrastructure and standards [...] will enhance space-based exploration, scientific discovery, and commercial utilization*".

The Signatories undertake to use

> "*current interoperability standards for space-based infrastructure, to establish such standards when current standards do not exist or are inadequate, and to follow such standards*".[47]

Interoperability refers to the

> "*ability of different computerized products or systems to readily connect and exchange information with one another, in either implementation or access, without restriction*".[48]

In the context of lunar exploration and export control, the interoperability of systems is crucial to ensure a safe and successful space exploration.[49] The notion of interoperability is not mention in international space law but it already represents a key element in the various ISS agreement. Indeed, the ISS partners have developed interoperable standards for communications, robotics and docking systems with the aim to simplify and support operations onboard the Station.[50] In addition, States are encourages to facilitate international cooperation in their scientific investigations (Art. I.3 of the Outer Space Treaty), as well as to conduct their space activities in accordance with principles of cooperation and mutual assistance, and due regard (Article IX of the Outer Space Treaty). These elements are particularly relevant in the context of export control and interoperability between technologies in order to develop common standards[51] and to facilitate the achievement of Artemis program.

47 Artemis Accords, Section 5.

48 *See* Omni Sci, Interoperability Definition: https://www.omnisci.com/technical-glossary/interoperability. In other words, according to Collins Dictionary, interoperability means the ability of a system or component to function effectively with other systems or components.

49 R. Deplano, *The Artemis Accords: Evolution or Revolution in International Space Law?*, ICLQ, 70, July 2021, 799-819; *see also* C. Johnson, *The Space Law Context of the Artemis Accords, op.cit.*

50 A. Salmeri, *One size to fit them all*, SpaceWatch Global, November 2020: https://spacewatch.global/2020/11/spacewatchgl-opinion-one-size-to-fit-them-all-interoperability-the-artemis-accords-and-the-future-of-space-exploration/.

51 International Deep Space Standards: https://www.internationaldeepspacestandards.com/.

For cooperative activities, interoperability between technologies is essential in order to reduce the risks of export control failure, avoiding unnecessary duplications of procedures by sharing different technologies or data during the mission.
Then, Section 8 deals with the 'Release of Scientific Data' and specifies that

> "*The Signatories retain the right to communicate and release information to the public regarding their own activities. The Signatories intend to coordinate with each other in advance regarding the public release of information that relates to the other Signatories' activities under these Accords in order to provide appropriate protection for any proprietary and/or export-controlled information. The Signatories are committed to the open sharing of scientific data. [...] The commitment to openly share scientific data is not intended to apply to private sector operations unless such operations are being conducted on behalf of a Signatory to the Accords*".

The sharing of data and information is a significant element in the case of cooperative space exploration mission, as well as at the end of the mission. This will to share scientific data and research is a result of article I of the Outer Space Treaty which stresses that space exploration has to be done in the benefit and interest of all states, and the sharing of scientific data is a good example of such benefit sharing. It is also necessary to mention article XII of the Outer Space Treaty that mentions that

> "*All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity*".

These elements, including data sharing and allowing access to stations, and equipements in future lunar exploration are particularly relevant in the case of lunar exploration. It is necessary to take these aspects into account in the development of export control procedures.
It seems that scientific data will be shared and be made widely available by Artemis partner countries. In the same vein that for the ISS, it will be important to foreseen scenarios to avoid situation of non compliance with export control rules, and to implement a 'marking procedure', with an appropriate stamp, for sensitive data/information/technology shared, considering foreign and commercial partners.
Lastly, Section 11 on 'Deconfliction of Space Activities' provides that

> "*The Signatory establishing, maintaining, or ending a safety zone should do so in a manner that protects public and private personnel, equipment, and operations from harmful interference. The Signatories should, as appropriate, make relevant information regarding such safety zones [...] available to the public as soon as practicable and feasible, while taking into account appropriate protections for proprietary and export-controlled information*".

The Section specifically mentions the respect of export control rules by implementing safety zones,[52] in particular for technologies and information.

6. Conclusion – Some Thoughts on Export Control Rules for Successful Lunar Exploration Missions

The future programs of space exploration and human settlement on the Moon, Mars or other celestial bodies, imply to consider the export control rules already existing (e.g. at European level, in the United-States) and to adapt them to the missions planned by taking into account international and commercial partners. In this dynamic regulatory environment, some points are important to consider in order to comply with export control rules[53]: (i) communication and cooperation between partners; (ii) common understanding of scheduled deliverables to foreign partners (get authorizations and take into account the interactions with foreign partners); (iii) jurisdiction and classification of spacecraft components; (iv) understanding on how and when to use license exceptions and exemptions; (v) fostering common and standardised procedures for sharing export controlled information with foreign partners.

Thus, there is a necessity to anticipate the scenarios and set up appropriate mechanisms (by taking into consideration what has been done for the ISS), for providing adequate protection, with a 'marking procedure' for technical data, goods and technologies exchanged during the mission. Moreover, it is needed to develop common approach with clear chain of control, through standardised procedures and interoperable technology based on different lunar activities, as highlighted in the Artemis Accords.

Finally, it is necessary to foreseen regulation changes all along of lunar exploration activities, and to adequately update the rules in order to avoid any risks of non compliance.

52 J.W. Nelson, *The Artemis Accords and the Future of International Space Law*, ASIL-Insights, 24(31), 2020, 1-7; *see also* M. de Zwart, *To the Moon and Beyond: The Artemis Accords and the Evolution of Space Law*, in M. de Zwart, S. Henderson (eds), *Commercial and Military Uses of Outer Space*, Springer, 2021, 65-80.

53 D. Flynn, *Managing Export Compliance and Lunar Exploration... op.cit.*