NATIONAL SPACE LEGISLATION IN EUROPE: ENVIRONMENTAL PROTECTION AND DEBRIS MITIGATION

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I. Development of International Standards on Environment Protection and Debris Mitigation

Space activity being ultra-hazardous in nature, stringent measures must be employed to ensure environmental protection. The first segment of this portion discusses the importance of environmental protection in space, while the second focuses on the attempts of European space legislation to address this concern.

Environmental protection in space is imperative is for three main reasons: *first*, that protection of the environment is desirable in and of itself.[1] Harmful microorganisms can possibly be transported between the Earth on one hand, and other planets and celestial bodies on the other, via spacecraft, astronauts or miscellaneous space equipment.[2] Such artificial alteration of the natural environment of outer space – or forward contamination – would invariably hinder efficient scientific exploration, while carriage of toxins to Earth – or back contamination – could prove hazardous to the health of its residents. In particular, if scientists believe life to exist on a particular celestial body, the dangers posed by environmental contamination are graver since the life on that body would also stand at risk.[3] *Second*, that generation of debris in space poses grave dangers to the viability of safe space exploration.[4] Orbiting satellites are at constant risk of destruction because of collisions with existing space debris – an ever-increasing corpus.[5] In turn, this could lead to physical damage to spacecraft, loss of mission

[1] Stephan Hobe, *Environmental Protection In Outer Space: Where We Stand And What Is Needed To Make Progress With Regard To The Problem Of Space Debris*, 8 THE INDIAN JOURNAL OF LAW AND TECHNOLOGY Volume 1, 3 (2012).

[2] Margaret Race, *Responsible Exploration: Protecting Earth and The Worlds We Explore From Cross Contamination*, ASTRONOMICAL SOCIETY OF THE PACIFIC, *available at* http://astrosociety.org/edu/publications/tnl/58/planetprotect.html (Last visited on September 9, 2015).

[3] *Id.*

[4] Hobe, *supra* note 1.

[5] *Space Debris: Orbiting Debris Threatens Use of Outer Space*, *available at* http://www.un.org/en/events/tenstories/08/spacedebris.shtml (Last visited on September 9, 2015); Space Debris Mitigation Guidelines of the Committee on Peaceful Uses of Outer Space, UNITED NATIONS OFFICE OF OUTER SPACE AFFAIRS, *available at*

and loss of lives in the case of manned flights. *Third*, if space debris survives the impact of atmospheric re-entry, it can have disastrous consequences for the surface of the Earth. The dilemma of space debris is compelling and current, and evidence indicates that mitigation measures must be implemented as soon as possible.

As of 2014, upwards of 4800 total launches had placed approximately 6000 satellites in orbit from different locations across the world – not even a sixth of these continue to function in the present.[6] Out of 12000 orbiting objects examined by the Space Surveillance Network in the United States, nearly 56% constituted fragments of other orbiting objects; about 200 such fragmentation events have been recorded since 1961.[7]

Space debris poses an immense risk to the safety and viability of operations in space, both national and transnational. For this reason, and for reasons of preservation of the space environment in its present form, it is imperative that modes of debris mitigation be developed and implemented across nations. Recognizing this, the Scientific and Technical Subcommittee of the United Nations Committee on Peaceful Uses of Outer Space in 1994 discussed the problem of space debris.[8] In the following year, the members emphasized upon the need to satisfactorily measure debris, and tried to evolve mitigation measures. Further, it adopted a three-year agenda to discuss various aspects pertinent to debris management until 1998.[9] In 1996, the Subcommittee passed a resolution sanctioning the preparation of a technical report on space debris covering these very aspects. [10] This report was adopted by the members in 1999, whereupon it was made available to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space ["**UNCOPUOS**"] and the Legal Subcommittee of UNCOPUOS, among other international organizations.[11] The recordings made in the report made it evident that the problem of space debris posed an imminent risk to spacecraft orbiting the earth.[12] A further three-year agenda was agreed upon in 2002, to continue until 2005, which imposed a twin mandate: *first*, to create and adopt international standards on debris mitigation

http://orbitaldebris.jsc.nasa.gov/library/Space%20Debris%20Mitigation%20Guidelines_COPUOS.pdf (Last visited on September 9, 2015).

[6] *Space Debris Mitigation*, EUROPEAN SPACE AGENCY, *available at* http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/Space_debris_mitigation (Last visited on September 9, 2015).

[7] *Id.*

[8] U.N. Doc A/AC.105/571, ¶63-74.

[9] U.N. Doc A.AC.105/605, ¶83.

[10] U.N. Doc A.AC.105/605, ¶83.

[11] U.N. Doc A.AC.105/720; U.N. Doc A.AC.105/736.

[12] United Nations Publication, Sales no. E.99.I.17.

as expeditiously as possible, and *second*, to continue the global effort on researching and reporting all relevant aspects of space debris.[13]

In conformity with this agenda, the Inter-Agency Space Debris Coordination Committee ["**IADC**"] convened in 2003 to list its findings on debris management, which were then placed before the Subcommittee for its consideration; in 2004, the members constituted a Working Group to review these measures.[14] The following year, the Group agreed upon a series of issues to be covered by international standards for debris management and accordingly prepared a draft text of the standards, to be considered for adoption by the Subcommittee.[15] Finally, the year 2007 saw the Subcommittee's adoption of the space debris mitigation guidelines to limit contamination of the environment of outer space, in order that exploration be carried out sustainably.[16] At a future session, the Subcommittee acknowledged that its endorsement and approval would promote wider acceptability of the guidelines, which would in turn minimize collisions and friction in outer space.[17] This understanding is reflected in the resolution adopted by the General Assembly on December 22, 2007, whereby it endorsed the Space Debris Mitigation Guidelines of the UNCOPUOS and recommended their implementation by member States via national legislation.[18] Significant developments brought about by these guidelines have been outlined below.

Debris Mitigation Guidelines

a) Defining Space Debris

In terms of defining 'space debris', the guidelines fulfil the dual task of providing both clarity and expansiveness, by stating that it consists of "*all manmade objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional.*"[19]

b) Debris Mitigation Techniques

Space debris can result from a variety of reasons, ranging from the accidental (such as mid-space collisions) to the intentional (such as breakups during launch stages).[20] Therefore, effective mitigation techniques must be tailored toward the nature of the cause. There are two main types of mitigation techniques. *First*, there are those that minimize debris creation and accumulation for the short term; these are focused on reducing the frequency of intentional

[13] U.N. Doc A/AC.105/761, ¶130.
[14] *Supra* note 6.
[15] U.N. Doc A/AC.105/848, Annex II, ¶5-6.
[16] U.N. Doc A/AC.105/890, ¶99.
[17] U.N. Doc A/62/20, ¶118-119
[18] U.N. Resolution 61/217.
[19] *Supra* note 6.
[20] *Supra* note 6.

breakups caused during launches. *Second*, there are those that aim at decreasing debris generation for the long term; these remove non-operational spacecraft and other debris from the vicinity of operational spacecraft.

c) The Aim

The Subcommittee formulated the guidelines with the aim that they would shape the process of mission planning by member States, making debris mitigation a prime consideration at the pre-launch stage itself.[21] Right from developing the mission to designing and manufacturing the spacecraft, States ought to proceed in accordance with these guidelines. Further, the guidelines aim also to govern the operational stage of the spacecraft – launch, mission and disposal.

d) The Guidelines

There are seven guidelines on debris mitigation.[22] They pertain to various aspects of space operations, such as normal operations, the operational phase, the orbital phase.

First, debris released via normal operations ought to be limited. When travel to outer space first began, it was frequent for vestigial parts of spacecraft to be projected into the Earth's orbit. These objects could include sensor covers and separation and deployment mechanisms. Since then, however, efforts have been made to both design and operate in a way so as to produce less debris.

The guidelines recommend that spacecraft should either be designed such that no intentional breakups need to be caused during launch. However, in case release of debris is inevitable, the operation should be designed in a manner that the effect it has on the space environment is negligible.

Second, the probability of accidental breakups in the operational phase ought to be reduced. During launch stages, both spacecraft and launch vehicles sometimes enter 'failure modes', recovery from which may involve accidental breakups. If spacecraft is designed in a way that failure situations could be avoided, the possibility of debris due to such breakups would automatically decrease. Further, a thorough failure mode analysis ought to be carried out prior to the launch in order to develop strategies to deal with disasters. In this way, when there does exist a reasonable probability of failure, the formulation of effective disposal mechanisms can ensure that objects resulting from accidental collisions do not accumulate as debris.

[21] *Supra* note 6.
[22] *Supra* note 6.

Third, the probability of accidental breakups in the orbital phase ought to be reduced. While planning and designing a space mission, an accurate study of pre-existing objects in the potential path of the spacecraft must be conducted. Accordingly, the probability of colliding with these objects should be measured. If such analysis reveals that a collision is likely, the launch window may be altered or the spacecraft may be fitted with an in-flight avoidance mechanism.

This guideline is especially significant in light of studies that predict such collisions to be the largest source of new debris. [23]

Fourth, States must refrain from intentionally destroying space objects. Intentional destruction of space objects – during both orbital and launch stages – should be avoided to the largest extent; when essential, it should be undertaken at a low altitude such that the resultant debris does not stay in orbit for very long.

Fifth, the risk of collisions due to energy build-ups ought to be reduced. While space operations typically require large storehouses of energy, often these are left intact even after they are no longer needed. This build-up of extra energy can cause post-mission collisions, which usually result in fragmentation and debris formation. In fact, the largest proportion of space debris is caused due to accidental collisions, most of which are caused by abandonment of spacecraft with significant energy storehouses.

As a prevention measure, it is essential that spacecraft be made passive at the end of each mission. This necessitates removal of all energy storehouses, such as compressed fluid or propellants.

Sixth, the accumulation of spacecraft and launch vehicle orbital stages in lower orbits of the Earth ought to be minimized. This is especially important given the frequency at which spacecraft that have either reached the end of their missions or become defunct for other reasons, are simply left in the Earth's orbit, where they stay for long periods of time.

This guideline recommends that such objects be periodically removed from orbit; otherwise, their presence ought to be shifted to orbits other than the lower Earth orbital area – the highest-risk zone for damage, pollution and other kinds of harm to persons and property on Earth.[24]

Seventh, spacecraft and launch vehicle orbital stages ought not to interfere with the geosynchronous Earth orbit area once their mission is complete. Efforts should be made to

[23] *Supra* note 6.
[24] *Supra* note 6.

ensure that these objects remain in orbits that would prevent them from adversely interacting with the geosynchronous Earth orbit area.

e) Implementation

Since the guidelines do not by themselves carry binding force, the General Assembly has expressed the view that they ought to be individually incorporated into national legislation by member States so that they may be implemented to the largest extent possible globally.[25] If these guidelines are applied to future mission planning endeavours, the risks posed by debris accumulation may decrease. Hence, the subsequent portion of the project focuses on the degree to which different spacefaring European States have adopted these guidelines in their national legislation.

II. European National Legislations' Implementation of International Protection and Mitigation Standards

Space activities are internationally regulated by means of the treaties. However aside from laying down certain broad mandates, these treaties, naturally, do not enter into the details of how space activities should be carried out. This extends to activities relating to environmental protection and debris as well. However, the fact that all activities, whether 'State' or private, will fall within the international responsibility of the State having the closest nexus, is a factor driving several States to regulate space activities via legislations.[26] This is increasingly necessary as commercial, private space activities increase.[27] In Europe in fact, even smaller States that were otherwise not "space-faring" have now come within the fold of the European Space Agency and hence, have commenced some measure of space activities of their own as well.[28]

Accordingly, as of date, eleven European countries have national space legislations registered with the United Nations Office for Outer Space Affairs ["**UNOOSA**"]. In addition, Italy has a space legislation recognised by the European Space Agency, although not by the UNOOSA. However, leaving aside non-European countries and those European countries which still lack space legislations, even amongst these twelve countries, there is little uniformity in the

[25] *Supra* note 6.
[26] Art VI, Outer Space Treaty, 1967.
[27] Irmgard Marboe, *Statement of the Chair*, Conference on National Space Law Development in Europe (University of Vienna, 21 September 2006) *available at*: https://intlaw.univie.ac.at/fileadmin/user_upload/int_beziehungen/space_law/sp_law_conf_chair.pdf (Last visited on 8 September 2015)
[28] *Id.*

substance of these legislations. Although following the contours of the international obligations, these statutes still differ significantly in their particulars.

This section of the paper seeks to examine each of these existing space legislations with regard to their approach to environment protection and debris mitigation in order to assess, cumulatively and individually, the European legal status in this regard.

a) Austria

Austrian space legislation[29] requires all space activities to be authorized by the Minister for Transport, Innovation and Technology.[30] Such authorization is contingent upon various factors,[31] including the development of appropriate mechanisms to mitigate space debris[32] and the assurance that the activity would not harmfully contaminate or cause adverse changes to the environment of outer space or celestial bodies.[33]

At this juncture, it may be noted that an explicit reference to the need for debris mitigation is very welcome; all States must similarly state make the development of appropriate debris mitigation strategies a prerequisite to authorization of any space activity. Moreover, the Austrian statute goes a step further in outlining this requirement: it is stated in Section 5 that the operator must make provision for debris mitigation in consonance with the state of the art.[34] Hence, if there exist any recently evolved scientific methods that have proven highly effective in managing the problem of debris, Austrian operators may be expected to incorporate them into their space missions before they can be granted authorization.

The most creditable provision in the statute, however, lies in the latter portion of the Section, which states that the debris mitigation provisions made by the operator must be in "*due consideration of the internationally recognised guidelines for the mitigation of space debris.*"[35] Without referring to each guideline individually, therefore, the statute makes it evident that operators are required to formulate their mitigation measures in consonance with the

[29] Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).
[30] S. 3, Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).
[31] S. 4, Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).
[32] S. 4(4), Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).
[33] S. 4(5), Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).
[34] S. 5, Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).
[35] S. 5, Austrian Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (28 December 2011).

international standards for the same. The only guideline referred to in particular is that on the limitation of debris released during normal operations.

The Austrian statute merits praise for its explicit reference to the need for debris management and its imposition of the obligation to pay heed to the internationally recognized debris mitigation guidelines. It is suggested that the current provisions be made stronger by the addition of the threat of revocation of authorization if debris mitigation measures are altered in a disadvantageous manner, or there is a threat to the environment of outer space, at any point in time.

b) Belgium

Belgium's regulation of space activities is carried out via two mechanisms – the Statute promulgated in 2005, Law of 17 September 2005 on Activities of Launching, Flight Operation or Guidance of Space Objects, and an additional Royal Decree (in the nature of an executive order) issued on the same subject on 19 March 2008. This subsequent decree is in the nature of specific rules, giving effect to provisions of the earlier statute. This statute, in Articles 4, 5 and 8, specifically deals with environment protection and debris mitigation.

The salient features of this regime is that it gives the State the power to impose conditions on "*protecting the environment*"[36] before granting authorisations. In addition, it requires private entities seeking a license for space activities to submit a "*study of the impact on the environment*"[37] of these proposed activities when submitting their applications to the State. This obligation to carry out an *Environmental Impact Assessment* ["**EIA**"] goes both ways however. In Article 8, the statute lays down the comprehensive nature of this assessment: in addition to the *initial* study of potential impact conducted by the private operator itself, and submitted to the State, the State must also itself carry out an *intermediate* study after the launch of operations do study the real consequences. Lastly, a *final* study must also be carried out by the State once the object returns to the Earth. The results of these studies will necessarily have to be submitted by such private parties before carrying out any subsequent space activities as well, as details of the "*past, current*" activities of the operator are also required to be submitted before grant of a license. Further, when the private operator contemplates use of nuclear energy,

[36] Art. 5. §1, Act
[37] Art. 7. §1, Act

the EIA requires even more stringent disclosure of details regarding the possible impact on the environment.[38]

Further, the definition of 'operator', as per the statute does not make any distinction between a Belgian and foreign operator – anyone exercising ultimate authority over a space activity within Belgian territorial jurisdiction is required to comply with these above requirements.[39]

Certainly, these requirements of EIAs and conditional authorisation that Belgium envisages, are far superior to the regulatory requirements for *general* environment protection in other countries. However, in terms of debris mitigation *specifically*, the Belgian regulation falls short of complete comprehensiveness. For instance, the requirements of creating and complying with debris mitigation guidelines may be among the conditions that the State imposes before granting a license – but this is left entirely at the discretion of the State which can pick and choose which of such guidelines to make compulsory at any point.[40] Admittedly, the national space authority, BELSPO and the ESA have entered into an agreement wherein the latter will exercise some supervision over the technical steps being taken by Belgium for debris mitigation.[41] Nevertheless, strict compliance with any one set of guidelines, whether the UNCOPUOS guidelines, IADC standards, ESA norms, or any of the other guidelines, would have more comprehensively committed all Belgian space activity to the cause of minimal harm.

c) France

Space Activities in France are regulated by the French Space Operations Act, 2008 (Act 518 of 3 June 2008) ["**FSOA**"].[42] Pursuant to Article 5 of this legislation, a more specific **Technical Regulation** was passed on 31 March 2011,[43] which deals with the compliance requirements for private operators relating to environment and debris mitigation. Contingent upon such compliance, the State grants its authorisation for space activities.

This Technical Regulation is largely compliant with the provisions of the UN COPUOS Space Debris Mitigation Guidelines; considering that France contributed actively to the development

[38] Art. 8. §9, Act; Article 7, Royal Decree.
[39] *Belgium*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/Belgium.pdf (Last visited on 8 September 2015)
[40] Art. 5. §1, Act;
[41] Space Debris Mitigation Standards, *supra* note 39.
[42] French Space Operations Act, 2008 (No. 518 of 3 June 2008), *available at*: http://legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000018931380&fastPos=9&fastReqId=1846263462&categorieLien=cid&oldAction=rechTexte (Last visited on 8 September 2015)
[43] Decree on Technical Regulation issued pursuant to Act no. 518 of 3 June 2008, 31 March 2011, *available at:* http://legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000024095828&fastPos=5&fastReqId=289170871&categorieLien=cid&oldAction=rechTexte (Last visited on 8 September 2015) ["**Technical Regulation, 2011**"]

of these guidelines, this is hardly surprising.[44] In addition, the Regulation is also consistent with the IADC Space Debris Mitigation Guidelines as well as the ISO 24113 standards, which also deal with debris mitigation.[45]

The 2011 Regulation deals, in the first part, with launch activities, and in the second, with orbital activities. In relation to launch, Article 21 lays down the 'Space Debris Limitation' measures: these include provisions identical to the aforementioned guidelines, such as the requirement of designing elements such as to "*minimise the production of debris*" during launch, including the end-of-launch segment. A limit is placed on the size of debris produced in different components of the launch process, the probability of accidental breakup or incomplete disposal is set at a maximum risk level, the lowering of energy reserves towards the end of operations is mandated, among other provisions.[46] Similarly, in relation to orbital activities, Art 40 requires that systems "*be designed…to avoid generating debris*". Here too, size limits on generated debris, maximum risk levels for accidental breakups and unsuccessful disposal manoeuvres, mandatory lowering of energy reserves, are among the requirements laid down. Undoubtedly the most comprehensive national legislation in this regard, this Regulation exemplifies the responsibility that a major spacefaring nation such as France must take for its actions; such comprehensiveness is sorely needed in the legislations of other spacefaring nations as well.

d) Germany

The German Aerospace Centre ["**DLR**"] is the State body responsible for carrying out all space activities. All private activities are carried out by operators, as *contractors* of the DLR. These contractors are bound by the delegated legislations issued by the DLR, including the *Product Assurance and Safety Requirements for DLR Space Projects* ["**DLR Requirements**"], a set of requirements promulgated in April 2012, under the Delegation of Space Activities Act, 1998 and the Telecommunications Act, 2004.[47] All such contractors must mandatorily meet these requirements, in every stage of their involvement with the DLR.

The DLR Requirements, like the French Technical Regulation, are a product of Germany's active involvement in the UN COPUOS deliberations. Hence, they are entirely compliant with

[44] *France*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/France.pdf (Last visited on 8 September 2015)
[45] *Id.*
[46] Article 21, Technical Regulation, 2011
[47] *Raumfahrtaufgabenübertragungsgesetz* 22 August 1998, BGBl. I, 2510 (Delegation of Space Activities Act); *Telekommunikationsgesetz*, 22 June 2004, BGBl. I, 1190 (Telecommunications Act), as amended 7 August 2013, BGBl. I, 3154

the standards set by the UN COPUOS Space Debris Mitigation Guidelines, as well as the similar guidelines of the IADC (in whose formulation as well, Germany was actively involved) and the European Code of Conduct. Further, they frequently refer to the ISO 24113 standards in this regard and even, in §56, to the recommendations of the International Telecommunications Union (ITU) with respect to debris mitigation.[48] Additionally, the NASA standards on *process* and *procedure* for limiting orbital debris have also been cross-referenced by the German regulations.[49]

Hence, the DLR Requirements include the usual plethora of design measures, risk assessments, disposal manoeuvres, as well as Mitigation Assessment Reports and project reviews in a manner reminiscent of the Belgian model.[50]

However, the German regulations are unique in the way that they too serve, only as broader (although domestically mandatory) guidelines – each space project refers to these guidelines to then formulate more specific, tailor-made safety and mitigation guidelines for each product and each step of that particular project. Once formulated, these *specific* requirements then become the basis of the tenders and contracts entered into with private contractors, to which they are then bound. Any waiver of requirements set out by the DLR in a specific project will need an application, justification and formal approval before it can be sanctioned.[51] This unique method of bringing together the rigidity and structural enforceability of statute, with the flexibility and nuance of a contract, makes the German approach one of the most effective mitigation strategies within Europe, and perhaps the world.

e) Ukraine

Ukrainian legislation on space activities, the Ordinance Of The Supreme Soviet Of Ukraine on Space Activity, makes reference to the need to control environmental contamination in its definitional clause itself.[52]

'Incident' is defined as "*an event related to space activity which has led to a threat to the life or health of persons or damage to or destruction of the property of citizens, enterprises, institutions or organizations, or damage to the environment*."[53] A graver form of the same is

[48] ITU Radiocommunication Assembly, *Environment Protection of the Geostationary-Satellite Orbit*, ITU-R S.1003-2

[49] NASA, *Process for Limiting Orbital Debris*, NASA STD 8719.14; NASA, *Procedural Requirements for Limiting Orbital Debris*, NASA-NPR-8715.6A

[50] Article 5.7, DLR Requirements.

[51] *Germany*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/Germany.pdf (Last visited on 8 September 2015)

[52] Law of Ukraine, 15 November 1996 (VVRU) 1997.

[53] Art. 1, Law of Ukraine, 15 November 1996 (VVRU) 1997.

given the status of 'emergency'.[54] Intriguingly, there is no indication regarding *which* environment these clauses refer to – that of Ukraine or that of outer space. In the interest of expansiveness, it may be assumed that the lack of a particular reference indicates the intent to cover both these categories.

Article 23 of the legislation requires information regarding such incidents or emergencies to be made available to executive authorities. Further, all authorities must furnish relevant information regarding any dangers imposed by space activities, and the measures taken to avoid the same, including risk of damage to the environment.[55] The National Space Agency must at all times take all necessary measures to protect the safety of lives, property and the environment.

Article 8 of the legislation dictates that State authorities within Ukraine must prescribe regulations to govern national space activities, including standards for environmental protection in the course of the activities.[56] Article 9 imposes prohibitions upon certain kinds of space activities, covering the issue of environmental protection in two important ways: *first*, by prohibiting utilization of space technology in order to produce effects upon the environment for any purpose (military or otherwise) that could put mankind at risk; and *secondly* by prohibiting activities that could cause damage to the environment.[57] It may be observed that the latter prohibition is very broad and could potentially cover any space operation that leads to environmental contamination. Since most launches lead to the creation of at least some amount of debris, a need exists to limit and define the scope of such an open-ended clause. *Thirdly*, the Article prohibits activities that contravene 'international standards' on space pollution.[58] Further, space activity that has been undertaken in pursuance of a project that has caused loss of human life, material damage or substantial environmental harm may be restricted or prohibited.

Article 21 states that space activity must be undertaken with due regard to the protection of the environment and shall take as many measures as possible to prevent damage to the environment.[59] Even transport of space technology ought to be carried out with regard to environmental protection.[60]

[54] Art. 1, Law of Ukraine, 15 November 1996 (VVRU) 1997.
[55] Art. 23, Law of Ukraine, 15 November 1996 (VVRU) 1997.
[56] Art. 8, Law of Ukraine, 15 November 1996 (VVRU) 1997.
[57] Art. 9, Law of Ukraine, 15 November 1996 (VVRU) 1997.
[58] Art. 9, Law of Ukraine, 15 November 1996 (VVRU) 1997.
[59] Art. 21, Law of Ukraine, 15 November 1996 (VVRU) 1997.
[60] Art. 22, Law of Ukraine, 15 November 1996 (VVRU) 1997.

Clearly, the Ukrainian legislation fulfils several important objectives. It does, for instance, place equal emphasis upon environmental protection as on the protection of lives and property. Furthermore, it creates a provision for the prohibition of activities that could pose a risk to the environment. It also requires those conducting space operations to carry out all measures necessary to preserve the environment.

However, it is submitted that the present regime can be improved in two meaningful ways: *first*, the statute must clarify whether, by the term 'environment', it intends to cover the environment of outer space (including celestial bodies). If not, special provisions addressing the environment of outer space need to be developed and incorporated. *Second*, the statute must incorporate particular provisions focused upon debris mitigation. It may be observed that while the statute is commendable in its environment-friendly approach, none of the debris mitigation guidelines have been adopted either in letter or in spirit. Certainly, the addition of clauses that impose obligations regarding debris management and minimization can bolster the present environment protection regime in Ukrainian space law.

f) Italy

Although in possession of a legislation dealing with registration of space objects,[61] as well as liability for damage caused by them,[62] Italian law has thus far, failed to deal with questions of environment protection and space debris within its national legislation. In the interim, the Italian Space Agency ["**ASI**"] uses standard contracts to enforce the guidelines of the European Code of Conduct for Space Debris Mitigation, which the have the ASI has accepted as mandatory by signing an agreement to this effect on 14 February 2005. The similarities between the Code of Conduct and other guidelines, such as those of the UNCOPUOS, IADC, ITU and ISO make Italy largely compliant, *de facto*, with these regulations as well.[63]

For projects subsequent to the signing of the 2005 agreement, the threefold objectives of the Code of Conduct, *namely*, mitigation of in-orbit breakups, end-of-life disposal and limitation of operational release, are all equally complied with by the ASI in framing its contracts. However, for contracts framed pre-2005, the Italian focus was on end-of-life mitigation strategies, while the remaining objectives were only complied with on a best-efforts basis.[64]

[61] Law on Registration of Space Objects, No. 153 of 12 July 2005
[62] Law for the Implementation of the Convention on International Liability for Damages caused by Space Objects, No. 23 of 25 January 1983.
[63] *Italy*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/Italy.pdf (Last visited on 8 September 2015)
[64] *Id.*

While the substance of the standard contracts employed is now certainly on par with the international standard, the method remains problematic. A standard contract model cannot replicate the streamlining, efficiency and predictability that a statutory regime can bring about. Hence, the sooner that Italy develops a legislation in this regard, the better it will be for robust growth of, and investment in its space industry.

g) Netherlands

Section 2 of the space legislation in the Netherlands[65] prohibits space activities from being carried out unless authorized by a licence.[66] Unlike the Ukrainian statute, the Netherlands statute makes amply clear its intention to regulate activities that pose a risk to the environment of outer space.

This is evidenced by Section 3(3)(b), which states that such a licence may carry certain rules and regulations along with it, including those that pertain to the protection of the outer space environment.[67] The impact of this provision is bolstered by Section 6(1)(b), which stipulates that the Minister may refuse to issue a licence if the facts or circumstances surrounding the activity indicate a risk to the environment of outer space.[68] In the same vein, if any space activity threatens to jeopardize the protection of the outer space environment, Section 10 requires the operator to take any and every step to prevent or limit and remedy the same.[69] Further, in such a situation, the licence may be revoked, prior to which the Minister is obligated to take mitigating measures.[70]

The clear reference to the environment of outer space in the Netherlands statute is a significant step toward ensuring environmental protection in the course of space activities. By demanding compliance with environmental regulations for space, the regime lays a great foundation for environmental sustainability of space operations. Unfortunately, however, the absence of detailed provisions under this aegis may hinder the effectiveness of such rules. For instance, it could be beneficial to describe, as far as possible, the elements of the 'outer space environment'; clarity could be introduced with regard to whether this term includes the

[65] Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Netherlands Space Activities Act).
[66] S. 3, Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Netherlands Space Activities Act).
[67] S. 3(3)(b), Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Netherlands Space Activities Act).
[68] S. 6(1)(b), Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Netherlands Space Activities Act).
[69] S. 10, Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Netherlands Space Activities Act).
[70] S. 7, Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Netherlands Space Activities Act).

environment of celestial bodies, whether it covers non-physical changes, and most importantly, whether the protection of the environment so defined entails debris mitigation. In any case, particular provisions on debris mitigation ought to be introduced, such as the obligation to limit debris production and minimise the detrimental effect of any debris already produced.

h) Norway and Sweden

Both of these Scandinavian nations possess rudimentary space acts that merely underline that launches and space activities can only take place with the authorisation of the State.[71] The conditions and terms under which such authorisation are not laid out, bringing to light the sore need for legislation in this regard.

i) Russia

Space Activities in Russia are governed by a multiplicity of legislations, centred around the *Law of the Russian Federation about Space Activity*[72], which states, in Article 4, that space activity shall be carried out along certain principles, "*including protection of the environment*" and that, "*harmful contamination of outer space which leads to unfavourable changes of the environment, including deliberate elimination of space objects in outer space*" are prohibited. This certainly lays down a clear principled basis for the Russian stance on environment protection and debris mitigation, which informs the other space-related decisions as well. For instance, under Article 6, the Russian Space Agency is empowered to issue licenses. However, a harmonious understanding of the Act would prevent issuance of licenses (or in fact, even a self-sufficient project) by the Space Agency if it contaminated the environment or created unnecessary debris. Article 9 leaves the terms of licenses open to the Space Agency; this may seem to leave a vacuum in a manner similar to Belgium where an excess of discretionary authority may cause deviance from international guidelines. However, the difference to be noted here is that, by elevating environment protection and debris mitigation to overarching principles, the State has curtailed any excess of discretion in this regard. Thus there is compliance in spirit, if not in word, with the international guidelines, as any violation of them, though not expressly prohibited, would still be construed as a violation of the foundational principles of Russian space activity.

[71] §2, Act on Space Activities, 1982 (Sweden); §1, Act on Launching Objects from Norwegian Territory into Outer Space, 1969.

[72] Decree no. 5663-1, Russian House of Soviets, *available at*: http://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/russian_federation/decree_5663-1_E.html (Last visited on 8 September 2015).

j) Spain

Spain lacks a specific legislation dealing with space debris and environment protection. Its space legislation, like Italy, is limited to matters of registration of space objects.[73] However, unlike Italy, Spain does not have any compulsory mechanism in this regard at all. It merely has the soft law of the UNCOPUOS guidelines, as a committee member, to rely upon. With the growth of space activities in Europe, support for such guidelines, and for the European Code of Conduct, will not translate into compliance, as there can be no effective control over private players in this regard. Hence, development of a national regime, or at the very least, of a temporary standard contract model such as in Italy, is a necessity.

k) United Kingdom

The United Kingdom was an early starter in the field of space legislation, having promulgated a comprehensive Outer Space Act ["**OSA**"] as early as in 1986. This Act forms the basis for the legality of all space activities carried out in the nation, whether by State agencies or by private parties. In terms of the latter, it is a personal rather than a territorial jurisdiction that the Act exercises. Hence, unlike the other European acts discussed thus far, the Act does not concern itself with whether the space activity is being carried out in the United Kingdom, as much as with whether *a* space activity *anywhere* is being carried out by a British national. Naturally, this is simultaneously broader (regular situations of personal jurisdiction which would cause Art. VI of the Outer Space Treaty to confer State responsibility), and narrower (leaving out territorial situations where foreign actors' acts could still confer State responsibility) than the other countries' approach.[74]

For such private British nationals, a licensing requirement is created, with the UK Space Agency holding the discretion in this regard, under the executive power of the Secretary of State. The license may be granted on the basis of conditions decided upon by the Space Agency, including the condition that the licensee, "*prevent the contamination of outer space*", and "*avoid interference with the activities of others in the peaceful exploration and use of outer space*" as well as conditions, "*governing the disposal of the payload in outer space*".[75] However, the Act itself does not mandate such conditions. This, once again, is reminiscent of the Belgian approach and faces a similar problem of relegating compliance with international guidelines to the discretion, from time to time, of the executive authority in charge.

[73] Royal Decree on the Establishment of a National Registry in Compliance with the Registration Convention, 6058 Royal Decree no. 278 of 24 February 1995.
[74] S. 2(2), Outer Space Act, 1986
[75] S. 5(2)(e) and 5(2)(g), Outer Space Act, 1986.

However, there are certain mandatory minimums that are prescribed by the Act – for instance, the Secretary ***shall not*** grant any license if the activities jeopardise public health, safety or are inconsistent with international obligations of the UK; a plethora of debris-causing activities and environmentally detrimental outer space activities could be brought within this broad prohibition.[76] In practice, the Space Agency enforces compliance with the UN COPUOS guidelines and IADC guidelines as a pre-condition to grant of license.[77] Nevertheless, the excess of discretionary authority is potentially problematic and could be easily corrected by minor statutory intervention.

l) Others

Nations such as the Czech Republic, Poland and Slovakia, which are making fledgling attempts at space activities, completely lack national legislation thus far.[78] Some other nations such as Switzerland, which conducts most of its activities through the ESA, come under the stricter applicability of the ESA Code of Conduct relating to Space Debris Mitigation.[79] However, in countries that are still negotiating their membership in the ESA, such as the aforementioned three,[80] it is only by virtue of their membership of the UN COPUOS that the Space Debris Mitigation guidelines are *technically* the prevailing standard. Naturally the enforceability of these guidelines, especially over the private operators within these countries, is questionable. This only underlines the need for space legislation in every country, no matter the magnitude of its space programme.

III. Conclusion

The comprehensive survey of extant European national legislation demonstrates a high level of divergence in the manner in which space legislation, in general, and environment protection and debris mitigation, in particular, have been dealt with. However, a broad nexus can be drawn between those a historical space-faring tendency and a comprehensive national legislation, as the statutes of older powers such as Germany, France and Russia demonstrate. However, even among the smaller nations that are just entering into the spacefaring arena, some nations have demonstrated great prescience in drafting far-sighted and lucid legislation, as the Belgian

[76] S. 4, Outer Space Act, 1986.
[77] *United Kingdom*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/United_kingdom.pdf (Last visited on 8 September 2015).
[78] UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html (Last visited on 8 September 2015).
[79] *Switzerland*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/Switzerland.pdf (Last visited on 8 September 2015).
[80] *Slovak Republic*, UNOOSA Space Debris Mitigation Standards, 2014 *available at*: http://www.unoosa.org/pdf/spacelaw/sd/Slovakia.pdf (Last visited on 8 September 2015).

statute has proved. Nevertheless, the need for greater legislation still exists in most European countries, with perhaps the exception of Germany and France.

In addition to such legislation however, an active exercise for uniformizing the resulting statutes must be carried out. While admittedly the Treaty for the Functioning of the European Union permits European space activities under the ESA to be carried out independently from each member State's individual programme, it is nevertheless a practical consideration that wide disparity in countries' approach to environmental protection and space debris mitigation may make such intra-European cooperation more problematic. Further, the ultra-hazardous nature of outer space will also cause such uncoordinated and clumsy attempts at mitigation to possibly snowball into a safety hazard for future space exploration. In order to forestall such damage, the European nations should leverage the cooperative structures and legislation they already possess to streamline themselves in the arena of space legislation, with an emphasis upon environment protection and debris mitigation. Such coordination will benefit not only Europe, but also the entire spacefaring world.