

## SET THE CONTROLS FOR THE HEART OF THE MOON: IS EXISTING LAW SUFFICIENT TO ENABLE RESOURCE EXTRACTION ON THE MOON? \*

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The extraction of natural resources from celestial bodies is an indispensable component of current plans to establish a permanent human presence on the Moon, Mars, and, eventually, other planets and moons in our solar system. These plans to settle the solar system begin with the international effort to construct a Lunar Gateway which is moving forward alongside NASA's Artemis program (which also involves international partners). This presence on the Moon promises to gradually expand as other space agencies, together with private industry, join the effort to create what is often referred to as a "Moon Village."<sup>1</sup>

Why is resource extraction an inescapable future reality? The simple answer is that the alternative (i.e., bringing all resources from Earth) would be prohibitively expensive in light of the aggressive missions being planned by NASA and others. Without going into the economic details of launching mass into outer space (which are amply explained with a simple Google search), suffice it to say that delivering oxygen, water, fuel, and construction materials to the Moon from Earth would far more expensive than developing the capability to harvest such resources from the Moon—particularly if we are talking about a Moon village with a significant population.

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\* The title of this article is inspired by the song "Set the Controls for the Heart of the Sun," written by Roger Waters (Pink Floyd, *A Saucerful of Secrets*, 1968).

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<sup>1</sup> The Moon Village Association has already created an extensive network of professionals dedicated to resolving the legal and technical issues that will face the early settlers of the Moon. See MOON VILL. ASS'N, [www.moonvillageassociation.org](http://www.moonvillageassociation.org) (last visited Apr. 17, 2020).

Once this premise is accepted, the next questions are legal/regulatory in nature. First comes the question of whether resource extraction is permissible under international law. Some have argued that Article II of the Outer Space Treaty prohibits mining operations as a logical corollary of the article's ban on the national appropriation of celestial bodies: "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 any other means."<sup>2</sup>

The purpose of this article of the Outer Space Treaty was to prevent the repetition of the Age of Discovery where European countries raced to plant their flags and claim all lands beyond the borders of Europe. Article II prohibits the United States from claiming the Moon as its fifty-first state (although the Apollo astronauts did plant flags to mark their arrival).<sup>3</sup> However, arguments to expand the meaning of this article so that it prohibits mining have fallen flat. To drive this point home, changes to domestic law in the United States, Luxembourg, and, most recently, Japan have codified the legality of space mining—and have done so with diminishing objections from the international community.<sup>4</sup>

This Article argues that despite the existence of some open questions regarding fine points in the law and the unlikelihood of a new treaty regulating lunar activity, investors (of whatever type, whether public or private) should not be deterred due to any concern about the state of the law. The current regulatory process to launch a vehicle and operate a payload may be "clunky" in places, but it is not unduly burdensome. While there is plenty of debate about regulatory reform, it is a debate about how to improve the existing system—not necessarily to fix it. In other words, existing international law is already sufficient to protect the interests of investors, nations, and humankind. This Article will first look at what resources are likely to be extracted and why. We then describe the current international initiatives to forge new law regarding resource extraction in outer space. We close by making the case that

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<sup>2</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. 2, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty].

<sup>3</sup> *Id.*

<sup>4</sup> For the U.S. law, see Space Resource Commercial Exploration and Utilization, 51 U.S.C. Ch. 513 (2015). For Luxembourg's law, see Law on the Exploration and Utilization of Space Resources (*Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace*); of 20 July 2017, published July 28, 2017, available in both French and English at <https://space-agency.public.lu/en/agency/legal-framework.html>. For the Japanese law, see Regulation for Enforcement of the Act on Launching of Spacecraft, Etc. and Control of Spacecraft (Cabinet Office Order No. 50 of 2017), [https://www8.cao.go.jp/space/english/activity/documents/space\\_activity\\_act.pdf](https://www8.cao.go.jp/space/english/activity/documents/space_activity_act.pdf). The legality of resource extraction under Japanese law is inferred from the permissibility of describing the purpose of a spacecraft in the launch license application as designed for resource extraction. See E-mail from Souichirou Kozuka, Professor of Law, Gakushuin Univ., to Mark J. Sundahl (Jan. 20, 2020) (on file with author).

existing law, although not ideal in every way, provides sufficient legal protections and regulatory certainty to allow both governments and industry to move forward with confidence.

To dispel a common misperception, platinum mines are not in the plans for NASA and (most) other celestial pioneers.<sup>5</sup> It's true that there are virtually unlimited amounts of platinum and other valuable metals in space. However, the resource that will be most important as mankind establishes its first outposts on the Moon and Mars will be ice and other forms of water. Ice will provide water to drink, oxygen to breathe, and hydrogen as fuel. Once these needs are met, attention will turn to harvesting regolith for use as building material.

The amount of readily available ice on the Moon and Mars is limited. The south pole of the Moon holds the great majority of relatively easily accessible ice and the race to reach the south pole is already on. In 2008, India's Chandrayaan-1 mission discovered the widespread presence of ice in the regolith of the south pole. In 2019, China's Chang'e 4 spacecraft was the first to achieve a soft landing near the south pole. It carried a rover named Yutu (or "Jade Rabbit") to explore the area near the landing site for traces of ice, among other objectives.

The fact that ice is a limited natural resource is one of the prime drivers of the need for a legal structure to ensure that a predictable legal regime is in place so that extraction can take place in an orderly, efficient, and fair manner without (military) conflict. Even more important at the moment is the need for regulatory certainty so that investors in those companies that plan to locate, retrieve, and process the ice (and then sell or itself use the ice-based products) will feel sufficiently secure to continue funding these ventures. Entrepreneurs need for assurance that they will have exclusive rights (which could be something less than property rights) over a certain surface area of a celestial body before they will expend large amounts of capital sending equipment and personnel to the area to begin mining.

There have been two noteworthy attempts at the international level to create norms to regulate the harvesting of ice and other natural resources. The 1979 Moon Agreement was drafted with the intention to provide a set of rules that would govern resource extraction.<sup>6</sup> In particular, Article 11 called for the creation of an international body that would undertake the drafting of these rules. This meant that when a country ratified or acceded to the treaty, that country bound itself to obey those rules—whenever they were adopted and

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<sup>5</sup> NASA, NASA'S PLAN FOR SUSTAINED LUNAR EXPLORATION AND DEVELOPMENT 6 (2020), [www.nasa.gov/sites/default/files/atoms/files/a\\_sustained\\_lunar\\_presence\\_nspc\\_report4220final.pdf](http://www.nasa.gov/sites/default/files/atoms/files/a_sustained_lunar_presence_nspc_report4220final.pdf) (explaining that resource extraction experiments will explore the extraction of oxygen and water).

<sup>6</sup> Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3.

whatever their substance.<sup>7</sup> This provision, among others, was immediately repugnant to the United States and the USSR. In fact, no major space actor has signed the treaty (which to date has only eighteen ratifications).<sup>8</sup> It is widely considered a failed treaty. Although there is talk currently in the halls of the UN of a new push among the proponents of the Moon Treaty for its expanded ratification as resource extraction activities are becoming a near-term reality, this effort is not expected to go anywhere since the attitude of major space actors toward the treaty has not changed.

Almost forty years later, in 2016, the University of Leiden and its consortium partners launched the Hague International Space Resources Governance Working Group with the goal of creating “Building Blocks” that could, in turn, be used as a guide for creating a new set of norms (of whatever nature, including a treaty law, domestic laws, or some form of soft law, such as a set of guidelines or best practices) regarding the extraction and use of natural resources.<sup>9</sup> The members of the Working Group were drawn from academia, industry, government, and NGOs who met twice a year for four years to debate the legal and policy issues that face the international community as resource extraction is commenced.

The resulting body of twenty Building Blocks recommended a registry-based system for registering so-called “priority rights.” Registrants would have a priority right to work the registered mine. A resource right registration would describe the location of the activity and a description of the activity to be conducted. “Safety zones” would be established to provide a buffer zone between the registered activity and any new activities undertaken by another operator.<sup>10</sup> How exactly these safety zones would be measured is left open by the Building Blocks due to the wide variety of activities that could be registered. The safety zone for an operation on a low-gravity celestial body using explosives would require a large buffer area. In contrast, an operation that merely scraped ice off the surface of the Moon may not need much of a safety zone at all. Other Building Blocks address diverse issues, such as the creation of a database of best practices and measures for preventing harmful impacts to the environment or the activities of other actors. The Building Blocks also

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<sup>7</sup> *Id.* at art. 11.

<sup>8</sup> *Status of Treaties: Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, UNITED NATIONS TREATY COLLECTION, [https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg\\_no=XXIV-2&chapter=24&clang=\\_en](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXIV-2&chapter=24&clang=_en) (last visited Apr. 17, 2020).

<sup>9</sup> See *Overview: The Hague International Working Group on the Governance of Space Resource Activity*, UNIVERSITEIT LEIDEN, [www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group](http://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group) (last visited Apr. 17, 2020). The Working Group was financed by contributions from the Dutch Ministries of Foreign and Economic Affairs, the Secure World Foundation, and Deep Space Industries.

<sup>10</sup> So-called “buffer zones,” typically in the range of 500 meters, are routinely provided for energy companies drilling for oil and gas from offshore platforms here on Earth.

contain provisions to protect cultural/historical sites (such as the Apollo landing sites) as well as site of particular scientific interest.

The Building Blocks have now been transmitted to the UN Committee on the Peaceful Uses of Outer Space in Vienna (COPUOS). A “general exchange of views on potential legal models for activities in exploration, exploitation and utilization of space resources” was placed on the agenda of the 2020 meeting of the COPUOS Legal Subcommittee.<sup>11</sup> The Building Blocks will undoubtedly be an influential document as this discussion takes shape at the UN (which will be aided by the high-profile attendance of key Hague Working Group members at the subcommittee meetings).

*Now the question presents itself:* Are we likely to see the emergence of a new treaty that will establish a comprehensive regime to govern resource extraction? The simple answer is no. In fact, any attempt to create a new treaty will almost certainly meet the same fate as the Moon Agreement. If the planets align and the old opposition among major players to treaty law somehow dissipate, the process of treaty-making in this day and age would be so protracted as to be virtually irrelevant to the need for immediate investment in resource extraction. Gone are the days of the 1960s and 1970s when four highly successful space treaties were concluded in less than a decade. The number of countries directly involved in space activity has expanded exponentially since the days when only the United States and the USSR had the ability to travel beyond the Earth’s atmosphere. The COPUOS has become a complicated and politically tumultuous body that makes consensus (the standard used by the committee to take action) very difficult to achieve. As an example of how arduous treaty-making can be, one need only look at the Space Assets Protocol to the Convention on International Interests in Mobile Equipment (a treaty that creates an international regime governing security interests in, as well as the leasing and sale of, satellites and other space assets).<sup>12</sup> The project was conceived in 1984 and the Space Assets Protocol was concluded in 2012—twenty-eight years later. As of this writing, the treaty has only been signed by four states and ratified by none (ten ratifications are required for the protocol to enter into force).<sup>13</sup>

So, where does this leave us? Is the world to move forward with settling the solar system without any binding law governing resource extraction activity? Will humanity be able to build a Moon village without a system of

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<sup>11</sup> See Comm. on the Peaceful Uses of Outer Space, Annotated Provisional Agenda of the 2020 Meeting of the UNCOPUOS Legal Subcomm., U.N. Doc. A/AC.105/C.2/L.312 (2020).

<sup>12</sup> For a general discussion of the Convention on International Interests in Mobile Equipment, see MARK J. SUNDAHL, *THE CAPE TOWN CONVENTION: ITS OPERATION AND RELATION TO THE LAW OF OUTER SPACE* (2010).

<sup>13</sup> *Status: Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Space Assets (Berlin, 2012)*, UNIDROIT, [www.unidroit.org/status-2012-space](http://www.unidroit.org/status-2012-space) (last visited Apr. 17, 2020).

recognizing the right to occupy a particular territory and extract resources from the surface and sub-surface of the Moon without interference from other actors? That scenario is scary. The possibility of conflicts between actors goes through the roof if there is not (1) a transparent system of registering land claims and (2) a binding legal regime that enables easy enforcement of these land claims. The next question is how to get there? If not by treaty, then how? Maybe a UN model law based on the Hague Building Blocks? This model law could facilitate the development of a “patchwork” of domestic laws which (1) provide for a national (or international) registry of claims, (2) provide for the easy enforcement of these claims, and (3) recognize the registered claims of nationals of other states.

A patchwork of domestic laws is one alternative to a multilateral treaty. But how good of an alternative is it? Given the fact that the U.S., Luxembourg, and Japan have already adopted laws regarding space resource extraction, the formation of bilateral or trilateral treaties among these states is easily foreseeable. Would the European Union consider joining the group? Australia? China? Russia? Brazil? India? All of these states and more, we hope.

So how good of an alternative to treaty law is this patchwork approach? It has the potential to provide a level of legal certainty comparable to a treaty and has the distinct advantage of being politically feasible in the short term. Even if the international community headed down the road of seeking hard law, how long will it take to forge a multilateral among these nine parties? Five years? Ten years? Never?

Let us wrap up this Article by taking up that last possibility. What if the international community is *never* able to conclude a broadly ratified treaty governing space resource extraction? Would we be doomed? Or could it be that we have sufficient laws in place already? In other words: Does existing space law suffice to govern the coming mining industry on the Moon and other celestial bodies?

The answer is yes—in a minimalist sense. In this thought experiment, the following laws suffice to enable the mining industry:

- the duty to operate in space “with due regard to the corresponding interests” of other states (Article IX of the Outer Space Treaty<sup>14</sup>)
- the duty to consult with affected states if there is a possibility of harmful interference with another state’s activity (Article IX of the Outer Space Treaty<sup>15</sup>)
- the liability that attaches when a state or national causes damage (The Liability Convention<sup>16</sup>)

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<sup>14</sup> Outer Space Treaty, *supra* note 2, at art. IX.

<sup>15</sup> *Id.*

<sup>16</sup> Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 (entered into force Sept. 1, 1992).

- general international law regarding (1) state liability and (2) prohibitions on the use of force (*Corfu Channel/Nicaragua*<sup>17</sup>)

Due regard is one of the touchstones of the Outer Space Treaty. It requires that the “corresponding interests” of other states be considered, at a minimum, when conducting space activities.<sup>18</sup> But the duty could impose broader obligations beyond merely giving thought to the interests of other countries prior to acting.<sup>19</sup> Julia Gaunce concludes, in her analysis of the use of “due regard” in the United Nations Convention on Law of the Sea (UNCLOS), that the duty requires “at least some consultation” with affected states.<sup>20</sup> However, consultation “need not continue indefinitely or until the other party is happy.”<sup>21</sup> Gaunce provides an example of what the arbitral tribunal in the *Chagos* arbitration considered a failure of the United Kingdom to fulfill this duty to act with “due regard”:

The Tribunal found that the Applicant Mauritius holds rights in the area of the [marine preserve] that arose from undertakings by the U.K. (reversionary rights to the Chagos Archipelago, and to fishing and preservation of mineral resources in its territorial sea and EEZ). The Tribunal ruled that the U.K. had “failed properly to balance its own rights and interests with Mauritius’ rights” in deciding to create the [marine reserve].<sup>22</sup>

Perhaps most interestingly, Gaunce goes on to explain that the duty to operate with “due regard” in the context of the UNCLOS requires not only a duty to take into account the interests of those states immediately affected, but also the broader interests of the international community, including ecological concerns and the effects of climate change:

The interpretation of due regard offered [in this paper] concludes, among other things, that the duty of due regard

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<sup>17</sup> Military and Paramilitary Activities in and Against Nicaragua (Nicar. v. U.S.), Judgment, 1986 I.C.J. 14 (June 27); *Corfu Channel* (U.K. v. Alb.), Preliminary Objection, 1948 I.C.J. 15 (Mar. 28).

<sup>18</sup> Outer Space Treaty, *supra* note 2, at art. IX.

<sup>19</sup> Our thanks to Jennifer Warren of Lockheed Martin who brought the use of the phrase “due regard” in the UNCLOS to the attention of the authors. One should keep in mind, as Julia Gaunce points out, that “the application of international law rules on interpretation of treaties to identical or similar provisions of different treaties may not yield the same results, having regard to, inter alia, differences in the respective contexts, objects and purposes, subsequent practice of parties and travaux préparatoires.” Julia Gaunce, *On the Interpretation of the General Duty of ‘Due Regard’*, 32 OCEAN Y.B. ONLINE 27, 43 (2018) (citing *MOX Plant Case* (Ir. v. U.K.), Provisional Measures, (Perm. Ct. Arb. 2001), para. 51).

<sup>20</sup> Gaunce, *supra* note 19, at 51 (internal citations omitted).

<sup>21</sup> *Id.*

<sup>22</sup> *Id.*

encompasses not only a mutual duty bilaterally between competing states to balance their activities but also a duty to the interests of the international community. In a post-*laissez-faire* legal order of the seas, international community interests must now also be identified with ecology, including climate change mitigation.<sup>23</sup>

Article 3 of the Chicago Convention on International Civil Aviation requires states to exercise “due regard for the safety of navigation of civil aircraft” when drafting their regulations regarding the operation of state aircraft.<sup>24</sup> A working paper presented by the Federal Aviation Administration in Paris in 2015 explains that the duty to operate with “due regard” to civil aviation requires that the pilot of a state aircraft operate as follows:

1. Separate his/her aircraft from all other air traffic; and
2. Assure that an appropriate monitoring agency assumes responsibility for search and rescue actions; and
3. Operate under at least one of the following conditions:
  - (a) In visual meteorological conditions (VMC); or
  - (b) Within radar surveillance and radio communications of a surface radar facility; or (c) Be equipped with airborne radar that is sufficient to provide separation between his/her aircraft and any other aircraft he/she may be controlling and other aircraft; or
  - (d) Operate within Class G airspace.<sup>25</sup>
  - (e) An understanding between the pilot and controller regarding the intent of the pilot and the status of the flight should be

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<sup>23</sup> *Id.* at 59.

<sup>24</sup> Convention on International Civil Aviation art. 3, Dec. 7, 1944, 15 U.N.T.S. 295 [Chicago Convention].

<sup>25</sup> Class G airspace is uncontrolled airspace (which typically involves flight at very low altitudes). AERONAUTICAL INFORMATION MANUAL: OFFICIAL GUIDE TO BASIC FLIGHT INFORMATION AND ATC PROCEDURES 3-3-1 (2017).



arrived at before the aircraft leaves ATC [air traffic control] frequency.<sup>26</sup>

Each of these conditions share the common goal of reducing the risk to civil aircraft and the risk of injury or death to civilian passengers. For our purposes, the more important lesson here is that these conditions all describe *positive actions* that must be taken by pilots in order to comply with the obligation. It is not sufficient for pilots to merely take into consideration the risk to civil aviation. Concrete action to reduce such risk must also be taken.<sup>27</sup>

In light of the foregoing, the requirement that states conduct space activities with due regard to the corresponding interests of other states has the potential to be interpreted more broadly than is typically understood and could be seen as requiring not only consideration of other states' interests, but also the interests of the international community (including ecological/environmental interests). Moreover, beyond mere *consideration* of others' interests, operating with due regard appears to require consultations with affected states and, perhaps, the taking of concrete actions to protect the interests of other states. In other words, this existing duty may be more effective than previously believed in addressing the concerns that surround resource extraction.

The duty to consult with affected states may be derived from the obligation of "due regard," but even if that were not so, Article IX of the Outer Space Treaty makes explicit that consultation with affected states is required if there is a possibility of "harmful interference" with such state's activities:

If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space . . . would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space . . . it shall undertake appropriate international consultations before proceeding with any such activity or experiment.<sup>28</sup>

In addition to placing a duty to consult on the acting party, Article IX also gives the affected state the right to request consultations if activity planned by

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<sup>26</sup> *Id.* at 1 (with some redactions).

<sup>27</sup> For purposes of comparison, U.S. law requires a flight safety analysis prior to the launch of a space vehicle. 14 C.F.R. §417.231(b). In the case of an orbital launch, for example, "the analysis must establish any launch waits needed to ensure that the launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a manned or mannable orbiting object during ascent to initial orbital insertion through at least one complete orbit." *Id.* at §417.231(b). It is worth noting that only collisions with "manned or mannable orbiting object."

<sup>28</sup> Outer Space Treaty, *supra* note 2, at art. IX.

another state “would cause potentially harmful interference” to its activities.<sup>29</sup> What exactly constitutes “harmful interference” in the context of Article IX is subject to debate. Frans von der Dunk has argued that “[w]hile there is a generic legal interest emanating from the Outer Space Treaty to avoid harmful interference . . . , the Treaty as such remains too unspecific and abstract to serve as a helpful legal instrument to combat harmful interference.”<sup>30</sup> This is a rather cynical view on what constitutes “harmful interference.” But where else can we look for guidance? Perhaps the best analogy is found in the ITU’s Radio Regulation 1.169, which defines “harmful interference” thus:

interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with Radio Regulations.<sup>31</sup>

Would activity that endangers the functioning of a mining operation constitute “harmful interference” under the Outer Space Treaty? What about activity that seriously degrades, obstructs, or repeatedly interrupts the operation of a mine? I would argue that all such activities would constitute “harmful interference” under the treaty. At the end of the day, the uncertainty at the edges doesn’t necessarily cause a problem. The definition of “harmful interference” is much like the definition of the edge of space—there is no pressing need to find a precise answer.

With this we have reached the end of our analysis of existing law. More can be said about the Liability Convention, the international law on the use of force, and domestic actions under tort law, but that is for another article.

We now bring the threads of this article together by positing the following:

The duty of due regard in concert with the duty to consult under Article IX of the Outer Space Treaty are together sufficient to:

- (1) deter harmful interference among different actors;
- (2) promote safe practices among all actors; and

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<sup>29</sup> *Id.*

<sup>30</sup> Frans G. von der Dunk, “*Space Side*” to “*Harmful Interference*”—*Evaluating Regulatory Instruments in Addressing Interference Issues in the Context of Satellite Communications*, in HARMFUL INTERFERENCE IN REGULATORY PERSPECTIVE: LEGAL RULES FOR INTERFERENCE-FREE RADIO COMMUNICATION: 3RD LUXEMBOURG WORKSHOP ON SPACE AND SATELLITE COMMUNICATION LAW 87, 91 (Mahulena Hofmann ed., 2015).

<sup>31</sup> 47 C.F.R. § 2.1 (1984).

(3) protect historical sites and sites of special scientific interest.<sup>32</sup>

This answers the question that was posed above: What if the political realities of the day prevent the creation of any new hard law? The answer is that the mining industry can move forward with confidence that the international order has already provided a sufficiently predictable and certain regulatory regime. Once a mining operation is initiated on the Moon, all subsequent actors must act with due regard for its interests (or more accurately, the interests of the operator's country). Moreover, if a subsequent actor is planning a nearby mining operation, that actor must actively engage any affected country by initiating consultations in the event that the planned operation could harmfully interfere with the existing operations.

Now the final plea. The international community should create a new international registry as follows:<sup>33</sup>

- The UN would create a registry of resource claims that is available online for free to the public 24/7.
- Each filing would contain the following information:
  - Name of authorizing state
  - Name and nationality of operator
  - Location of the activity
  - Nature of the activity
  - Duration of the activity
- The registry would be indexed and searchable by location (by latitude/longitude or other appropriate cartographical parameters).
- A search would produce any filings made in proximity to the location searched (the closest existing operation being listed first).
- Sites of cultural heritage and scientific interest could be filed in order to protect such sites.

The operation of the registry would be similar to the coordination process used in conjunction with the ITU Master Register. When the registry opens, those states and companies that are already operating on the Moon (or other celestial bodies) would register their activity. The Apollo landing sites will be among the first sites of cultural heritage to be registered. The first sites of natural heritage and scientific interest will also be registered.

New operators will eventually move in. These new operators will search the registry by inputting the location of the potential site. The result of the

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<sup>32</sup> "Corresponding interests" could be interpreted broadly to discourage harm historical sites and sites of special scientific interest.

<sup>33</sup> This registry format was first proposed by Prof. Sundahl in Mark J. Sundahl, *An International Registry and Registrar for Priority Rights to Extract Resources on Celestial Bodies*, in 2019 PROCEEDINGS OF THE INTERNATIONAL INSTITUTE OF SPACE LAW (forthcoming in 2020).

search would be a map of the location and the surrounding area. The user could zoom in or out of the map. On the map, the user will see any sites that have already been registered. If there is an existing operator in the vicinity of the potential location, the new operator would have to make a decision. Can the new company operate without harmfully interfering with the existing operator?

And here is the how the registry is the glue that holds this sparse regime together—and why its creation is our final plea. By registering your resource claim you are putting the world on notice of the sphere of your planned activity. If a later actor undertakes any resource extraction activity in the vicinity of a registered claim, such actor will not be able to claim ignorance. That actor must act with due regard to the interests of the registered party—and if there is a chance of harmful interference, consultations must be undertaken.<sup>34</sup> A treaty will be needed to create this registry. The question is whether there is sufficient political will to support even this modest proposal. Even a voluntary registry, perhaps administered by a nonprofit organization, could make public the necessary information about planned and existing missions to allow other actors to fulfill most effectively their duty to operate with due regard. The broad adoption of the voluntary registry would be the most critical aspect of its success. As its use becomes customary, the registry will eventually serve as the *de facto* mechanism for avoiding conflicts between space resource operations.<sup>35</sup>

The next step? We will see how these issues play out during the general exchange of views on space resource activity at next meeting of the COPUOS Legal Subcommittee in Vienna. In the meantime, preparations for establishing a permanent human presence on the Moon move forward aggressively. If the UN takes no concrete action on the issue, we will all have an opportunity to observe in real time whether or not existing law is sufficient to handle any potential conflicts that arise.

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<sup>34</sup> The notice provided by registration could also be important in an action under the Liability Convention. Again, ignorance would be impossible to claim.

<sup>35</sup> At a bare minimum, the international community would have to rely on the existing UN registry that requires the sharing of information about space objects “launched into Earth orbit and beyond.” Convention on Registration of Objects Launched into Outer Space art. III, Jan. 14, 1975, 1023 U.N.T.S. 15. This registry does not typically contain much detail regarding either the location or purpose of space objects, so it would be of questionable utility (particularly when lunar activity evolves to include many actors and activities at which point specific information about neighboring activities will be critical to avoid interference). The utility of the existing registry could be enhanced by an agreement (or understanding) among states to provide more detailed information.