The need for an International rules-based framework for Artificial Intelligence technologies & systems in space activities

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A thesis submitted to McGill University in partial fulfilment of the requirements of the degree of Master of Laws (LL.M.) (Thesis) in Air and Space Law

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June, 2022

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ACKNOWLEDGEMENTS

I offer my acknowledgement and gratitude to the guidance and supervision of my supervisor Prof. (Dr.) Ram S. Jakhu throughout the writing of this thesis. He provided me with support and encouragement in all facets of this undertaking. His devotion to the field of space laws and towards his students is inspiring, and his support and empathy humbling. I would also like to sincerely thank my erstwhile supervisor, Prof. (Dr.) Brian F. Havel, who listened to my ideas and proposals with great interest, and advised, supported and guided me towards making a thesis submission on this subject matter.

Within the Institute of Air and Space Law, I humbly acknowledge the contributions of and thank Maria D'Amico, our Senior Administrative Coordinator, for her presence as well as support, as well as to Dr. Maria Manoli (then a DCL candidate), who was my student supervisor in the first year of my study. I humbly acknowledge the role of all concerned in the receipt of Nicolas M. Matte Fellowship, Nicolas M Mateesco Matte Prize & Setsuko Ushioda-Aoki Prize.

Within the Faculty of Law, McGill University, I like to thank Prof. (Dr.) E. Richard Gold as well as Prof. (Dr.) Andrea K. Bjorklund for their support and guidance as associate dean(s) of graduate studies. Specifically, I thank Prof. Gold for allowing me to change my course to a thesis course and Prof. Bjorklund for granting me academic leave during tough pandemic times. I also like to acknowledge the support, and humbly thank Bianca Bourgeois, Lina Chiarelli & Silvana Solitiero from the Graduate Programs office for their constant support, kindness and compassion during these years. They have made themselves available to meet the needs of students at all times and quite promptly.

I thank the office and all concerned for their generous financial support through the Graduate Excellence Award in Law, Stephen Smith – James McGill Award as well as other support and bursaries during the period of my study. I would also like to take this opportunity to thank all involved people in the Scholarships and Student Aid Office, McGill University.

In addition, I like to humbly acknowledge the financial contribution of Secure World Foundation and their members and staff for bestowing me with the Ray Williamson Future Fund Scholarship (2021). I also humbly acknowledge and thank all the members and staff of KEATCA Fund towards their generous bursary and financial award in 2021.

I offer my gratitude to Isha Foundation and all involved for their moral support, kindness and compassion, and for moving me towards spirituality and yoga.

I humbly acknowledge the role, and offer my sincerest gratitude, to my family, friends and mentor for their constant support, love and encouragement throughout the duration of my course and thesis writing.

"... And now, yoga"

Sadhguru, Patanjali's Yoga sutras

ABSTRACT

Any new technology which has captured the attention and imagination of human beings has often subsumed, until the last century, within its legal framework at the international level, domestic or State-level governance systems, and at the very least pertaining to core aspects of its regulations; further leaving its implementational aspects to States and their governments. Thus, when space technologies were new and being introduced during the cold-war era, marked by increasing volatile and ever-changing political commitments and stances of the sovereign nations and the international community, binding treaties were adopted and enacted to govern space technologies to maintain certainty. However, since the 1980s, there have been other objects and subjects of its legal regulation, thus constituting and comprising what we refer to as the global space governance system.

Artificial intelligence ('AI') technologies and systems, preceded by cyber activities, are the newest domains which needs urgent attention of the international community, including international space law and policy enthusiasts, academicians, technical experts and social scientists, and law and policy-makers. In brief, AI systems are being developed with the core objective of mimicking the capabilities of the human mind artificially through machines. The implementation of this technology in the sector of space activities (although, equally applicable to all sectors) has various nuances such as introduction of objective 'expert legal knowledge'. In Machine learning phases, the international community is (and will further be) required to constitute and determine space-specific 'high level objectives'.

Due to the fact that this technology (along with other new technologies, such as cyber technology) knows no state boundaries, it has the potential to upend traditional and historical ways of law-making, both at the international as well as State governments level. A top-down approach is not only forthcoming but also unsustainable and unsuitable; thus also laying foundations towards a bottom-up approach involving all stakeholders and in all stages of AI life cycle. In view of the constantly changing and evolving subjective and objective international standards for regulation of space conduct, the researcher wishes to also introduce the need for socio-legal research, particularly highlighting the need to be in sync with legal consciousness approaches. In doing so, one can locate and deal with ongoing issues and future challenges for conceptualizing an

international rules-based order for introduction and operation of AI technologies in space activities.

The new space era 4.0 is also marked by increasing private sector presence and operations in space activities, with supervisory roles being played by State governments. This submission would thus capture some of the modifications or interpretational nuances which may be required in the context of interpretation and regulation of the binding international treaties applicable to the space ecosystem. Apart from space sustainability issues (as opposed to a strictly economic based conduct of space activities), other issues include the need to consider ethics of AI, environmental cost of introduction of AI, data privacy issues arising from high resolution pictures being provided by satellites, and more such issues. It also includes broadening of our notion of what constitutes space law itself.

There remains larger questions of whether the space governance system in itself, for the portions that apply to regulation of AI activities, would, in due time, be subsumed into a potential international legal framework for artificial intelligence systems. While this question remains largely unanswered thus far, in the meantime, this an attempt at looking at the space governance framework or system with a view towards analyzing and assessing its potential to adapt or absorb or subsume regulation of AI technologies and systems for the foreseeable future.

RÉSUMÉ

Jusqu'au siècle dernier, toute nouvelle technologie qui a capté l'attention et l'imagination des êtres humains a souvent été intégrée, dans son cadre juridique, au niveau international, à des systèmes de gouvernance nationaux ou étatiques et, tout au moins, à des aspects fondamentaux de sa réglementation, tout en laissant les aspects de sa mise en œuvre aux États et à leurs gouvernements. Ainsi, lorsque les technologies spatiales étaient nouvelles et introduites à l'époque de la guerre froide, marquées par une volatilité croissante et des engagements et positions politiques en constante évolution des nations souveraines et de la communauté internationale, des traités contraignants ont été adoptés et promulgués pour régir les technologies spatiales afin de maintenir la certitude. Cependant, depuis les années 1980, d'autres objets et sujets de sa réglementation juridique sont apparus, constituant et composant ainsi ce que nous appelons le système mondial de gouvernance spatiale.

Les technologies et les systèmes d'intelligence artificielle ("IA"), précédés par les cyber activités, sont les domaines les plus récents qui requièrent une attention urgente de la part de la communauté internationale, notamment des passionnés de droit et de politique spatiale, des universitaires, des experts techniques et des spécialistes des sciences sociales, ainsi que des législateurs et des responsables politiques. En bref, les systèmes d'intelligence artificielle sont développés avec l'objectif principal d'imiter artificiellement les capacités de l'esprit humain par le biais de machines. La mise en œuvre de cette technologie dans le secteur des activités spatiales (bien qu'elle soit également applicable à tous les secteurs) présente diverses nuances, comme l'introduction de "connaissances juridiques spécialisées" objectives. Dans les phases d'apprentissage de la machine, la communauté internationale est (et sera) invitée à définir et à déterminer des "objectifs de haut niveau" spécifiques à l'espace.

Étant donné que cette technologie (ainsi que d'autres nouvelles technologies, telles que la cyber technologie) ne connaît pas de frontières, elle est susceptible de bouleverser les méthodes traditionnelles et historiques d'élaboration des lois, tant au niveau international qu'au niveau d'états d'un même pays. Une approche descendante n'est non seulement pas envisageable mais également non durable et inadaptée ; il faut donc poser les bases d'une approche ascendante impliquant toutes les parties prenantes et à tous les stades du cycle de vie de l'intelligence artificielle. Compte tenu de l'évolution constante des normes internationales subjectives et objectives pour la réglementation de la conduite dans l'espace, le chercheur souhaite également introduire la nécessité d'une recherche socio-juridique, en soulignant particulièrement la nécessité d'être en phase avec les approches de la conscience juridique. Ce faisant, on peut

localiser et traiter les problèmes actuels et les défis futurs pour conceptualiser un ordre international fondé sur des règles pour l'introduction et l'exploitation des technologies d'intelligence artificielle dans les activités spatiales.

La nouvelle ère spatiale 4.0 est également marquée par l'augmentation de la présence et des opérations croissantes du secteur privé dans les activités spatiales, avec des rôles de supervision joués par les gouvernements des États. Cette communication engloberait donc certaines des modifications ou nuances d'interprétation qui pourraient être nécessaires dans le contexte de l'interprétation et de la réglementation des traités internationaux contraignants applicables à l'écosystème spatial. Outre les questions de durabilité de l'espace (par opposition à la conduite des activités spatiales sur une base strictement économique), d'autres questions incluent la nécessité d'examiner l'éthique de l'IA, le coût environnemental de l'introduction de l'IA, les questions de confidentialité des données découlant des images à haute résolution fournies par les satellites, et d'autres questions de ce type. Il s'agit également d'élargir notre notion de ce qui constitue le droit spatial lui-même.

Il reste des questions plus larges, à savoir si le système de gouvernance spatiale en soi, pour les parties qui s'appliquent à la réglementation des activités d'IA, serait, en temps opportun, intégré dans un cadre juridique international potentiel pour les systèmes d'intelligence artificielle. Bien que cette question reste largement sans réponse jusqu'à présent, il s'agit ici d'une tentative d'examen du cadre ou du système de gouvernance spatiale en vue d'analyser et d'évaluer son potentiel d'adaptation, d'absorption ou de subsumer la réglementation des technologies et des systèmes d'IA dans un avenir prévisible.

ACRONYMS AND ABBREVIATIONS

AAS	American Astronomical Society
ADR	Active Debris Removal
AI	Artificial Intelligence
DNN	Deep Neural Networks
FCC	Federal Communications Commission, United States
IAU	International Astronomical Union
IoT	Internet of Things
ISO	Intelligent Space Objects
ITU	International Telecommunication Union
ML, or Simple AI Phase II	Machine Learning
NASA	National Aeronautics and Space Administration, United States
NN	Neural Networks
OoS	On-orbit Servicing
OST	Outer Space Treaty
SGR	Secretary General Report of the United Nations
SSA	Space Situational Awareness
STM	Space Traffic Management
TLEs	Two-line Elements
UN	United Nations
UNCOPUOUS	United Nations Committee on the Peaceful Uses of Outer Space
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGA	United Nations General Assembly
UNOOSA	United Nations Office for Outer Space Affairs
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
US	United States
USSR	Union of Socialist Soviet Republics
VCLT	Vienna Convention on the Law of Treaties

CHAPTER I

INTRODUCTION

> All technological inventions, progress and implementation were first conceived in the minds of human beings. From human beings' dreams to fly in the sky to exploration of the unknown, including outer space, we have come a long way in making human imagination and longing come true. And thus, in adopting artificial intelligence in human activities and systems, including in space activities, the triad of law, science and technology, if employed with care and diligence, will provide humanity every opportunity, and a mirror, to ascertain and determine the evolution of our minds through the centuries, and in particular, conceptualize, challenge and perhaps even redefine what we refer to as human intelligence itself. In other words, *sans* sustainable development objectives, it would really all be for nothing.

Beautiful things are happening to human beings. The opening decades of this millennium have witnessed ecstatic attainments in the field of technology, both in traditional spheres of operations as well as in new domains such as digital technology, and now, in artificial intelligence systems. The industrial revolution of the bygone centuries provided mankind an opportunity to look into and refine the physical aspects of human beings. So to say, when excessive, and to a point exploitative, physical labour and activity began to cause widespread misery and suffering in the form of high mortality rates, widespread diseases, brutal wars, territorial conquests and resultant bloodshed, etc., mankind took the opportunity to develop and turn to machines to make the physical aspect of human lives easier. This phase, spanning across centuries, saw adoption of simple machines, completely and absolutely controlled, owned and operated, by human beings, and with a view to make life easier on a day to day basis. Physics was employed to reduce human effort, and humanity chartered a course to make their lives more comfortable in the way we lived and interacted with all those around us.

Once physical aspects of our survival process was well taken care of, we took to developing and enhancing our mental abilities and capabilities. However, as we approached this millennium, and in particular, the last decade, it appears that we are on track to extend our mistakes that we had made in the industrial revolution era into this new era of enhanced, predominant and excessive focus and reliance on use of our mental capabilities. Moreover, the focus on the ability of our

minds is in only a limited aspect of its overall potential i.e. the focus has predominantly been on memory retention and reproduction, with an excessive, and at times abusive focus on this sole aspect.[1] As a result, and in particular in the light of the ongoing Covid Pandemic, our mental capabilities, or rather its overuse and misuse, has resulted in a state of mankind where we are currently witnessing large scale and global mental health repercussions, impairments, degradation and diseases. So to say, it appears that our own intelligence has turned against us.

And thus, in this new and ushering era of digital age and revolution, mankind is yet again turning to machines, and this time to reduce its overindulgence or dependance on singular aspects of a human mind. As we have seen with basic computing systems, including computers, phones, tablets, etc., machines have already outpaced the 'memory' aspect of human intelligence. What was lacking was a machine's ability to covey and express its stored memory (data and information) to an audience, and thus this has typically provided human beings with some sense of superiority over machines till now. With artificial intelligence systems, this aspect of dissemination of information stored in machines (with human supervision; and in due course of time, without such supervision) to a large audience, or even to entire mankind, is being facilitated and without subjective human views (or bias) pertaining to societal constructs, thoughts and emotions.[2] And thus, in this regards, intelligent machines being developed have the potential ability to outmatch, or operate outside the boundaries of, well-defined legal systems and other human constructs.[3]

---

[1] At current levels of human interactions in most societies, human intelligence has been ascribed and heavy reliance has been placed on human memory. So to say, in most societies, a human being who can typically retain, process and provide a large amount of information to its surrounding is being considered as an 'intelligent' human being – computer systems, and now artificial intelligence systems are already upending this notion in more ways than one.

[2] Human beings, as compared to machines, are typically constrained by our biological functions and thus often restrained by limitations in our biology and evolution, in both our physical aspects of activities as well as in our mental capabilities. In regard to our mental abilities, human 'thought' and 'emotion' can be largely enabling as well as severely constraining. These aspects, in large scale expression and implementation, has manifested itself into differing and distinct societal, cultural, economic, political, ethical and legal systems. And thus, a significant aspect of current literature around artificial intelligence machines and their implementation have largely been focused on 'ethical' issues. However, the very notion of what is ethical is also subjective in the sense that what one group of people or a sovereign nation or multinational corporation(s) (in a largely economy-based/driven society) consider ethical may not be so for another group of demographically, culturally, socially, emotionally, financially distinct group of people or sovereign nation or other legal entities or persons.

[3] Through the lens of artificial intelligence, modern day scientists, including data and social scientists, programming and technical experts as well as multinational corporations are being able to perceive how a human mind collects data or information from its surroundings, how it processes it, and how it implements such processes into the everyday lives of human beings. In essence, this technology has the ability of providing a third person perspective of how human beings have evolved and conducted ourselves over lengthy periods of time. As this determination is crucial to understanding how legal systems have evolved around the world, it is likely to play the most significant role in an impartial evaluation of the 'objectives' (legal as well as ethical and social) with which mankind could pursue implementation of these new and revolutionary systems and technology.

Cyber activities and technologies, Internet of Things (IoT) and now artificial intelligence have all the capabilities to operate outside the traditional paradigm of State sovereignty. Legal systems of today's world, which is largely based on a group's perception of (i) what is ethical and moral and what is not, (ii) what is enforceable and permissible and what is not; has accordingly been modeled on similarity of ethics, morals, values, perceptions, etc. And thus, when any technology has the ability to, and actually surpasses or penetrates beyond traditional sovereign boundaries, it raises more questions than one could fathom or imagine. It has the potential to challenge the very notion of law itself (a theme which is largely beyond the scope of this thesis) and asks mankind if it would be able to set aside its otherwise important (looked at or approached in a national or State territory based precept) but narrow and didactic views (in an international legal order context), and look at the technology and its capability beyond and above and over its traditional notions, ideas and conceptions. In a way, and in this context, international space law[4] (and at least in its core precepts and tenets) has led the way for mankind to see that when the right time approaches, mankind has often been able to put aside its differences and adapt to find common ground in regulation of new and revolutionary technologies.

The important point, however, to note here is that through digital computing and processing technologies, the pace in the development of machine-assisted human technologies has intensified and is progressing at a much, much more rapid pace than ever before when compared to any previous technology (which, at a time, was considered revolutionary). As an example, it took space activities more than half a century to consider introduction and induction of new non-State actors, whilst with cyber technologies and artificial intelligence, actors other than States have been pivotal since the very introduction of these technologies, with States and their governments' playing a limited role so far.

Thus, if not employed with care and diligence, and with the 'objectives' of sustainable development of Earth and human beings and all lives around us, artificial intelligence technologies also have the capability to challenge, compete and perhaps outpace human

[4] See, for example, international space laws contained in (i) *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205, (entered into force 10 October 1967) [*Outer Space Treaty* or *OST*], (ii) *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*, GA Res 1962 (XVIII), UN GAOR, 18th Sess, Supp. No. 15, UN Doc. A/5515 (1963) page 15 [*1963 Declaration of Legal Principles*], containing the set of legal principles, morals and values held in the highest regard by the international community in the conduct of space activities, and containing several agreed upon principles in the form of (i) peaceful purposes, (ii) common benefit of mankind, (iii) free access to all areas of celestial bodies, (iv) non-discrimination, (v) non-appropriation, (vi) regulatory provisions such as international State responsibility, liability and jurisdiction and registration, and (vii) enabling provisions such as 'prior consultation' [*Core principles of space laws*].

evolution.[5] This thesis is thus an attempt at locating, identifying, accumulating the objectives, specifically the legal, quasi-legal and political objectives, with which this new technology may be employed, specifically in the conduct of space activities.

1.1 A conceptual perspective of Artificial Intelligence or Intelligent machine systems

> *The Institute for the Future (IFTF) states that we are at the beginning of a new era, a partnership between man and artificial intelligence, and by 2030, people and robots will have an extremely close collaboration relationship.*[6]

Although various attempts have been made to conceptualize artificial intelligence, in its core essence, it springs from the concept that human intelligence is computational and the human mind can be 'modelled as a program that runs on a computer'.[7] This mirrors one of the earliest explanations provided by John McCarthy in 1955, based upon a relevant and contextual analysis of the work done by the pioneer of artificial intelligence – Alan Turing, wherein McCarthy offered one of the most convenient conceptualization of artificial intelligence in saying 'a machine that behaves in a way that could be considered intelligent if it were a man [woman/human being]'.[8] The English Oxford Living Dictionary provides this definition: "the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."[9] In essence, so far thus, attempts at developing and implementing artificial intelligence, in the technological sector, has been based on an overall objective to mimic the capabilities of human mind.

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[5] See, for example, Alison Arden Besunder, "Not Your Parents' Robot", (2018) 90 NY St Bar J 20; George Anthony Long, "Artificial Intelligence and State Responsibility under the Outer Space Treaty", (2018) 5 Proc of IISL, 69th IAC (2018: Eleven Int'l Publishing), at 2, stating: "Prominent individuals have made dire warnings about artificial intelligence with Elon Musk predicting it will be the 'end of civilization' and that 'we're summoning the demon', and Stephen Hawking having said it will 'spell the end of the human race'."

[6] Simona-Ioana Marinescu, "Artificial Intelligence: The Nexus Between Neural Networks and Space Critical Infrastructures", in U. Tatar, et al, eds, *Space Infrastructures: From Risk to Resilience Governance*, (IOS Press, 2020), doi:10.3233/NICSP200025, 243, at 243.

[7] Lawrence B. Solum, "Legal Personhood for Artificial Intelligences", (1992) 70:4 NCL Rev 1231, at 1231.

[8] Jeremy Kepner & Vijay Gadepally, *Mathematics of Big Data and Machine Learning,* (IAP, January 2020: RES.LL-005), Lincoln Laboratory, Massachusetts Institute of Technology, online: MIT OpenCourseWare <https://ocw.mit.edu>, in interpreting and analyzing John McCarthy & Patrick J. Hayes, "Some Philosophical Problems from the Standpoint of Artificial Intelligence", 1969, Section 2.1, online: Stanford University <http://www-formal.stanford.edu/jmc/mcchay69.pdf>.

[9] See, for example, Definition of Artificial Intelligence, online: Oxford Reference <https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095426960>.

Fast-forward to modern developments in the field, in its technological aspects, the Lincoln Laboratory of Massachusetts Institute of technology further categorizes artificial intelligence ('AI') into:

> Narrow AI (or Simple AI): The theory and development of computer systems that perform tasks that augment for human intelligence such as perceiving, classifying, learning, abstracting, reasoning, and/or acting; and
>
> General AI: Full autonomy of machines, without any human involvement and supervision.[10] [11]

Narrow AI or Simple AI, based on its technological aspects, has been further categorized into four waves, or four phases, depending on the level of technological aspects and components embedded in these systems.

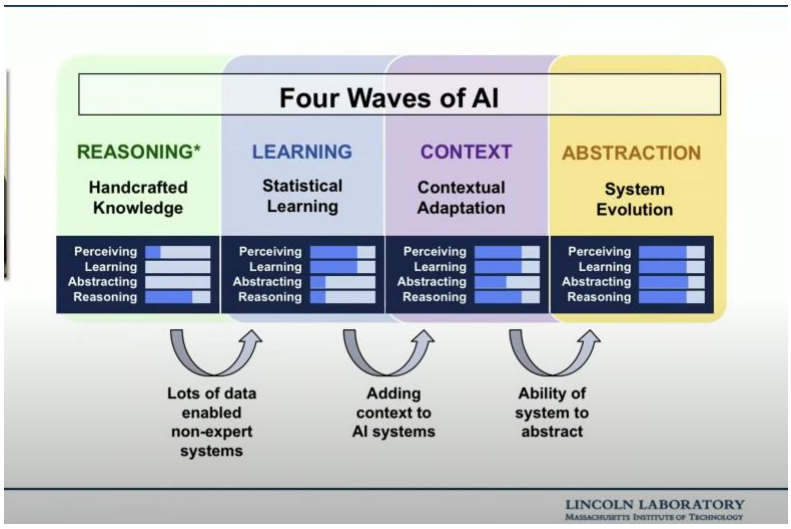

Figure – 1: A description of Narrow AI (or Simple AI) technology and its components or phases provided by Lincoln Laboratory, MIT.

Particularly in technological community, General AI or full autonomy for intelligent machines is being considered as a far-fetched objective, with no immediate insight into when this would be

[10] Kepner & Gadepally, *supra* note 8.

[11] See, for example, Long, *supra* note 5, observing: "The software evolution 'involves the application of computing capacity and analytical techniques to enable computers to learn without being programed explicitly.' In other words, the computer or machine 'will collect information without an express instruction to do so, select information from the universe of available data without direction, make calculations without being told to do so, make recommendations without being asked and implement decisions without further authorization'." See also, E.A. Karnow Curtis, "Liability For Distributed Artificial Intelligences", (1996) 11 Berkeley Tech LJ 147, at 152.

achieved or implemented.[12] Thus, this thesis would largely be dealing with concepts pertaining to Narrow AI or Simple AI to keep it relevant and precise.

Moreover, the United Nations Educational Scientific and Cultural Organization's 'Recommendations on the ethics of Artificial Intelligence'[13] have been adopted unanimously by all its Member States on 23 November 2021, and is the only internationally agreed upon document on AI systems and technologies ('UNESCO Ethics of AI'). This document acknowledges that there is no one definition of AI, since such a definition is likely to change over time, in accordance with technological developments;[14] however, conceptualizes it in these terms:

> *"AI systems are information-processing technologies that integrate models and algorithms that produce a capacity to learn and to perform cognitive tasks leading to outcomes such as prediction and decision-making in material and virtual environments. AI systems are designed to operate with varying degrees of autonomy by means of knowledge modelling and representation and by exploiting data and calculating correlations. AI systems may include several methods, such as but not limited to:*
>
> *(i) Machine learning, including deep learning and reinforcement learning;*
>
> *(ii) Machine reasoning, including planning, scheduling, knowledge representation and reasoning, search and optimization.*
>
> *AI Systems can be used in cyber-physical systems, including the internet of things, robotic systems, social robotics, and human-computer interfaces, which involve control, perception, the processing of data collected by sensors, and the operation of actuators in the environment in which AI systems work".*[15]

Moreover, AI system life cycle, has been perceived to mean and include, and range from research to design and development to deployment and use, including operation, trade, financing, monitoring and evaluation, validation, end of use, disassembly and termination.[16]

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[12] Kepner & Gadepally, *supra* note 8.

[13] For the full text of this document, see, United Nations Educational, Scientific and Cultural Organization, *Recommendations on the Ethics of Artificial Intelligence*, 23 November 2021, adopted by the 41st session (9 – 24 November 2021, UN Doc. SHS/BIO/REC-AIETHICS/2021, online: UNESCO < https://unesdoc.unesco.org/ark:/48223/pf0000380455> [*UNESCO Ethics of AI*].

[14] *Ibid.*, para 2.

[15] *Ibid.*, para 2(a).

[16] *Ibid.*, para 2(b).

In this backdrop, an assessment of the four phases of Simple AI, as typically understood and comprehended in the technological sphere, is as below.

1.2 Four Phases of Simple AI:

At the outset, it is relevant to note that these phases are all interlinked, and any attempt to view one level or phase of its development, without (i) the overall objectives; and (ii) in isolation when compared to its other phases; would not serve the purpose of an accurate portrayal of this technology and its capabilities, and its potential use.

Simple AI Phase I: The first phase or early AI development systems,[17] which also forms the base or foundations of operation of AI systems, involve converting unstructured data to structured data based on 'expert knowledge systems'. This is usually the case when experts in a field enter their knowledge into simulated systems to convert data to structured data. For example, unstructured data could come from various sources such as social media, human behavioural observations, reports, etc., which would then need to be converted to structured data[18] for implementation, further action and processing.

In the theme of this thesis, and as this phase lays the foundation of further development of AI and its subsequent phases, this researcher, upon a nuanced observation of the technical requirements, submits that the conversion of unstructured to structured data not only requires expert technical knowledge, but also expert knowledge of law and legal systems specific to the domains in which such AI systems are targeted for deployment and use. So to say, without the objectives, which are usually set by (i) legal systems, (ii) socio-legal and political indicators and parameters, and (iii) currently, influence or involvement of economic factors; any attempt to convert data to structured data would not fulfil the purposes for which such AI technology is intended for use or implementation, and may also likely result in eventualities where AI systems

[17] In literature, this has also been referred to as 'Reactive AI' machines and systems.

[18] Some instances of structured data types, at the current level of technology, involves speech output, sensors, meta data, etc. This may be achieved through various processes such as forming databases, data curation and data labelling. However, as distinguished from Simple AI Phase II, this phase only involves output based on the data fed to it. Thus, for example, while AI technology in this phase can produce speech output to an extent, it will not provide speech processing and recognition. There is no learning or reasoning involved in this phase as well. In simple terms, this would be akin to cyber activities, except that a machine is processing the data, based on parameters fed to it, instead of a human being accumulating and processing data, which was seen in the early phases of cyber activities.

appear to be acting against common interests of a society.[19] Moreover, in an evolving AI framework, where actions of AI systems need to be justified or explained in the future (see Simple AI Phases III & IV below), particularly involving situations with minimal human supervision or interference, this phase I would assume likely status of 'evidence' as commonly understood under legal systems. And thus, this phase requires an objective, active and need-based attention of the space law and policy community, to the effect:

> 'Expert legal knowledge' introduction, with objectives and compliance aspects that are compatible with legal systems in which the AI technologies are sought to be introduced, forms the core basis for further action, and thus an important component of this thesis. As specificity has become the norm of the day, AI technologies and systems sought to be introduced in space activities must be compliant with its legal systems, and an early introduction of space-specific legal components into the technological aspects of AI systems would go a long way in ensuring that introduction of such AI systems and technologies further the cause of sustainable development in the field of space activities.

Simple AI Phase II: This phase involves a dialing down of expert knowledge or data and stepping up the machines ability to 'learn'. AI systems, in this phase, are still expected to operate under high level data or programming (or human supervision) i.e. the learning is not autonomous and completely independent, but conducted under metadata and rules or under the overall guidance and structure of 'high level objectives' set by human beings; however, initial set algorithms are reduced to a minimal, and the systems are programmed to interpret and learn.[20] This phase involves high components of perceiving and learning, but there is still limited abstraction and

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[19] See, for example, Emily M. Bender, et al, "On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?", ACM Conference on Fairness, Accountability, and Transparency, 3 – 10 March, 2021, Virtual Event, Canada at 610, online: <https://dl.acm.org/doi/pdf/10.1145/3442188.3445922>, scoping the term 'stochastic parrots'. Stochastic parrots is a term being used where an AI or Machine Learning system essentially replicates any bias held by its creator or developer in generation of text strings. In this, an AI system or Machine Learning system progressively presents its views without any regard to the meaning associated to such views, which meanings could vary from person to person, and societies to societies.

[20] In AI research and development, for example in the case of autonomous driving systems in the United States, what this basically entails is that some high level 'state-to-state' rules of driving are fed into the system, while such AI systems are left to decide specific rules of operation such as transitioning from one province to another and what rules would apply or how it would change as per different requirements in different provinces. In literature, this phase is also being referred to as 'Type II or Limited Memory Systems', in the sense that AI systems are enabled to use past experiences to inform future decisions, however, the data or actions generated through this is limited and are not stored permanently.

reasoning. High level development, or the highest achievable potential, in this phase is also otherwise being referred to as machine learning ('ML').[21]

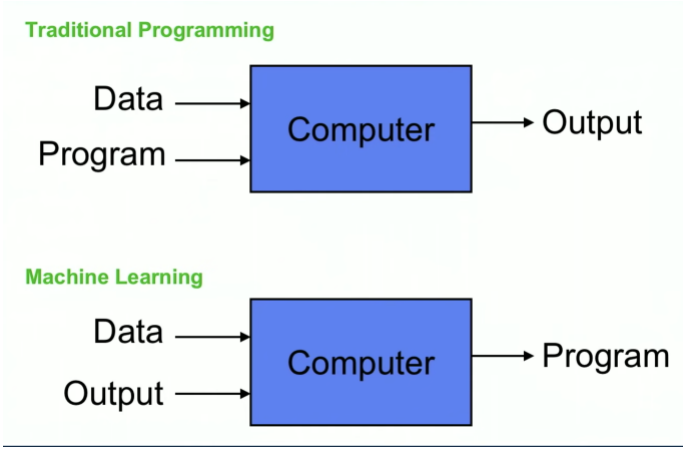

Figure II explains the difference between traditional programming vs. machine learning. Image courtesy of Lincoln Laboratory, MIT.[22]

Moreover, in ML systems, as can be seen from Figure II, the output of the intelligent machines (or, desired objectives for the machines to achieve) are essentially fixed by human beings (creators or developers of AI systems), and the machines run programs or conduct actions to achieve this desired output.

Although AI theories and evolutionary technology has been gradually developed over the past many decades, availability of big data, computing power (CPU – GPU – TPU), and machine learning algorithms have really provided necessary breakthroughs in AI technology in the past couple of years or so. As an example, a system that would have taken 6 minutes to train in 2018 now takes only about 13 seconds.[23] High opportunities and heavy financial investments have only aided the progress in recent times. Heavy human involvement, implying readily available structured data sets, high quality sensors being developed to perceive human responses other technological upgrades required for a AI system to progress to machine learning, etc. have added to the pace of development.[24]

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[21] Long, *supra* note 5, "Machine learning 'is not unlike the brain of a human child' – ready to be molded and shaped by its experiences." See also, Weston Kowert, "The Foreseeability of Human-artificial Intelligence Interactions", (2017) 96 Tex L Rev 181, at 183.

[22] Kepner & Gadepally, *supra* note 8.

[23] Charlotte Hu, "Artificial intelligence is everywhere now. This report shows how we got here." (16 March 2022), online: Popular Science <https://www.popsci.com/technology/stanford-artificial-intelligence-index-report/>.

[24] See, for instance, Daniel Zhang, et. al, "The AI Index 2022 Annual Report" (March 2022), AI Index Steering Committee, Stanford Institute for Human-Centered AI, Stanford University, online: <https://aiindex.stanford.edu/wp-content/uploads/2022/03/2022-AI-Index-Report_Master.pdf>, also stating: "The

Even in ML systems, the evolution and a machine's ability to learn would largely depend on the initial data sets and programs on which the machine acts. In simple terms, this justifies the need for urgent and prudent involvement of the space law and policy community in these two initial phases of AI systems, as they are already being, and are likely to be incorporated, in the domain of space activities. In ML, for instance, the high level legal objectives fed to AI systems would determine how such AI systems process and act in the space environment to achieve the desired objectives or output, whether through the ground infrastructure of space systems or by being actually embedded as part of space missions and launches.

Simple AI Phases III & Phase IV: While significant developments have been made and still are being made in the first two phases, from a technological aspect, very early research is being conducted in Phase III. So far, Phase IV is only at a conceptual level.[25]

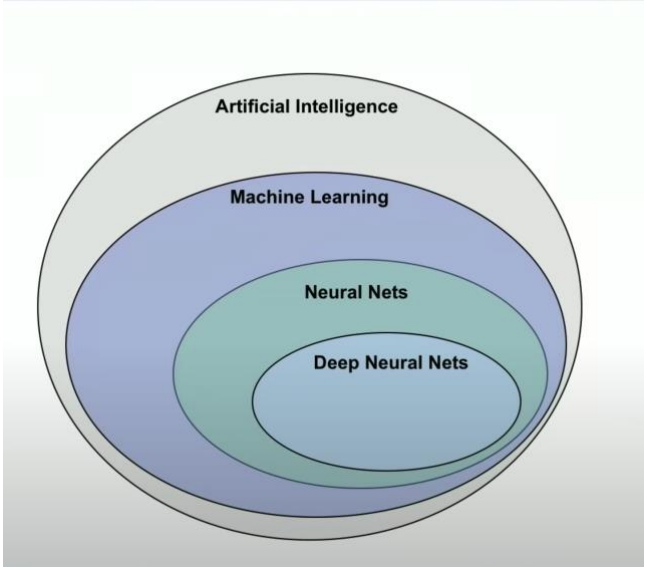

Figure III provides conceptualizations of all phases of AI systems. Phase III and Phase IV are represented as subsets of Machine Learning. Image courtesy of Lincoln Laboratory, MIT.[26]

Although at a very nascent stage, Phase III or contextual adaptation is being based on the significant improved ability of machines to reason, while slightly enhanced ability to abstract.

report examined 25 countries around the world, and found that they have collectively passed 55 AI-related bills to law from 2016 to 2021. Last year, Spain, the UK and the US each had three AI-related bills that became law".

[25] Kepner & Gadepally, *supra* note 8.

[26] *Ibid.*

Reasoning is the ability of a AI system to provide reasons for its actions i.e. what it knows and how it comes to a conclusion in any given case or in any of its actions. In the most simplest of terms, an example of Phase III would be when AI systems' are able to detect (without any external input) a chair as a chair because (i) it is placed right next to a table, or (ii) it is usually comparable, in size, dimension and function, to other chairs which a machine has previously detected and verified. In other words, a machine learns about surrounding objects like a human mind does.[27]

> It is relevant and necessary to point in brief that the progress and development in this Phase III (including in advanced stages of ML or Simple AI Phase II) are already raising accountability issues. In the sense that, in ML, and specifically in neural networks, the training models and simulations are so expensive that data scientists and researchers are picking up what someone else has done and start working on those models to simulate and generate further advancements.[28]
>
> This leads to subjectivity issues, based on geo-political, economic, social, emotional, conscious human actions and responses as well as the ability to (a) perceive legal knowledge applicable to an activity, and (b) ability and willingness to act and implement AI development and activity within the legal framework(s) applicable to such activities (in this instance, AI in space activities), and other such human factors to which an original developer or researcher was subjected to, or which forms the basis of actions in Simple AI Phase I, or, to an extent even in Simple AI Phase II implementation ('Personal zone of influence').

Phase IV or abstraction[29], which is absolutely new, even in theoretical terms, involves the ability of a machine to add context to what it is doing. In simple terms, instead of just applying Phase III evolution to detect that a table is a table because it has four legs, AI systems can make out that a table is usually a place where you put things on, or you study and work, or you have your lunches or dinners in, coupled with a further enhanced ability to apply this abstraction in any

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[27] In literature, Phase III is also being referred to as Neural Networks or 'Theory of Mind'. Neuromorphic systems of computing are being developed and researched upon, which is supposed to mimic the human brain (in physical dimensions or in virtual domains) in the way that a computing architecture functions or performs.

[28] Kepner & Gadepally, *supra* note 8.

[29] In literature, Phase IV is also being referred to as Machine Self-Awareness i.e. AI systems would be developing a sense of self when compared to its surrounding. In theory, machines with this level of awareness understand their current state and can use the information to infer, for example, what human beings feel or how they perceive and process information, etc.

other unrelated domain, without any explicit guidance or supervision of a human being/human programmer or creator or developer.

> Here, it is relevant to re-iterate that these different systems (or phases) actually depend on availability or combination of one or more of the above stipulated factors and nuances. Expert systems, or Phase I, is usually employed where data and computing power is average, however, there is a lot of expert knowledge available. In other instances, where a programmer or creator wants to input very little knowledge, however there is huge amount of data and high computing power, AI systems use Phase II or machine learning; and then begin to progress towards neural networks (or, Phase III). In Phase III, machines are learning what human system of knowledge essentially is.[30] Implementation of Phase III, to its highest potential, would also depend a lot on future progress of Neuromorphic systems of computing i.e. the ability of machines to create the human mind's framework in physical dimensions and mechanical terms.

In summary, for the moment, it is essential that focus must be laid on development of 'expert legal knowledge' for the field of space activities, and early communications and collaborations with technical expertise in the field of AI systems as well as in the space ecosystem. ML development would in turn require ascertainment of desired space-specific 'high-level legal objectives' for beneficial growth and development of such systems and to facilitate their incorporation in the domain of space activities.

1.3 Setting the context through a hypothetical example:

It has been a constant human endeavour to make technology better, faster and more effective. In the context of deep space missions, for example, the 2020 Mars Rover currently takes about 5 to 20 minutes for communication with its ground infrastructure i.e. the time taken by a radio signal to travel the distance between Mars and Earth.[31] This creates a need for faster and more effective communications between the ground segment of a space activity, through human operators, and its space segment, usually in the form of radio signals. Further, in this manual mode of operations, there is no intelligent activity of the machines i.e. a human controller

[30] Kepner & Gadepally, *supra* note 8.

[31] NASA Science, "Communications", Mars 2020 Mission Perseverance Rover, online: NASA Science < https://mars.nasa.gov/mars2020/spacecraft/rover/communications/>.

generates commands which is the basis of actions of a machine-extension. In appropriate circumstances, this human controller may also generate commands from a space segment of a space activity to its technological extensions or machine explorers, such as the case of an astronaut generating commands of operation to a robotic arm being used to fix or repair parts of say the International Space Station. Current issues of the day also calls for attention to cyber activities and cyber security issues between such communications in the context of (i) ground infrastructure, (ii) space segment, and (iii) the link segment, of space activities, and in the form of potential threats such as spoofing, jamming, etc.[32] All of this points towards the increasing need (and great potential) for introduction of AI technologies and systems in space activities (Please also see Chapter III below for more details).

In an attempt to lay out a hypothetical with a view of exploring the potential and use of AI systems in space activities, keeping in mind current levels of technological progress in AI systems i.e. the first phases (I & II) of Simple AI, let's look at the following example:

> In the first level of evolution in the assumed 'brain' of an intelligent machine (for example, a mars rover, or a robotic arm of a space-craft, etc.), when certain conditions are met, the program starts controlling and operating the machine and its physical components, with or without any further external input from human controllers from its ground infrastructure. In Phase II or ML, an intelligent machine is continuously learning and evolving. So to say, let's consider that A and B are two programs initially designed to operate a mars rover or a robotic arm of a spacecraft. While the machine operates under these two programs and performs its functions, different results or output are likely to arise such as C, D, E, etc. An evolving machine then integrates C, D, E, etc. as raw data and self-generated and assessed programing (or conduct) while performing future actions such as X, Y, Z. In this, a human operator or developer or programmer of Simple AI had only fed two initial programs with (i) the ability to evolve further, and (ii) based on express instructions to act under certain high-level objectives; while a machine detects that maybe C or D or E is a better program in the context of a specific deep space mission based on its assessment from prior results obtained.

And thus, in the current stages of AI development, let's say, a robotic arm of a machine or a rover is sent to Mars:

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[32] For example, see, Gil Baram & Omree Wechsler, "Cyber Threats to Space Systems: Current Risks and the Role of NATO", Joint Air & Space Power Conference 2020, online: Joint Air Power Competence Centre < https://www.japcc.org/cyber-threats-to-space-systems/>.

- Manual operations, through human controllers from a ground infrastructure, would involve giving this robotic arm or rover explicit instructions on when and how to take a picture or video, or of which particular geographical structure of Mars, or perform other specific objective-based actions, and these links are being continuously generated and operated through the ground infrastructure of a particular space activity, and the machine simply obeys. The downlink or relaying of results of a particular activity or action is also done exclusively on the basis of instructions from a ground infrastructure.
- In the first phase of Simple AI, the robotic arm is not receiving direct instructions from human operator but has been pre-programmed, to say, take pictures of certain geographical structures of Mars when visibility conditions are good and a certain threshold is met. For instance, when visibility is 100 kms, it automatically activates its system, and shoots high resolution pictures or videos. In certain circumstances, such action may be subject to a final approval of human operator, however, that is not necessarily always the case. As long as stipulated atmosphere conditions continue to exist, it will click high resolution pictures or videos. Moreover, it may also be programmed to include taking minimalistic decisions such as to select which kind of pictures (or rather, which background or objects) are best highlighted when these conditions are detected, rather than going for shoot and click everything on its way. The inbuilt programs and codes automatically set detection and shoot to such levels and such objects only. It may also involve other nuances like selecting which pictures to send back to its ground infrastructure through downlink channels, etc.
- In Phase II of Simple AI or ML, instead of specific instructions or programming as highlighted above in Phase I of Simple AI, it is now only programmed with high-level objectives such as, for instance, to click and shoot 'best resolution pictures' with potential minimum operational threshold of visibility of 100 kms. For the sake of this hypothetical, let's assume that this robotic arm or rover has already been operating in Mars for about 50 days. In these 50 days, it is constantly observing weather conditions and integrating the results to constantly update and evolve. So, while at a certain time, the visibility might be 100 kms and it should have ideally activated the click and shoot function, it knows, (i) from potential prior results, explained above as eventualities C, D, E, from its 50 days of operation that next week the visibility has a high probability of being 150 to 200 kms, or (ii) activating the click and shoot function on this particular day would not yield the desired 'best resolution pictures'. Thus, in ML systems, despite explicit programmed

initial instructions, the machine will wait till next week, or another time, to perform the desired and designated functions. In appropriate circumstances, and owing to current levels of constraints in downlink capacity and speed, it may also choose to discard certain pictures and videos, or perform tasks such as prioritization. Detailed modus operandi or other nuances will vary a lot depending on how this technology is approached and incorporated for use in the space domain.

- Although Phase III of Simple AI is only at a very early stage of research, design and development, theoretical conceptualizations in this field would involve the ability for an intelligent machine to reason with limited ability to abstract. So to say, the machine, if required and desired, would be able to provide reasons to as why it selected a certain geographical structure, basing its actions or decisions on an assumed overall objective to find, say, 'presence of life' on Mars.

This researcher has provided a simple hypothetical of a potential use of AI technology or system in a deep space mission based on the overall objectives of peaceful exploration and use of outer space.[33] However, practically, the technical and regulatory nuances surrounding application of AI systems in space activities in and around Earth-orbits, or involving space-earth based applications, are soon becoming very complex, and requiring and demanding many aspects of human indulgence and scrutiny (please see Chapter III below for more details). Thus, in such a rapidly evolving technological environment, emphasis must be placed the 'objectives' which with such technologies and systems are being designed, or with which they are likely being used or would be put to use for space activities.

1.4 Research hypothesis and objectives

[33] See, for example, provisions of 'peaceful purposes' in: 1963 Declaration of Legal Principles, *supra* note 4; Outer Space Treaty, *supra* note 4; at preamble 4, and read with *Vienna Convention on the Law of Treaties*, 23 May 1969, 1155 UNTS 331, (entered into force 27 January 1980) [*VCLT*], art. 31. See also, United Nations General Assembly, *Question of the Peaceful Use of Outer Space*, UNGA Res. 1348 (XIII), UN GAOR, 13th Sess, volume 1, Supp. No. 18, UN Doc. A/4090 (1958) pages 5-6, recognizing that "it is a common aim that outer space should be used for peaceful purposes only"; United Nations General Assembly, *International Co-operation in the Peaceful Uses of Outer Space,* UNGA Res. 1472 (XIV), Part A, UN GAOR, 14th Sess, Supp. No. 16, UN Doc. A/4354 (1959) page 5, recognizing 'the common interest of mankind as a whole in furthering the peaceful uses of outer space'; United Nations General Assembly, *Recommendations on national legislation relevant to the peaceful exploration and use of outer space*, UNGA Res. 68/74, 11 December 2013, U.N. Doc. A/RES/68/74 (16 December 2013) [*Peaceful purposes*].

AI is not a single technology but a family of technologies.[34] Moreover, there is no currently agreed upon international document governing legal regulation of AI systems. The only international instrument i.e. UNESCO's Recommendations on the Ethics of Artificial Intelligence[35] has been agreed upon as a set of morals and values for development and use of AI systems. It stipulates ethical and moral responsibility and liability as opposed to approaching these areas from a legal point of view. Given the excruciatingly slow place of international consensus being achieved in newer technologies, such as for cyber activities and cyber security, it appears unlikely that any legal consensus on research, design & development, operation and use of AI systems is forthcoming at the international level. Thus, there is no international framework for regulation of AI systems and technologies in any domain, including for the space domain.

In this backdrop, the research hypothesis is that application of AI systems being imported for use and operation in the space domain or ecosystem can likely be successfully regulated, for the foreseeable future, with tweaks and re-interpretations of international space law, including its more broader, global space governance framework. The desirability of tackling the challenges from its very early stages can likely result in development and incorporation of space domain specific 'expert legal knowledge' as well as 'high-level objectives', which are crucial and imperative for sustainable developments in space activities and in light of introduction and operations of AI systems. There is also an underlying hypothesis that there is an urgent need for collaboration of all relevant and involved stakeholders.

The central questions towards AI systems' use and operations in the space domain are likely to concern all stakeholders, including the space law and policy community, the technical experts working towards research, design and development of AI systems, law and policy makers, States and their governments, regulatory bodies, social scientists and the scientific community, environmentalists, and most importantly, the many individual actors in the space domain as well as AI systems domain, including the business sector and multinational corporations, etc. (to name a few). The relevant questions in this regard could be put as:

> Do we rush head along to implement this new technology across all sectors of space activities without understanding its nuances, and without specifically adhering and catering to the risk management factors? If mankind decides and

[34] For instance, see, International Telecommunication Union Trends, *Assessing the Economic Impact of Artificial Intelligence*, September, 2018, Issue Paper No. 1, online: ITU < https://www.itu.int/dms_pub/itu-s/opb/gen/S-GEN-ISSUEPAPER-2018-1-PDF-E.pdf> [*ITU Report on AI*], at 6.

[35] UNESCO Ethics of AI, *supra* note 13.

> approaches its incorporation and implementation it in a phase-wise manner, as it should, what are the gradual changes and regulatory challenges that need to be taken care of? In Simple AI Phase I, what legal components need to be ascribed or prescribed for conversion of data and its use? In ML phase of Simple AI, what are the space specific high-level objectives that are absolutely critical and cannot be derogated from?

To demonstrate this, and possibly present a preliminary analysis towards regulation of AI systems and technologies for space activities, this researcher has highlighted the technical aspects and conceptualization of AI systems and technologies in this Chapter, and by highlighting the need for space specific 'expert legal knowledge' and 'high-level objectives' under which such technologies and systems could be developed, imported for use or function and operate. If technical developments and progress is left unchecked and unsupervised, AI systems also have the risk of causing more harm than good. Thus, this thesis adopts a preventive as well as precautionary approach, with a strong emphasis on awareness of applicable issues and involvement of all concerned stakeholders.

In the next Chapter, this researcher has, in view of recent developments and activities in the space ecosystem, averted to the growing and urgent need to adopt a legal consciousness approach. If international space law is to be equipped to be able to deal with the nuances and technical underpinnings of AI systems, there is a need to transit from historical approaches which has typically seen heavy involvement of States and their governments towards a 'relational continuum', including a co-constitutive model. A co-constitutive model would see States and their governments performing supervisory roles, while providing the individual actors a seat at the table at decision-making and in view of ascertaining and inculcating aspects of ethical liability and responsibility, as provided in the UNESCO document. Attempts must be made though to gradually progress towards legal liability and responsibility. While a co-constitutive model lays a foundation for involvement of all stakeholders, meaningful developments can be made more easily if approached through the 'individual stakeholder' model of legal consciousness approach. As AI technologies and systems are being developed and adapted in a gradual phase-wise manner, the legal components for its regulation would also need to be looked at accordingly in a phase-wise manner, with the involvement of all stakeholders. This chapter also presents a vivid picture on the need and desirability of sustainable development in space activities in light of introduction of new technologies and systems such as AI.

While the structural changes towards a more 'functional' approach of law is looked at and dealt with by the broader international community, Chapter III discusses the applications as well as potential applications of AI use and operations in the space ecosystem, and also the potential legal implications of such use, in the absence of AI specific international legal consensus or agreements. Thus, it addresses core aspects of international space law, with a view of highlighting the changes that would be required to address important aspects of AI systems' legal regulations in the space ecosystem. Sustainability in space activities being kept as the central objective, this Chapter offers an insight to the changes that may be required so that international space law successfully absorbs or imbibes important aspects of regulation of AI systems. These fundamental considerations could also be assimilated as 'expert legal knowledge' for development of AI systems for use in the space domain.

The last Chapter IV is an initial and preliminary attempt at drawing the attention of all stakeholders of the international community and for garnering support towards development and adoption of space-specific high level objectives. These objectives are crucial for importing some or other units of AI systems (out of the family of AI technologies) for its use in the space domain, and more specifically relevant to the adaptation required for ML technologies. Before concluding, this chapter also provides an overview of ethical issues pertaining to development and use of AI systems, including its environmental cost.

In sum, while the broader question of, 'if an internationally agreed legal framework could be developed and adopted to provide for regulation of AI systems in any domain, including for the space domain', is yet wide open; this thesis is an attempt to provide insights into how these technologies and systems could be successfully navigated within the realm of international space law, keeping sustainable agendas and developments as the focal or central points of consideration.

CHAPTER II

Need for Legal Consciousness approach and research in the global space governance framework in the context of artificial intelligence systems

> Legal consciousness refers to the ways in which people experience, understand, and act in relation to law. It comprises both cognition and behaviour, both the ideologies and the practices of people as they navigate their way through situations in which law could play a role. Legal consciousness does not simply refer to legal awareness, nor is it meant to measure knowledge — or ignorance of the law. Indeed, some legal consciousness research demonstrates the extent to which people do not invoke or think about the law at all — or perceive it to be irrelevant. Often enough legal consciousness research documents the absence as well as the presence of law in people's understanding of the social world and their place in it.[36]

In an attempt to navigate complex domains of human beings' subjective understanding of relevance of technical parameters[37] as well as a keen and in-depth understanding of legal knowledge and systems governing the domains in which AI systems are designed to be implemented, it becomes obvious that this revolutionary technology being designed to aid and assist human activities requires:

(i) technical experts or designers/creators/operators/users of AI to have appropriate legal knowledge;

(ii) legal experts and policy makers to have appropriate technical knowledge; and

(iii) actors and implementers of AI systems in human endeavours, such as in space activities (States and their governmental entities, multinational private

[36] Lynette J. Chua & David M. Engel, "Legal Consciousness Reconsidered", (2019) 15 Ann Rev L & Soc Sci 335, at 336.

[37] For example, 'expert knowledge' in Phase I conversion of unstructured to structured data, or 'high-level objectives' in Phase II of AI systems for ML systems, which is likely to then determine the future course of progress in Phase III or IV, varies for AI systems designed to be adopted and implemented in Earth-based human systems and applications (such as autonomous driving or piloting systems, human observation based speech detection and translation softwares, robotic systems, etc.) as distinguished from AI technologies designed to be implemented in space activities.

corporations or non-governmental entities, international organizations, etc.) to have knowledge of both its technical as well as legal components.

Moreover, expert legal knowledge for introduction for AI systems being designed for space activities involve a complex web of:

(i) space law jurisprudence and space governance systems along with a renewed focus on its implementational aspects,

(ii) international rules-based order being developed for cyber technologies and security, which forms and is likely to form, the backbone (along with radio communications and its regulation) for regulation of space activities from ground infrastructure, and adapting such regimes for use and operation of AI systems and technologies, and

(iii) likely special regimes being drafted or incorporated to govern the specific technological and implementational aspects of AI systems itself within national systems[38], with a view of also assessing the possibility of a future potential international rules-based governance system for AI technologies.

And thus, in order to conceptualize and theorize a governance framework for introduction of this technology in space activities (a) which includes a consideration of special parameters ranging from subjective issues governing a AI developer or creator's Personal zone of influence[39], to (b) objective legal parameters agreed upon, or still being formulated and being agreed upon, by the international community for conduct of space activities, a socio-legal approach, specifically a legal consciousness approach has been considered appropriate by this researcher to deal with and navigate the plethora of challenges that lie ahead.

2.1 Legal Consciousness: a brief history

Traditionally and historically, irrespective of research methods or theoretical orientation, three elements of subjectivity has been of prime interest to legal consciousness scholars, aptly and

[38] Daniel Zhang, et. al., *supra* note 24, at c. 5, 175.

[39] See, Chapter I, Section 1.2, 'Personal zone of influence'.

appropriately summarized and captured by Chua & Engel[40], as: worldview[41], perception[42], and decision.[43]

Although none of these three elements are a given and all emerge in distinctive ways from social interactions, and all are interconnected,[44] based on the inter-play of the three elements, historically, and broadly, three schools of thought have emerged through the 1980; with no distinct separation but with one or the other element weighing heavily, and namely:

2.1.1 Identity School: The Identity school of thought in legal consciousness relies on the foundation that the place of law in people's lives [arguably, per the submission of this researcher, also within States/Nations as a collective: please see section 2.3 below] is intimately connected to their sense of who they are, which is itself a product and producer of their worldview.[45] Scholars further argue, for example, that for the marginalized, 'law may seem a double-edged sword; as they assert legal rights based on an identity protected by the law to win acceptance and inclusion, yet they find themselves constructing an identity that may actually be stigmatized and oppositional. Upon encountering new events, individuals may regard law as irrelevant if their identity seems consonant with those events.[46]

2.1.2 Hegemony School: The Hegemony school of legal consciousness has typically seen law as a pervasive and powerful instrument of state control that shapes the worldviews,

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[40] Chua & Engel, *supra* note 36, at 337.

[41] Worldview refers to individuals' understanding of their society, their place in it, their positions relative to others, and, accordingly, the manner in which they should perform social interactions. It emerges from their prior experiences, and it influences how they perceive and respond to new experiences — and whether they should mobilize the law.

[42] Perception refers to individuals' interpretation of specific events. People may, for example, perceive a new event as normal, problematic, harmful, or wrong. For individuals who perceive an event as unexceptional, law may seem immaterial; for those who perceive the same event as violative of interests or rights, law may seem significant.

[43] Decision refers to individuals' responses to events and typically reflects both their worldview and perception. Decisions may at times involve deliberate choices to use the law but at other times to leave it dormant. A decision and its outcome form a new experience that can reconstitute the individual's worldview and perceptions for the future.

[44] Chua & Engel, *supra* note 36, at 336.

[45] *Ibid.*, at 338, citing further, the work of, David M. Engel & Frank W. Munger, *Rights of Inclusion: Law and Identity in the Life Stories of Americans with Disabilities*, (Chicago: University of Chicago Press, 2003).

[46] *Ibid.*, at 338-39, further observing: "That being so, their perception makes the circumstances seem natural, and they are likely to decide there is nothing for the law to fix. If, however, events appear incongruent with their identity, individuals may perceive the circumstances as unfair and decide to take legal action. ... Furthermore, it is no exaggeration to say that virtually every study of legal consciousness has implications for identity, because law is invoked only by those who possess an identity that makes them perceive law to be relevant to their circumstances."

perceptions, and decisions of individuals [arguably, in an international context, of its State's governmental or non-State (private) actors], even when it is not applied directly or instrumentally."[47] Citing previous works in the field[48], Chua & Engel summarized the views held by scholars in this field as: (i) law was 'all over', a 'shadowy presence' of 'power and of compulsion', (ii) law as 'majestic', or (iii) law as a 'game', with some attempting to go against it. Moreover, to the radical environmentalists, law is a hegemonic power to be challenged in *toto* for protecting an illegitimate social order.

2.1.3 Mobilization School: Scholars and members of this school of thought study legal consciousness to understand law's potential for transforming society, particularly by deploying rights that are intended to achieve justice or protect disadvantaged populations [least developed countries in an international context].[49] In this school of thought and research, law typically looms as a powerful presence — as in studies by the Hegemony school — but human agency receives more attention and is generally portrayed as less constrained by law.[50] Further, any researcher's central concern here is not to document law's dominance but to explore the circumstances under which law is deployed to protect interests, and thus to better understand law's potential contribution to positive change.

These three schools of thought largely caught the attention of socio-legal scholars on and from the 1980s (although foundations and components have existed through the early decades of the 1900s) till the beginning of this century. Normatively, towards the beginning of this century, Silbey, for example, critiqued these schools of thought, however focusing largely on the hegemony school, arguing that legal consciousness research was focussed to address issues of legal hegemony, particularly how the law sustains its institutional power despite a persistent gap between the law on the books and the law in action.[51] Shortly before or during this period, in the early 2000s, this field of legal consciousness research underwent turbulence.[52] There were various

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[47] *Ibid.*, at 339.

[48] See, for example, A. Sarat, " 'The law is all over': power, resistance and the legal consciousness of the welfare poor", (1990) 2 YJ L & Hum 343, at 345-46; Patricia Ewick & Susan S. Silbey, *The Common Place of Law: Stories from Everyday Life*, (Chicago: University Chicago Press, 1998), at 247; Erik D. Fritsvold, "Under the law: legal consciousness and radical environmental activism", (2009) 34:4 L. & Soc Inq 799.

[49] Chua & Engel, *supra* note 36, at 340.

[50] *Ibid.*, at 341.

[51] See, for example, S.S. Silbey, "After Legal Consciousness", (2005) 1 Ann Rev L & Soc Sci 323, at 323.

[52] Chua & Engel, *supra* note 36, at 342.

arguments for and against retention of legal consciousness research. However, as a consequence normally associated with any period of introspection, legal consciousness research continued to diverge in newer areas and with renewed focus and enthusiasm, and with the emergence of 'relational legal consciousness' theory. Legal consciousness research now explores a broad range of social scientific questions connected to several different research concerns and theories associated with a variety of academic disciplines.

2.2. Emergence of relational legal consciousness continuum:

Acknowledging the overwhelming view that no individual legal consciousness [even in State sovereignty based legal systems] arises in a social vacuum[53], recent approaches at defining socio-legal and legal consciousness approaches have divulged into treating its theoretical aspects as a 'relational' concept. Theorists have thus propounded a relational form of worldview basing this concept on a 'conscience collective'[54], referring to a set of shared moral beliefs and values held by members of a society [or, arguably, in specific instances, even by States' or members of the international community],[55] which is then translated into a legal system.

Modern day scholars and theorists have thus adopted the relational legal consciousness theory, treating legal consciousness research as a 'continuum' ranging from the most atomistic (individualistic conceptions)[56] on one end to the most relational. In the middle region are mostly studies that retain their focus on individual as the object of study, however, treat other individuals as co-creators, rather than mere external variables.[57] Finally, at the other end of the continuum is the concept of 'relationism', which in its essence, rejects the individual as the unit of analysis and views legal consciousness as a fully collaborative phenomenon.[58]

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[53] *Ibid.*, at 344.

[54] *Ibid.*, at 345, citing: E. Durkheim, *The Division of Labour in Society*, translation by G. Simpson, (New York: Free Press Macmillan Company, 1964 (original print1893)).

[55] See, for example, Core principles of space laws, s*upra* note 4. See also, *The Antarctic Treaty,* 1 December 1959, 402 UNTS 71, (entered into force June 23, 1961); *Convention on Civil Liability for Nuclear Damage*, 21 May 1963, 1063 UNTS 265 (entered into force 12 November 1977), etc.

[56] Chua & Engel, *supra* note 36, at 346, stating: "At one end of the continuum are legal consciousness studies that view the self as essentially autonomous and independent, not entirely divorced from social relationships yet functioning primarily on its own in terms of the worldview–perception–decision-making."

[57] D.M. Engel, *The Myth of the Litigious Society: Why We Don't Sue*, (Chicago: University Chicago Press, 2016), exploring 'why tort victims do not mobilize the law and sue their injurers, explains that humans 'make decisions as part of their social network, even when they act without explicit direction i.e. human identity isn't formed in solitude. We are our relationships.'

[58] Chua & Engel, *supra* note 36, at 347.

In this context, although legal consciousness scholars have not fully theorized a purely co-constitutive model, the questions being presented and asked is:

> *"Should we now imagine relational legal consciousness to be something like a computer cloud storage shared by multiple users? Do individuals download relevant contents from the cloud as they perceive their experiences and make decisions in response? Do they upload new or modified contents to the cloud?"*[59]

As stated above, at the other extreme end of this continuum, individual subjectivity might fade completely into relationships, and researchers might abandon the individual entirely as the relevant unit of analysis ('individual stakeholder' model).[60]

2.3. Need for adoption of 'relational legal consciousness' approaches at the international level:

Historically, these different approaches to legal consciousness theories, including the recently conceptualized 'relational legal consciousness continuum' have only been applied by scholars and academicians, at a national or State level to study: (i) how specific individuals or groups view the legal system, or the role of law in protecting or asserting their rights; (ii) how and why these individuals act a certain way in relation to the legal system, influenced further by social, cultural, moral, economic or other factors; and (iii) the level of fulfilment or satisfaction that they derive by application or non-application of the law, which in turn influences the experience of related or homogenous groups. In turn, as explained above, these actions or inactions are governed by the elements of worldview, perception and decision that individual people or groups (units) of a society hold, and also fundamentally through the way these find expression in a society. In an international context, though, collective morals or conscience or values shared by people in a specific geographic territory or socio-cultural and economic context and in a State-sovereignty

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[59] *Ibid.*, at 348, also suggesting: Because the co-constitutive region of the relational legal consciousness continuum has not been fully theorized, some critically important questions still await analysis. It is not clear whether all legal consciousness is to be deemed relational or just some types, nor is it obvious how some participants in a relationship adopt features of collective legal consciousness but others do not.".

[60] *Ibid.*, at 349: "If such a view were adopted fully, a significant modification in research methodology would be required. The person-by-person research methods used by legal consciousness scholars from the early 1980s to the present could become irrelevant. Instead, researchers would need to devise new approaches that focus on the observation and analysis of relationships and social interactions to determine how different forms of legal consciousness arise from the dialogic process."

based international system, then takes the form of international positions (legal as well as political) taken by a State nation at the global level.

Owing to the transient and evolving changes in the international legal and political ecosystem, this thesis is also an attempt to provide reasons or initiate attempts or draw the attention of the international community on the need to extend the 'relational legal consciousness continuum' approach, to an international level to study the effect of (i) how international space laws evolved, (ii) how they are applied in an international context amongst States, often wielding unequal power and capabilities, (iii) increasing role and influence of non-State actors in the conduct of space activities and determination of 'rules of the road' and (iv) how it could possibly be adapted to incorporate use of new technologies such as artificial intelligence.

Internet of Things (IoT) and social media, cyber activity and its global impact, artificial intelligence technologies and systems, and to some extent, even privatization of space activities; have all shown significant progress and the potential to dissolve the traditional and otherwise overwhelming impact of state sovereignty (and boundaries) and associated legal systems. Thus, modern efforts would require analysis of application of these technologies in the socio-legal context with which they are sought to be applied, and in relation to the overall global space governance framework system of the modern world.

In an applied extension of the relational legal consciousness continuum, the individualistic atomistic approach can be portrayed as 'State' dominant approach to international law and policy making. The middle range of the spectrum or a co-constitutive approach would involve States as well as other actors to lay down guidelines, rules of the road, etc., and for private non-State actors to map and claim their individual positions in this framework, preferably and ultimately leading to decision-making potential and capability at the international level. The other extreme, 'individual stakeholder' model would entirely dissolve the predominance of States as subjects and look at each and every actor in a specific domain as equal actors in law and policy making. Some progress is being made as regards co-constitutive models while theorizing and conceptualizing the 'individual stakeholder' model is entirely new.

There are two further potential ways of bringing in this legal consciousness approach in an international context: (i) the first, is to treat an individual (or a group of people, or non-State actors, multinational corporations or legal persons, howsoever constituted and organized) as a constitutive unit of the international legal system – as an example, this approach is already seen

in the United Nations Sustainability Goals, 2030[61], which attempts to shift focus from a purely State-based action plan to collective responsibility of all peoples ['persons', natural or legal], including that of international organizations, business sector and non-State actors, and where applicable to all individuals and groups,[62] regardless of wherever people [or legal persons] are situated or located. This would be based on shared social, cultural, ethical and moral values (for example, towards ending poverty and hunger, diseases and want, and with a view that all life can thrive; in other related areas, environmental sustainability issues is widely being considered as one of the most recent uniting force amongst masses, irrespective of jurisdictional issues and limitations), or even the most prevalent and dominant shared economic values of the business sector as contrasted with sustainable issues and agendas (social responsibility of businesses and other non-State actors along with international organizations, funding agencies, etc.); (ii) the second, and potentially more nuanced, method would be for an actor or group of actors to initiate activities that shock the otherwise dormant 'collective conscience' of the international community, which is likely to then initiate or begin collective approaches in an equal footing for all stakeholders concerned – in the field of State-level action at the United Nations ('UN'), for example, this approach has recently been seen when the international community reinvigorated a 40-year old legal instrument, the Uniting for Peace Resolution,[63] to condemn the military conflict (invasion/special military operation) in Ukraine, particularly after Russia's hegemonial conduct in the form of its use of veto powers was deemed untenable and unsustainable by State members of the UN. In another example related to the conduct of space activities, Rwanda's

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[61] United Nations General Assembly, *Transforming our world: the 2030 Agenda for Sustainable Development*, UNGA Res. 70/1, 25 September 2015, UN Doc. A/RES/70/1 (21 October 2015).

[62] *Ibid*, preamble, the New Agenda, para 18: "We are setting out together on the path towards sustainable development, devoting ourselves collectively to the pursuit of global development and of "win-win" cooperation which can bring huge gains to all countries and all parts of the world.", para 28: "We commit to making fundamental changes in the way that our societies produce and consume goods and services. Governments, international organizations, the business sector and other non-State actors and individuals must contribute to changing unsustainable consumption and production patterns ..."; Means of Implementation, para 39: "...It will facilitate an intensive global engagement in support of implementation of all the Goals and targets, bringing together Governments, the private sector, civil society, the United Nations system and other actors and mobilizing all available resources.", para 41: "... We acknowledge the role of the diverse private sector, ranging from micro-enterprises to cooperatives to multinationals, and that of civil society organizations and philanthropic organizations in the implementation of the new Agenda."; A Call for Action to Change our World, para 51: "What we are announcing today – an Agenda for global action for the next 15 years – is a charter for people and planet in the twenty-first century. Children and young women and men are critical agents of change and will find in the new Goals a platform to channel their infinite capacities for activism into the creation of a better world.".

[63] United Nations General Assembly, *Uniting for Peace*, Resolution 377 (V), 3 November 1950, UN Doc. A/1775, 10; Security Council Report, "Ukraine: Vote on Draft 'Uniting for Peace' Resolution", 27 February 2022, online: Security Council Report < https://www.securitycouncilreport.org/whatsinblue/2022/02/ukraine-vote-on-draft-uniting-for-peace-resolution.php>, with 141 out of 193 members voting in favour of the resolution; See also, Christina Binder, "Uniting for Peace Resolution (1950)", (Oxford Public International Law: Max Planck Encyclopedia of International Law, 2017).

Space Agency filed at the International Telecommunication Union to put 330,000 satellites with 27 orbital shells.[64] This move may not as much be a practical or a State or business move, as much as it might have been done to shock the conscience of the international space law and policy community, particularly in light of the conduct of a few dominant non-State actors in the launching of satellite constellations in low-earth orbits. Regardless of whichever approach may potentially be explored, followed and/or adopted, there are cogent and urgent reasons to do so, in light of few relevant and recent examples, as below:

2.3.1 Internet of things, social media, etc.

- Through the use of social media and internet of things, it is now possible, and even becoming increasingly prevalent, that social, moral, cultural or even political values are shared by individuals or groups who come from different geographical regions and territories;
- Information and mis-information campaigns have the ability to, and actually have, influence entire States or nations, irrespective of the fact that such conduct is often initiated and channelized through privately funded small groups of people.

2.3.2 Cyber activity and international involvement

- In one recent instance, when the United States failed to take cognizance and protect the interests of its legitimate (or, officially backed) hacker, one US hacker took down the internet of North Korea.[65] Apart from apparent jurisdictional issues involved in such cyber action, this would also highlight instances of lacunae in international liability regimes,[66] as well as gray areas in State's actions towards regulating or preventing such conduct on either sides;

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[64] Space Watch Africa, "Rwanada files at ITU for nearly 330,000 Satellites" (22 October 2021), online: Space Watch Global < https://spacewatch.global/2021/10/rwanda-files-at-itu-for-nearly-330000-satellites/>.

[65] David Winder, "One American Hacker Suddenly Took Down North Korea's Internet—All Of It" (5 February 2022), online: Forbes < https://www.forbes.com/sites/daveywinder/2022/02/05/one-american-hacker-suddenly-takes-down-north-koreas-internet-all-of-it/?sh=56de9c166698>.

[66] While this particular instance could be construed as some form of individual self-defense, had the situation been the case of this hacker being an aggressor and causing transboundary harm or damage, in one of the recognized ways under international law and another State would have made a claim of liability, the United States has held the view that it is not liable for the actions of its private entities, including those of its citizens –this leaves a potential lacuna in the uniform application of liability in such instances of cross-border cyber action. See, for example, the written comments submitted by the United States of America to the International Law Commission, A/CN.4/481, para. 24. See also the statement of that delegation in the Sixth Committee, A/C.6/51/SR.39, paras. 31–33: "The United States did not believe that "under customary international law, States are generally liable for significant transboundary harm caused by private entities acting on their territory or subject to their jurisdiction or control". It

- Hacker Collective, an anonymous hacking group across different countries and States, recently united to wage cyber war against Russia to deter potential aggravation in the Russia/Ukraine military conflict[67];

The implications of these actions, as could be traced by a few simple examples, is huge in the sense that it has the ability to toss established regimes of international state responsibility, liability, jurisdiction, etc. upside down.[68] In short, these activities are *sans* jurisdiction, with cyber domain being recognized as a complete domain in itself, with the further ability to dissolve traditional state-sovereignty based boundaries and its associated legal concepts, principles and implications. These activities, having the potential of being initiated from anywhere in the world has the ability to affect any State or its actors or individuals in any other part of the world. They are moreover very hard to trace. All of this makes the aspect of 'attribution', which is crucial under the Articles of State Responsibility, improbable if not impossible.[69] Likewise, as can be gauged through the declarations and actions of a few politically influential States, such as United States,[70] the prevalent views pertaining to liability remains that such States consider themselves not liable for the actions of its private individuals.

2.3.3 Artificial intelligence

- All of the issues pertaining to cyber activities highlighted in the preceding section 2.3.2 has the potential to only multiply itself, presenting newer and unforeseen challenges and complexities, in the context of use and operation of AI technologies and systems. Instead of a human being conducting such activities, with associated limitations such as burn-out issues, time constraints, survival instincts, legal compulsions, moral or

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added that, "from a policy point of view, a good argument exists that the best way to minimize such harm is to place liability on the person or entity that causes such harm, rather than on the State." [*US Liability claim*].

[67] The Guardian, "Anonymous: the hacker collective that has declared cyberwar on Russia" (27 February 2022), online: The Guardian < https://www.theguardian.com/world/2022/feb/27/anonymous-the-hacker-collective-that-has-declared-cyberwar-on-russia>.

[68] Cyber capabilities offer the perfect means for covert operations and enable authors of many cyberoperations to hide under the invisibility cloak of plausible deniability. See, for example, Marco Roscini, "Cyber operations and the use of force in international law", (Oxford University Press: 2014), at 38, 40, 75; See also, U. Tatar, A. Georgescu, & K. Geers, "Strategic Approach to a Fierce Domain: Findings from the Advanced Research Workshop," in *Strategic Cyber Defense: A Multidisciplinary Perspective*, (IOS Press, 2017), at 1–15: "Cyber threats are asymmetric; attackers can hide their acts easily, and compared to conventional threats, cyber threats are extraordinarily cheap and prevalent...".

[69] ILC, *Articles on Responsibility of States for Internationally Wrongful Acts*, 53 UN GAOR Supp (No. 10) at 43, UN Doc. A/56/83 (2001), [Articles on State Responsibility], arts. 4 – 11.

[70] See, US Liability claim, *supra* note 66.

ethically subjective views or bias, and other human factors such emotional intelligence, etc., intelligent machines could be trained to conduct such cyber operations without any limitation whatsoever.

- In addition, as stated in the chapter I, section 1.2 above, the 'personal zone of influence' of an AI creator or operator has the likely potential to have effect on the entire international community. Due to huge costs involved in research in Simple AI Phase I or even early phases of Phase II, researchers working towards advanced stages of Phase II ML systems (or even Phase III) are essentially picking up simulation models and research works done by an original researcher in Phase I. Thus, for example, simulation models or structured data of a first researcher in the United States (MIT, for example) could be picked by someone in India or China to further his/her/its progress. *Sans* sustainable objective issues at an international level, and in the context of this thesis – in space activities, the effects could be hugely enabling as well as severely and irreversibly destructive.
- Ethical issues being discussed, debated and potentially legislated upon, in the context of use of AI systems, specifically with regard to the use of AI systems in multinational corporations – such as the issue of Dr. Gebru's resignation from Google's Ethical AI team, primarily emerges from a concept known as 'stochastic parrots'[71]. Stochastic parrots is a term being used where an AI or ML system essentially replicates any bias held by its creator or developer in generation of text strings.[72] In this, an AI system or ML system progressively presents its views without any regard to the meaning associated to such views, which meanings could vary from person to person, and societies to societies. As is normally the case in the internet age, this dissemination of information to the entire international community, with varied meanings and interpretations of what bias in itself is[73], has resulted in large-scale ethical implications in the use of AI systems for human activities in terrestrial domains.
- Likewise, in the context of ethical issues, the environmental cost of training and simulating large-scale language models also varies, largely being driven by profit-

[71] Bender, *supra* note 19.

[72] Tiernan Ray, "Ethics of AI: Benefits and risks of artificial intelligence" (30 April 2021), online: ZD Net < https://www.zdnet.com/article/ethics-of-ai-the-benefits-and-risks-of-artificial-intelligence/>.

[73] The concept of bias, with the exception of a few internationally recognized notions, in itself is quite a subjective one. And thus, this requires an in-depth analysis of social, cultural and moral notions associated in a particular society. However, this is tautological when AI-based information is released or published to the entire international community as the views held by all of mankind are rarely ever the same.

> making motives of multinational corporations. For example, it is being estimated that training a large language model, a version of Google's Transformer that is smaller than Switch-C, emitted 284 tons of carbon dioxide, which is 57 times as much CO2 as a human being is estimated to be responsible for releasing into the environment in a year.[74]

And thus, for all the reasons stated above, it is now needed more than ever to incorporate and inculcate elements of socio-legal or legal consciousness research into the otherwise strictly legal and/or political domains of law enactment and regulation.

2.4 Need for Legal consciousness approach in international space law:

International space law and policies is one of the rare domains of legal regulation where the 'collective conscience' of the international community was presented and ratified as a unified set of international regulations (binding treaties) and guidelines. Moreover, space technology and domain has often been successful in avoiding the nuances of earth-based laws and its applications by designing and leading innovational forms of politico-legal management of these technologies. Although, as with any international approach, this has come with its own sets of subjective influences and limitations.

Typically, international space laws or *corpus juris spatialis* primarily comprises (i) Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space[75], (ii) space law international treaties such as Outer Space Treaty[76], Rescue and Return Agreement[77], Liability Convention[78], Registration Convention[79] and the Moon Agreement,[80] and (iii) United

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[74] Ray, *supra* note 72.

[75] 1963 Declaration of Legal Principles, *supra* note 4.

[76] Outer Space Treaty, *supra* note 4.

[77] *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, 22 April 1968, 672 UNTS 119, (entered into force on 03 December 1968) [*Rescue Agreement*].

[78] *Convention on International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187 (entered into force 1 September 1972) [*Liability Convention*].

[79] *Convention on Registration of Objects Launched into Outer Space*, 6 June 1975, 1023 UNTS 15 (entered into force 15 September 1976), [*Registration Convention*].

[80] *Agreement governing the Activities of States on the Moon and Other Celestial Bodies*, 5 December 1979, 1363 UNTS 3, (entered into force 11 July 1984) [*Moon Agreement*].

Nations principles and declarations.[81] Moreover, Article III of the Outer Space Treaty[82] has incorporated principles of the United Nations Charter[83] as well as relevant principles of general and customary international law into this framework.[84]

However, the last of the agreement(s) or treaty-law, as per the meaning contained in the Vienna Convention of the Law of Treaties ('VCLT')[85], was enacted in 1979. When space technologies were new and being introduced in the cold-war era, marked by increasingly volatile and ever-changing political commitments and stances of the sovereign nations and the international community, binding treaties were adopted and enacted to govern space technologies to maintain certainty. In addition, the Travaux Préparatoires or preparatory works of these treaties, and specifically the Outer Space Treaty as an example, which forms one of the basis of interpretation of the text of the Treaty itself,[86] is replete with statements and positions mostly by United States and Russia [then USSR], and with a few other States which mostly sided either with the United States or with Russia [then USSR].[87] This was due to the then needs of the time, by the States [other than US or USSR], to derive economic or technological assistance from US or Russia [then USSR] to begin and advance their own space programs. Notably thus, the views of Japan, China and a few other major space faring nations of today were absent from the incorporation phases of treaty-based laws in space activities. Nonetheless, they do constitute binding

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[81] United Nations General Assembly, *Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting*, UNGA Res. 37/92, UN GAOR, 37th Sess, Supp No 51, UN Doc. A/37/51 (1983) page 98, Part B; United Nations General Assembly, *Principles relating to Remote Sensing of the Earth from Outer Space*, UNGA Res. 41/65, UN GAOR, 41st Sess, Supp No 53, UN Doc. A/41/53 (1987), page 116; United Nations General Assembly, *Principles Relevant to the Use of Nuclear Power Sources in Outer Space*, UN Doc. A/RES/47/68 (1993) at 2; United Nations General Assembly, *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries*, UN Doc. A/RES/51/122 (1997) at 2 [*Benefits Declaration*].

[82] Outer Space Treaty, *supra* note 4, at art. III: "States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding."

[83] *Charter of the United Nations*, 26 June 1957, 1 UNTS XVI, (entered into force 24 October 1945) [*UN Charter*].

[84] See generally, Ram S. Jakhu, Steven Freeland & Kuan-Wei Chen, "The Sources of International Space Law: Revisited", (2018) 4 ZLW 67, at 606.

[85] See, generally, VCLT, *supra* note 33.

[86] *Ibid.*, at art. 32.

[87] See generally, Travaux Préparatoires to the Outer Space Treaty, online: United Nations Office for Outer Space Affairs <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/travaux-preparatoires/outerspacetreaty .html>.

international law,[88] and subsequently a large number of States have signed and ratified most of the treaties, thus conveying their acceptance to be bound by these laws.

From an academic research point of view though, one does indeed find elements of Identity schools of thought and hegemonial nature of conduct of space activities of a few States. For example, the identity and conduct of space faring nations are largely different and varied from the rest of international community. Likewise, arguably unethical (if not unlawful, when evaluated on the basis of legal provisions in treaty-law) conduct of some States, in the specific conduct of anti-satellite tests and creation of space debris is also indicative of hegemonial conduct of these States. Moreover, notably this approach is being followed till date. To state a few examples:

- While the Moon Agreement, with its non-discrimination principles and Moon and its natural resources being common heritage of mankind,[89] has seen significant less participation by the international community, the most recent venture of the United States in the form of Artemis Accords portrays a somewhat hegemonial conduct.[90] This Accord has been initiated despite provisions in the Outer Space Treaty pertaining to 'free access to all areas of celestial bodies' and prohibition in the form of 'the moon and other celestial bodies [are] not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.'[91] The debated and problematic portions in Section 11 of this Accord pertains to establishment of 'safety zones', and this is being seen as problematic when analyzed as per provisions in the Outer Space Treaty. While this accord has eighteen (18) signatories so far, it is often seen that the views held and conduct of select space faring nations in space activities have largely dominated the way forward in establishing international legal regimes as well as guidelines in outer space.

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[88] VCLT, *supra* note 33, at art. 26: "Every treaty in force is binding upon the parties to it and must be performed by them in good faith."

[89] Moon Agreement, *supra* note 80, at arts. 4(1), 6(1), 11(1),(2),(3),(4).

[90] Alexander Stirn, "Do NASA's Lunar Exploration Rules Violate Space Law?" (12 November 2020), online: Scientific American: https://www.scientificamerican.com/article/do-nasas-lunar-exploration-rules-violate-space-law/>, stating: " The Artemis Accords are NASA's rules to which all international partners must adhere if they wish to participate in the space agency's Artemis program ... According to NASA, those who do not agree to the accords cannot participate ... Its 13 sections seem to show that the rules are about the use and exploitation of the moon in order to maintain American dominance, possibly undermining international law ... 'The Artemis Accords are an attempt by the Americans to walk softly to legitimize their deviation from the Outer Space Treaty', ... There are a few countries that are not satisfied with the interpretation of [binding treaty] law. So they create guidelines with the hope that eventually they will develop into customary law that will weaken the existing space law. That's a really clever maneuver.".

[91] Outer Space Treaty, *supra* note 4, at arts. I, II.

- Similarly, the 'identity' held and 'hegemony' displayed by United States, China, India and Russia in conduct of anti-satellite tests are a case in point. Despite provisions in the Outer Space Treaty, (i) with its peaceful purposes provision[92], and (ii) regarding 'exploration and use of outer space' to be carried out for the benefit and interests of all countries, and with outer space being considered as province of all mankind[93]; and (iii) obligation of prior consultation stipulated in Article IX of the Outer Space Treaty; these provisions were arguably ignored in the conduct of these tests. Moreover, no attention whatsoever was accorded to the Space Debris Mitigation Guidelines, both by the Inter-Agency Debris Coordination Committee (IADC) as well as its adoption by the UN[94], in the conduct of these tests.
- Due to geo-political, economic, legal and other related factors and disagreements, draft PPWT treaties[95] initiated by China and Russia has constantly been rejected by the United States and other allied States.

This 'dualistic' and identity-based hegemonial conduct of either sides, transpiring and gaining expression on and from the cold-war era, continues till date. Moreover, when binding treaties and their adoption stalled or dried up, international community took to adopting declarations and principles, as noted above. For other aspects of regulation of space activities where principles or declarations were not favoured, the international community has been passing annual United Nations General Assembly resolutions to indicate its preference. Notable instruments in this regard are PAROS Resolutions[96], Resolutions for International Co-operation in the peaceful uses

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[92] See, for example, Peaceful purpose, *supra* note 33.

[93] Outer Space Treaty, *supra* note 4, at art. I.

[94] United Nations Office for Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, (endorsed by the United Nations General Assembly Resolution 62/217 of 22 December 2007, United Nations General Assembly, International cooperation in the peaceful uses of outer space, adopted 22 December 2007, UN Doc. A/RES/62/217, para 26), (UN, Vienna, 2010), online: United Nations Office for Outer Space Affairs < https://www.unoosa.org/pdf/publications/st_space_49E.pdf>; Inter-Agency Space Derbis Coordination Committee, *IADC Space Debris Mitigation Guidelines*, Revision 3 (June, 2021), IADC-02-01. [*Space Debris Guidelines*].

[95] Conference on Disarmament, *Letter dated 12 February 2008 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Secretary General of the Conference transmitting the Russian and Chinese texts of the draft "Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT)" introduced by the Russian Federation and China*, UN Doc. CD/1839 (29 February 2008); Conference on Disarmament, *Letter dated 10 June 2014 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Acting Secretary-General of the Conference transmitting the updated Russian and Chinese texts of the draft "Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT)" introduced by the Russian Federation and China*, UN Doc. CD/1985 (2014).

[96] See, for example, United Nations General Assembly, *Prevention of an arms race in outer space*, UNGA Res. 36/97, UN GAOR, 36th Sess, Supp No 51, UN Doc. A/RES/36/97[C] (1981); United Nations General Assembly,

of outer space[97], etc. In urgent issues concerning and highlighting the duties to protect the space environment, and particularly with regard to sustainable developments in space activities which concerns the rights and interests of all of mankind, guidelines have been adopted. The Space Debris Mitigation Guidelines as well as its wide-scale adoption by States in their national legislations[98] as well as by the private space industry has been considered akin to legal regulation of the subject matter. Likewise, similar to the UN Sustainability Agenda, 2030, for space activities, the Guidelines on the Long Term Sustainability of Space Activities[99] have been formulated to detail and charter sustainable principles and guidelines in management of the space ecosystem (please see Chapter IV for more details). These guidelines and its subsequent adoption through resolutions of the UNGA, although non-binding, signify and state political commitments. When incorporated into national legislations, they have often been able to regulate specific areas of space conduct and activities.

All of this could be said to be a departure from strictly legal instruments (binding international treaties and conventions of the last century) to instruments that capture and reproduce social, political, economic and other elements being currently favoured by the international community as a whole. Other social elements of research in the organization, regulation and conduct of space activities have influenced:

No first placement of weapons in outer space, UNGA Res. 72/27, UN GAOR, 72nd Sess, Supp No 49, UN Doc. A/RES/72/27 (2017).

[97] See, for example, United Nations General Assembly, *International Cooperation in the Peaceful Uses of Outer Space,* UNGA Res. 76/76 (adopted 9 December 2021), UN Doc. A/RES/76/76 (15 December 2021), United Nations General Assembly, *International Co-operation in the Peaceful Uses of Outer Space,* UNGA Res. 74/82, UN Doc. A/RES/74/82 (2019); United Nations General Assembly, *International Co-operation in the Peaceful Uses of Outer Space,* UNGA Res. 73/91, UN Doc. A/RES/73/91 (2018); and so on.

[98] See United Nations Office for Outer Space Affairs, *Compendium of space debris mitigation standards adopted by States and international organizations*, Part 1: National mechanisms, online: United Nations Office for Outer Space Affairs <http://www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html>. For a few examples in the international context, see, International Organization for Standardization, *Standard 24113 'Space systems – Space debris mitigation requirements'*, ISO Reference Number 24113:2019(E), (3rd edition, July, 2019); European Code of Conduct for Space Debris Mitigation, Issue 1.0 (28 June 2004). For national legislations, see, China, *Space Industry Standard* - Orbital Debris Mitigation Requirements, QJ3221-2005, (came into effect in 2006, and revised in 2015); Russia, *Space Technology Items. General Requirements for Mitigation of Near-Earth Space Debris Mitigation*, GOST R 52925-2018, adopted by Order of the Federal Agency for Technical Regulation and Metrology Order No. 632-st of 21 September 2018, effective as of 1 January 2019; France, Decree on Technical Regulation issued pursuant to Act n°2008-518 of 3rd June 2008, 31 March 2011, at arts. 21, 40; Canada, *Remote Sensing Space Systems Act*, Statutes of Canada 2005 (SC 2005), 5 November 2005, c 45, at s 9 "System disposal plan and arrangements."; United States Government, *Orbital Debris Mitigation Standard Practices*, November 2019 Update, Objective 4: Postmission disposal of space structures, online: < https://orbitaldebris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf>.

[99] United Nations Committee on the Peaceful Uses of Outer Space, *Guidelines for the Long-term Sustainability of Outer Space Activities*, adopted in June, 2019, UN Doc. A/AC.105/C.1/L.366 [*Long-term Sustainability Guidelines*].

- Views of States regarding voluntary provisions in international space law such as registration of space objects, jurisdiction and nationality, on-orbit transfer of satellites and ownership, etc. and their compliance by individual States, has elements of legal consciousness or socio-legal research aspects within it. Thus, the United Nations Office for Outer Space Affairs ('UNOOSA') has been regularly asking States to provide 'response to questionnaires' on the practical application of the five United Nations Treaties.[100] The United Nations General Assembly has also been providing recommendations for enhancing the practice of States and international intergovernmental organizations in registering space objects to supplement the treaty provisions.[101]
- Similarly, the International Telecommunication Union (ITU) and its regulation of radio communications present a crude and evolving, but potent example of a co-constitutive model in application of relational legal consciousness approach at the international level. Often seen and considered as a significant deviation from the workings of other UN bodies and agencies, participation of State governments as well as private enterprises (almost 900 'sector members' which have a seat at the decision making table) has been crucial for effective regulation of radio communications through the ITU model of governance and administration.[102] This has resulted in a situation where it is being considered as a new source

[100] See, as examples, *Responses to the set of Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space*, Committee on the Peaceful Uses of Outer Space, UN Doc. A/AC.105/C.2/2012/CRP.11 (22 March 2012); *Responses to the set of Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space*, Committee on the Peaceful Uses of Outer Space, UN Doc. A/AC.105/C.2/2013/CRP.13 (27 March 2013); *Responses to the set of Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space*, Committee on the Peaceful Uses of Outer Space, UN Doc. A/AC.105/C.2/2013/CRP.18 (08 April 2013); *Responses to the set of Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space*, Committee on the Peaceful Uses of Outer Space, UN Doc. A/AC.105/C.2/2015/CRP.11 (10 April 2015); *Responses to the set of Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space*, Committee on the Peaceful Uses of Outer Space, UN Doc. A/AC.105/C.2/2017/CRP.6 (23 March 2017); *Responses to the set of Questions provided by the Chair of the Working Group on the Status and Application of the Five United Nations Treaties on Outer Space*, Committee on the Peaceful Uses of Outer Space, UN Doc. A/AC.105/C.2/2018/CRP.12 (06 April 2018);

[101] See, for example, *Registration of space objects: harmonization of practices, non-registration of space objects, transfer of ownership and registration/non-registration of "foreign" space objects*, UN Doc. A/AC.105/867 (19 January 2006), II; United Nations General Assembly, *Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects*, UNGA Res. 62/101, 17 December 2007, UN Doc. A/RES/62/101 (10 January 2008).

[102] Kristen Cordell, "The International Telecommunication Union: The Most Important UN Agency You Have Never Heard Of" (14 December 2020), online: Center for Strategic and International Studies < https://www.csis.org/analysis/international-telecommunication-union-most-important-un-agency-you-have-never-heard>.

of international law,[103] while others are seeing this on a continuum scale, where at the very least, the principles of prior consent and non-interference have the potential to be considered, or are already being considered customary.[104] Ofcourse, in the absence of a judicial determination of its customary nature by the International Court of Justice, the point regarding its customary nature yet remains uncontested, and thus unproven. This presents more reasons and opportunities to argue for the need for legal consciousness research and approach in the field of space laws: in addition to evaluating the potency of binding international treaties, it would assist in evaluating the increasing role of private sector in practical aspects of legal implementation in the new space age 4.0,[105] where almost two-third of all activities conducted in the space domain are by non-State actors.

- At the 'individual stakeholder' model, although typically seen as non-entities in international space law regime, the work of individual associations such as astronomical societies, community of concerned scientists, etc. have, at least twice, been extremely relevant in providing push-back or deterrence to otherwise reckless actions of the United States government. The first instance was that of Project Westford[106], where this community was active in voicing concerns regarding interference with their studies on optical and radio astronomy. Their concerted actions led to issuance of a resolution "to all governments . . . launching space experiments which could possibly affect astronomical research" to consult with the IAU before conducting such experiments,[107] with the United States announcing subsequently that it would conduct no such experiments until the results were fully realized and in any case without proper scientific safeguards. It is this precedent created by the United States and this community of scientists and astronomers that laid the foundation for Article

[103] Jens Henricher, "The Law-Making of the International Telecommunication Union (ITU) - Providing a New Source of International Law?", (2004) ZaöRV 64 at 489.

[104] Sarah M. Mountin, "The Legality and Implications of Intentional Interference with Commercial Communication Satellite Signals", (2014) 90 Int'l L Stud 103 at 172.

[105] European Space Agency, "What is Space 4.0", online: European Space Agency < https://www.esa.int/About_Us/Ministerial_Council_2016/What_is_space_4.0>, stating, "Space 4.0 era, a time when space is evolving from being the preserve of the governments of a few spacefaring nations to a situation in which there is the increased number of diverse space actors around the world, including the emergence of private companies, participation with academia, industry and citizens, digitalisation and global interaction. Space 4.0 represents the evolution of the space sector into a new era, characterised by a new playing field. This era is unfolding through interaction between governments, private sector, society and politics. Space 4.0 is analogous to, and is intertwined with, Industry 4.0, which is considered as the unfolding fourth industrial revolution of manufacturing and services.".

[106] Project West Ford of the United States aimed to study the effects on global radio communications of dispersing a network of five hundred thousand tiny copper metal strips (dipoles) into a short-lived orbit.

[107] Mountin, supra note 104, at 149.

IX of the Outer Space Treaty.[108] Most recently, with respect to light pollution issues due to launch of satellite constellations, the community of astronomers and astronomical societies, with (i) the support of United States National Science Foundation and Noirlab[109], as well as subsequently of (ii) UNOOSA United Nations Office for Outer Space Affairs in collaboration with International Astronomical Union[110], have once again raised various issues pertaining to launch of satellite constellations. These initiatives have allowed dominant space industry actors of the day (SpaceX, OneWeb, Amazon, etc.) to directly interact and understand technical problems raised by these associations, and try to resolve differences and concerns without the need for State involvement. Moreover, while international space law has typically been an activity-centric legal system (with international responsibility placed for States' regulation of national space activities along with authorization and continuing supervision, liability placed on the act of launching, etc.), this community is now advocating for, in part and as one of the potential options, domain [space] specific laws and regulations, including 'in-orbit regulation'[111] of space activities. Thus, the actions and activities of these societies and individuals and concerned scientists forms elementary, yet early components of the individual stakeholder model, which notes individual actors as an integral part. Particularly in light of introduction of new technologies such as cyber activities and artificial intelligence, this approach may be desirable for effective regulation of certain components of space activities in the foreseeable future. With the UNESCO's Ethics of AI document[112] laying down only ethical responsibility and liability (with no legal provisions for liability, responsibility, etc.) the concerted actions of individual actors may largely be enabling to counter the otherwise hegemonial nature of conduct of space activities, and to offer expansions or explanations of what ethical responsibility and liability entail for actors in the AI systems life cycle.

Elements of socio-legal research or legal consciousness approach would thus look at how the international community approaches and deals with recent advances in technology. For example,

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[108] *Ibid.*, at 150.

[109] United States National Science Foundation – NoirLab, "SATCON 2 Working Group Reports", 12-16 July, 2021, online: Noirlab < https://noirlab.edu/public/media/archives/techdocs/pdf/techdoc033.pdf> [*Satcon2*].

[110] United Nations Office for Outer Space Affair, "Dark and Quiet Skies II for Science and Society: Working Group Reports", online: Noirlab < https://noirlab.edu/public/products/techdocs/techdoc051/>.

[111] Satcon2, supra note 109, at 4, 1.3 "Considerations regarding orbit as an environment"; 44, 5.1.2 "Impact of On-Orbit Operations in Outer Space as Distinguished from the Environmental Impact of Launch and Re-entry of Launch Vehicles; Legal Policy and Support".

[112] UNESCO Ethics of AI, *supra* note 13.

if a strictly binding international treaty regime even possible anymore? how is a legal instrument of modern day society look like? Or, how is it perceived and implemented?[113] Or, what is its relational value, as compared to other actors in a field? It would also require involvement of a sectoral issue as to how such instruments treat or regard the views of the most marginalized sections i.e. how it addresses or protects the identities and views of non-space faring nations or technologically least advanced states in the field of AI systems. In addition, due to large scale nature and operations of few non-State actors (private entities – business sector – multinational corporations) in space activities, their distinct identities (irrespective of the identity held by their appropriate State(s) in the international community) has the potential of (and is also in fact[114]), as is being put forth by this researcher, becoming a relevant unit of assessment and evaluation.

Thus, there is a need to inculcate legal consciousness research and approaches in the sphere of space activities. The 'relational' legal consciousness approach is more suited to advancements in space activities, as well as in AI systems, with its need for incorporation and induction in a phase-wise, gradual and transient manner. The 'continuum' approach departs from one-size-or-theory-fits-all to a more result and objective oriented approach. States retain their largely international presence in the first side of the continuum, in their participation in multilateralism and in international political and legal commitments. However, as we move towards the co- middle range of the continuum in the New Space Era 4.0, with private sectors' space activities even surpassing the activities of many space faring nations, the identity of such private corporations may take on the form of distinct and separate identities (co-constitutive model, e.g., the ITU model of governance of radio communications). Even at this stage, the individual stakeholder model at the other extreme is of vital importance.

2.5 Desirability of legal consciousness approach in the face of geo-political situations and economic developments, and in the evolving international treatment of new technologies

While it is not this researcher's aim to highlight the conduct of a specific state such as the United States (or even China, India or other European powers), however, the needs of the day require specific evaluation of actions of certain States simply because their laws are more transparent, detailed and nuanced, and also have usually led to other States adopting similar laws. Moreover,

[113] For, even in the case of binding international treaties in space laws or even in other areas of human activities, its international implementational aspects have always been the weakest link.

[114] See, for example, discussions above on laws and regulations of the International Telecommunication Union.

as example, the most dominant private actor is SpaceX, which is a private entity of the United States ('US'). Thus, highlighting or assessing (or providing a critique, or, in some cases an explanation) some of the actions of the US and its private entities is being done solely on a 'need basis'. With Russia losing its international influence in the space sector (as compared to USSR presence in the 1970s and 80s), and mostly broad policies and often secretive actions and conduct by China in their space ventures, and the often neutral stance adopted by India as well as a few other European powers; evaluation of United States and its regulatory action is a suitable mechanism to trace certain issues to its root causes. The introduction, incorporation and operation of new technologies such as AI systems and technologies are also predicted to be dominated by China and North America, with economic gains from such use expected to be the strongest in these regions and representing 70 percent of AI's global impact.[115] Moreover, as with space activities, AI systems also have a 'winner takes it all dynamics',[116] which needs to be appropriately addressed and regulated. Thus there is need for certainty and uniformity in laws and policies, while all indications in the geo-political situation around the world of today points towards a transient international geo-political environment titled towards (or biased in favour of) assertions and actions of a few States (or, dominance of their private sector), and even in space conduct and activities. Increasingly, the international community is realizing and coming to terms with this fact, with even a few of NATO countries, typically aligned with the US, have, in the sector of space activities, asserted in recent times that small constellations of US and China are essentially land grab of low-earth orbits and that they are deeply linked with sovereignty issues.[117]

2.5.1 High priority being accorded to economic gains as opposed to sustainable objectives:

As a simple example of how political and economic interests have affected space policy is in United State's treatment of SpaceX. Selective or no application of terrestrial laws has allowed SpaceX to become the most dominant entity, not just in the US but in the entire world, where more than one-third of all active satellites belong to SpaceX. This is despite the US being one of the foremost States to bring into effect anti-trust laws. With market share of SpaceX being more than 90 percent in the US, these numbers likely justify at least regular scrutiny and appropriate

[115] UNESCO Ethics of AI, *supra* note 13.

[116] *Ibid.*

[117] Peter B. De Selding, "French Space Command: Europe must react to U.S., Chinese constellations' land grab in low Earth orbit" (21 June 2021), online: Space Intel Report < https://www.spaceintelreport.com/french-space-command-europe-must-react-to-u-s-chinese-constellations-land-grab-in-low-earth-orbit/>.

checks and balances as per competition laws or anti-trust laws in most jurisdictions (or States) in the world. However, under Section 2 of the Sherman Act (15 USC s 2), monopoly power is not prohibited but monopolization or attempted monopolization is checked (i.e. in addition to monopoly power, it is required that there must be anti-competitive conduct that helps to obtain or maintain that power). Section 5 of the Federal Trade Commission Act (15 USC s 45) prohibits unfair methods of competition; however, there is no indication of any scrutiny under this provision as well for SpaceX. Moreover, with SpaceX enjoying governmental contracts on a regular basis, there is also a reasonable probability that it would not generally be subject to scrutiny and checks and balances, as other entities (private corporations) which usually are constrained to operate within the parameters of market laws and balancing (or competing) economic forces. Such practices have allowed a single entity to dominate (and sometimes dictate) space conduct, adding to the hegemonial approach which was already being pursued by the United States governmental entities.

Unlike the early days of the aviation industry when air supremacy was equated with sovereign dominance, if we are to prevent a repetition of the same dominant approach by private entities and corporations in the space domain, attention needs to be paid to the early approach and conduct of dominant business enterprises in space ecosystem. Unlike the aviation industry though, where airspace above the ground has been considered as sovereign territory[118], international space law stipulates a common benefit for mankind approach[119], and space being the domain (territory) of all of mankind subject to non-appropriation principle.[120] Thus, unless appropriate checks and balances are incorporated even in the conduct of non-State actors and in a timely manner, all of this could have disastrous consequences for the international community. In a rather hurried approach towards asserting business dominance in the space domain, SpaceX's recent actions have been rather questionable. To note a few instances:

- In 2019, a European Space Agency satellite, Aeolus Satellite, had to move out of the way of a Starlink satellite to avoid a potential collision. According to Holger Krag, head of the Space Debris Office at ESA, the risk of collision between the two satellites was 1 in 1,000 – ten times higher than the threshold that requires a collision avoidance maneuver.

[118] Paul Stephen Dempsey, "The definition and delimitation of Outer Space" (30 March 2017), online: United Nations Office for Outer Space Affairs < https://www.unoosa.org/documents/pdf/copuos/lsc/2017/tech-05.pdf>.

[119] Outer Space Treaty, *supra* note 4, at art. I.

[120] *Ibid.*, at art. II.

However, despite the ESA satellite being in-orbit 9 months prior to Starlink-44, SpaceX refused to move its satellite.[121]

- In March, 2021, SpaceX and Oneweb satellites came in dangerous proximity to each other's satellites, missing by 190 feet, as per a US Space force alert. This is after SpaceX had disabled its AI-powered collision avoidance system to let the OneWeb Satellite pass through, with no clear response as to why such collision avoidance system was disabled.[122]
- Likewise, SpaceX's AI-powered automated systems have come under criticism, with other satellite operators raising concerns that they have no way of knowing which way the system will move a Starlink satellite in the event of a close approach,[123] all of this being in the absence of any global or national authority which could compel or direct satellite operators to take action on predicted collisions.
- Space X most recently, on 3 February 2022, lost 40 out of its 49 satellites to a geomagnetic solar storm.[124] This happened after it ignored warnings from concerned scientists.[125] Thus, whilst the company has filed for 12,000 satellites, and subsequently more than 30,000 satellites, for its satellite constellations, FCC & NASA's response to actions of SpaceX included asking SpaceX to demonstrate its capability to handle large volume of satellites, concerns over increasing congestion in low-earth orbits and for better coordination in launch windows.[126] It also re-iterated that the claim by SpaceX that probability of collision of its satellites is zero is being disputed.[127] Moreover, despite recommendations in the

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[121] Jonathan O'Callaghan, "SpaceX Declined To Move A Starlink Satellite At Risk Of Collision With A European Satellite" (2 September 2019), online: Forbes <https://www.forbes.com/sites/jonathanocallaghan/2019/09/02/spacex-refused-to-move-a-starlink-satellite-at-risk-of-collision-with-a-european-satellite/?sh=715453341f62>.

[122] Joey Roulette, "OneWeb, SpaceX satellites dodged a potential collision in orbit" (9 April 2021), online: The verge <https://www.theverge.com/2021/4/9/22374262/oneweb-spacex-satellites-dodged-potential-collision-orbit-space-force>.

[123] *Ibid.*

[124] BBC News, "SpaceX loses 40 satellites to geomagnetic storm a day after launch" (9 February 2021), online: BBC <https://www.bbc.com/news/world-60317806>.

[125] Jeffrey Kluger, "Solar Storm Knocks 40 SpaceX Satellites Out of the Sky, After the Company Ignored Scientists' Warnings" (10 February 2022), online: Time <https://time.com/6146986/space-x-satellites-solar-storm/>.

[126] United States Department of Commerce, *Letter dated 8 February issued by Federal Communications Commission issued to Space Exploration Holdings, LLC*, 8 February 2022, Report No. SAT-01598 Space Station Applications Accepted for Filing, Space Exploration Holdings, LLC (SAT-AMD-20210818-00105) [*FCC & NASA Letter to SpaceX*].

[127] *Ibid.*

Guidelines for Longer Term sustainability in space activities[128], it appears that no attention is being paid towards space weather and its effect on satellite constellations.

While all of this is still a salvageable issue, the application of artificial intelligence systems and technologies coupled with the rather hegemonial and dominant, and at times negligent, actions of some of the private entities in the space ecosystem, and in the backdrop of the ever increasing problem of space debris or space junk, is likely to present nuances and complexities unforeseen before. Thus also, socio-legal research and approaches, using legal consciousness approach, for an effective and nuanced evaluation of actions of non-State actors by all relevant and involved stakeholders seems to be one of the urgent needs of the day.

In an otherwise profit-motive based and dominated space ecosystem, setting up of sustainable objectives for use and operation of AI technologies, potentially in a Space Situational Awareness (SSA) system or a Space Traffic Management (STM) system should be taken up on an urgent basis. As an example, let's assume that SpaceX follows a strictly capitalist and business model, with profit-making as its chief objective. In this context, if the right (internationally agreed upon) objectives are not fed to its AI systems (including for ML), and a purely profit or business model is fed to its systems, it is likely that its AI systems would strictly preserve its own satellite constellation, even at the cost of more damage to other satellite operators, companies, States and to the entire international community. Thus, if say, its AI systems predict that a crash between SpaceX and Oneweb satellite is likely to happen again, and there is no possible way to avoid the crash, a strictly business oriented approach will activate SpaceX constellations, through its AI-powered collision avoidance maneuver system, in such a way that minimum harm is caused to its own constellations, even at the cost of grave harm to the international community. While, on the other hand, a sustainable approach/objective would look for the best solution for all of mankind. Currently, there are no such safeguards in international law and policy to ensure sustainable objectives.

[128] Long-term Sustainability Guidelines, *supra* note 99, at Guidelines B.6, B.7.

2.5.2 International treatment of cyber activities and cyber security presents significant challenges for legal adaptation for AI systems

Cyber threats with diverging interests and capabilities are expanding and transforming at an unprecedented speed, and they encompass space systems.[129] The functioning of modern satellite systems is increasingly reliant on cyber technology. Internet-based networks are used in space assets, including the operation of satellites. This connection can turn those assets into 'devices on the Internet of Things'. This also makes space assets more accessible and vulnerable from anywhere in the world to any adversary with access to the Internet. Cyberattacks targeting a satellite's controls, reliability, or bandwidth availability would pose a compelling challenge to critical national infrastructure.[130] Moreover, as satellites provide for provision of internet services to many critical national infrastructure, cyber vulnerabilities and threats exist at the user segment levels as well.

Even though a call on the need to "create a global culture for cybersecurity"[131] was initiated by the UNGA as early as December 2002, the nature of cyber operations and its protection are supported by the cyber norms noted in the General Assembly Resolutions 65/41 (adopted 8 December 2010)[132], 68/243 (adopted 27 December 2013)[133], and 70/237 (adopted 23 December 2015)[134]. These resolutions contain evidence of emerging principles formed by consensus of the States represented in the United Nations Group of Governmental Experts (UN GGE) on Developments in the Field of Information and Telecommunications in the Context of International Security.[135] However, it is important to note that a specific mandate provided

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[129] Gokhan Ikitemur, Bilge Karabacak & Andy Igonor, "A Mixed Public-Private Partnership Approach for Cyber Resilience of Space Technologies", in U. Tatar et al, eds, *Space Infrastructures: From Risk to Resilience Governance*, (2020: IOS Press) 120, at 123.

[130] *Ibid.*

[131] United Nations General Assembly, *Creation of a global culture of cybersecurity*, UNGA Res. 57/239, 20 December 2002, UN Doc. A/RES/57/239 (31 January 2003).

[132] United Nations General Assembly, *Developments in the field of information and telecommunications in the context of international security*, UNGA Res. 65/41, adopted 8 December 2010, UN Doc. A/RES/65/41 (11 January 2011).

[133] United Nations General Assembly, *Developments in the field of information and telecommunications in the context of international security*, UNGA Res. 68/243, adopted 27 December 2013, UN Doc. A/RES/68/243 (9 January 2014).

[134] United Nations General Assembly, *Developments in the field of information and telecommunications in the context of international security*, UNGA Res. 70/237, adopted 23 December 2015, UN Doc. A/RES/70/237 (30 December 2015).

[135] United Nations, *Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security*, UN Doc. A/65/201 (30 July 2010); United Nations, *Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security*, UN Doc. A/68/98 (24 June 2013); United Nations,

directly to the Secretary General of the United Nations, through UN General Assembly Resolution 70/237 (adopted 23 December 2015), whereby the Secretary-General appointed a group of governmental experts from 25 States to consider and prepare a report on the basis of previous recommendations of the UN GGE, came back without a consensus report.[136]

Moreover, on and from 2018, there has been a significant bifurcation in the working of these group of governmental experts. The first is through a resolution titled 'Advancing responsible State behaviour in cyberspace in the context of international security', through its resolution 73/266.[137] This resolution calls upon member states to be guided by the erstwhile consensus reports of the UN GGE; however, requests the Secretary General to form another group of governmental experts with the mandate stipulated in paragraph 3 of this resolution. And thus, the Secretary General constituted another UN GGE with 25 selected member States. Accordingly, the first report of this GGE on 'Advancing Responsible State Behaviour in Cyberspace in the Context of International Security' has been published as a consensus report.[138] ('2021 UN GGE Report'). Likewise, in parallel, in 2018, the United Nations General Assembly also adopted another resolution, being Resolution 73/27, titled 'Developments in the field of information and telecommunications in the context of international security'.[139] This constituted the United Nations Open-Ended Working Group (UN OEWG), and its membership was open to all the Member States of United Nations. A final substantive report ('2021 UN OEWG Report') has been published in the form of a conference room paper on 10 March 2021.[140]

In summary, and most notably, these groups and the various resolutions in support have only been able to garner international consensus on making certain UN Charter provisions applicable to ICT-based communication technologies, with some developments on the elements of 'attribution' i.e. 'the incident's technical attributes; its scope, scale and impact; the wider context,

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Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security, UN Doc. A/70/174 (22 July 2015).

[136] United Nations, Report of the Secretary General, *Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security*, UN Doc. A/72/327 (14 August 2017).

[137] United Nations General Assembly, *Advancing responsible State behaviour in cyberspace in the context of international security*, UNGA Res. 73/266, adopted 22 December 2018, UN Doc. A/RES/73/266 (2 January 2019).

[138] United Nations, *Report of the Group of Governmental Experts on Advancing Responsible State Behaviour in Cyberspace in the Context of International Security*, UN Doc. A/76/135 (14 July 2021).

[139] United Nations General Assembly, *Developments in the field of information and telecommunications in the context of international security*, Resolution 73/27 (adopted 5 December 2018), UN Doc. A/RES/73/27 (11 December 2018).

[140] United Nations, *Open-ended working group on developments in the field of information and telecommunications in the context of international security*, Final Substantive Report, UN Doc. /AC.290/2021/CRP.2 (10 March 2021).

including the incident's bearing on international peace and security; and the results of consultations between the States concerned. Moreover, the bifurcation in the working groups since 2018 has also been a result of geo-political situations, which has now led to a third neutral group, comprising of mostly 40 States initiate a Programme of Action (PoA) (co-sponsored by these 40 states) with a view to ending the 'dual track discussions' - namely the GGE and the OEWG - and establish 'a permanent UN forum to consider the use of ICTs by States in the context of international security'.[141]

While these simple developments have taken approximately two decades, and have concluded with much less favourable terms than required or desired, the complexities in terms of rampant and increasing quantity of cyber-attacks, jurisdiction issues, etc. have multiplied many times over, with most recent attacks and their effects described in the preceding sections. Such slow and divergent nature of the progress of international consensus, in the face of exponentially increasing and widely present cyber-attacks around the world, presents a somewhat dim picture on hopes of international consensus and agreements on legal regulation in the field of AI systems. This presents a more accurate picture on the need for legal consciousness approaches, with involvement of all relevant stakeholders, with a view to expanding or acting upon the ethical framework agreed upon by member States of UNESCO or to begin attempts at attaining international legal consensus and agreements and on a much faster footing.

2.5.3 International approach towards AI systems

There is currently no specific international framework for legal regulation of AI technologies and systems. The only form of international consensus (or, an internationally agreed upon document) is seen in the United Nations Educational, Scientific and Cultural Organization's unanimous adoption of 'Recommendations on the ethics of Artificial Intelligence'.[142] (See chapter IV for more details). Even in this document, a relational legal consciousness approach in early forms of 'individual stakeholder' model can be seen, thus making a slow but gradual move away from state-centric action plans of the past. Primarily based on ethical values, norms, responsibility and liability, it recommends that Member States engage all stakeholders (including business

[141] DigWatch, "UN OEWG and GGE", online: DigWatch Geneva Internet Platform < https://dig.watch/processes/un-gge>.

[142] UNESCO Ethics of AI, *supra* note 13. See also, UNESCO, "Recommendations on the Ethics of Artificial Intelligence" (23 November 2021, adopted by the 41st session (9 – 24 November 2021, UN Doc. SHS/BIO/REC-AIETHICS/2021, online: UNESCO < https://unesdoc.unesco.org/ark:/48223/pf0000380455>.

enterprises) in order to bring the recommendations to the attention of the authorities, bodies, research and academic organizations, institutions and organizations in public, private and civil society sectors involved in AI technologies.[143] The involvement of all stakeholders, necessary for an inclusive approach and in the context of this document have been captured as States and their governments, intergovernmental organizations, the technical community, civil society, researchers and academia, media, education, policy-makers, private sector companies, human rights institutions and equality bodies, anti-discrimination monitoring bodies, and groups for youth and children.[144]

Moreover, certain recommendations are specifically relevant in the context of space activities, and include:

- Values and principles must comply with international law, including the UN Charter, Member States' human rights obligations and internationally agreed social, political, environmental, educational, scientific and economic sustainability objectives, such as the United Nations Sustainable Development Goals,[145]
- At the international level, the most technologically advanced countries have a responsibility of solidarity with the least advanced to ensure that the benefits of AI technology such that access to and participation in the AI system life cycle for the latter contributes to a fairer world order;[146] and
- Ethical responsibility and liability (without any further information on what ethical liability implies in a legal sense) for the decisions and actions based in any way on an AI system should always ultimately be attributable to AI actors corresponding to their role in the life cycle of the AI system,[147]

National mechanisms and legislations (draft proposals, draft legislations, etc.) have been largely excluded from the scope of this thesis to make it precise and based on international principles, norms, values, etc. However, very briefly, a few observations are noteworthy:

[143] UNESCO Ethics of AI, *supra* note 13.

[144] *Ibid.*, at para 47.

[145] *Ibid.*, at para 9.

[146] *Ibid.*, at para 28.

[147] *Ibid.*, at para 42.

- The proposed regulation of the European Parliament and of the Council for laying down harmonized rules on Artificial Intelligence (Artificial Intelligence Act)[148] calls for regulation of high-risk AI systems as per its proposed Article 6. Apart from defining certain high-risk AI systems as per Union harmonization legislation in Article 6(1), it stipulates in Article 6(2) that AI systems referred in its Annex III would be classified as high-risk AI systems. However, in Annex III, there is no mention of space systems and its application as a high-risk AI system. Moreover, in the portion titled 'management and operation of critical infrastructure' in the said Annex III, such critical infrastructure has been noted to include management and operation of road traffic and supply of water, gas, heating and electricity.
- Likewise, Canada does not have central regulatory regime, and is approaching the topic of AI regulation in lines with EU's proposed framework and in the form of a 'Trustworthy Artificial Intelligence' Framework to support AI use that is accountable, safe, and rights based.[149] Canada's 'Directive on Automated Decision-Making'[150] applies only to systems that provide 'external services' as defined in the 'Policy on Service and Digital' (defining external services as 'a service that is external to the government of Canada'), and excludes automated decision systems (i.e. any technology that assists or replaces the judgment of human decision makers) operating in test environments. Moreover, the Directive itself excludes National Security Systems. In all, it is unclear where and how space activities occupy a role and place in these national incentives and directives towards AI systems.
- In United States, the Algorithmic Accountability Bill, 2019 requires companies to assess the impacts of the AI powered automated systems they use and sell, attempting to bring in transparency about when and how such automated systems are used, and empowers consumers to make informed choices about the automation of critical decisions.[151] It requires impact assessments to be made in respect of AI technologies and systems. However, it is yet to become the first federal US regulation. As also argued in earlier sections, the space activities sector and private space entities have typically been kept out

[148] European Commission, *Proposal for a Regulation for a European Parliament and of the Council – Laying down Harmonized Rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union legislative Acts*, 21 April 2021, Brussels, COM(2021) 206 final (2021/0106 COD).

[149] Ronak Shah, Morag McGreevey & Molly Reynolds, "The future of AI regulation in Canada: what we can learn from the E.U.'s proposed AI framework" (25 May 2021), online: Torys < https://www.torys.com/Our%20Latest%20Thinking/Publications//2021/05/the-future-of-ai-regulation-in-canada/>.

[150] Canada, Directive on Automated Decision-Making, 1 April 2019 (amended and modified 1 April 2021).

[151] For more details, see, United States Congress, H.R.2231 - Algorithmic Accountability Act of 2019, 116th Congress (2019-2020), online: congress.gov < https://www.congress.gov/bill/116th-congress/house-bill/2231>.

of the purview of application of terrestrial based laws in the United States, thus making it uncertain if this proposed regulation or bill would cover AI systems used in space activities.

In all of this i.e. the international UNESCO document on Ethics of AI as well as in national mechanisms and upcoming regulatory and legal instruments, the absence of any specific mention of the space ecosystem leaves the broader question of 'if an international regulatory framework could be discussed and adopted, in time, to govern use of AI systems, including for space activities?' unanswered.

Notably, as an example, the EU proposed harmonized rules, in its Annex III (high-risk AI systems being regulated as per proposed Article 6(2)) not only mentions AI systems in management and operation of critical infrastructure but also AI use in public and private sector services; law enforcement; administration of justice and democratic process; migration, asylum and border control; biometric identification and categorization of natural persons, etc., but critically omits any specific mention or applicability to the space ecosystem.

While many academicians and scholars are making a case for space ecosystem to be designated as critical infrastructure,[152] even if this is not the case, at the very least, many critical infrastructures are increasingly becoming dependent on space infrastructures. In turn, and in an inter-operable technological world, space systems are dependent on cyber systems and cyber security, which is an issue of concern to most States. Irrespective of the inextricable linkage between space and cybersecurity, cyber threats against satellites, etc. space assets are often overlooked in critical infrastructure literature.[153] AI technologies and systems have the potential to become a common denominator in all of these activities,[154] thus posing significant challenges to recognized critical infrastructures. Possibly, mobilization school of legal consciousness approach as well as relational legal consciousness approach, as has been discussed throughout this Chapter, would also be required (involving individual stakeholders) to lay out and solidify claims to classify space as critical infrastructures, or, in the alternative, to classify AI systems used and operated in the space ecosystem as high-risk activities needing centralized regulation.

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[152] Marinescu, *supra* note 6; A. Georgescu, O. Bucovetchi & U. Tatar, "Space Systems as Critical Infrastructures", 2018 6:1 FAIMA Bus. Manag. J. 24–34.

[153] G. Falco, "Job One for Space Force: Space Asset Cybersecurity." Harvard Kennedy School, Jul-2018; D. Livingstone & P. Lewis, "Space, the Final Frontier for Cybersecurity?" (2016: Chatham House); K. Suzuki, "Satellites, the floating targets," (February & March, 2016), World Today.

[154] See, for example, Marinescu, *supra* note 6, at 255.

Until this happens, it would be incumbent on the space law and policy community to adopt a 'rules of the road' approach, or other similar alternatives, to govern and regulate the use of AI technologies and systems in the space ecosystem. These approaches are also desirable to prevent hegemony in space activities to trickle down to hegemony in use and operations of AI systems and technologies supporting such space activities, to the detriment of the international community.

CHAPTER III

Artificial Intelligence systems in space activities and legal challenges

> AI Machines deal with algorithms, and they are in turn based on the parameters, and more importantly, the "objectives" set forth by the creators of AI technology. This second concept of 'setting the right objectives' assume paramount importance in today's global context. For example, if profit-making is set as an objective, computers and machines using AI would not consider environmental impacts of a business venture (for instance), as long as projected and computed models highlight that profits would in turn be generated. In this regard, AI machines are not so different from human beings.

While the structural changes in legal adaptation, as highlighted in preceding sections of Chapter II is taken up by the international community, and methods or mechanisms are devised to promote multilateralism in the field of AI, there is surely a requirement of international instrument(s) that involve or capture international consensus on legal and regulatory matters concerning AI systems and technologies. However, law often lags behind society and technological progress. Thus, in the meantime, this Chapter would present ways in which international space law and the global space governance framework could likely be tweaked, modified or re-interpreted, as per specific needs, to govern the regulation of artificial intelligence technologies in space systems or in the use of intelligent space objects. That is, until legal consciousness approaches are adapted or utilized to frame or come up with an international rules based framework for regulation of AI systems in a centralized and harmonized manner, this chapter (discussing the current potential uses of AI systems and technologies in space activities) offers ways in which the global space governance framework could be effectively used to subsume regulation of AI systems or Intelligent Space Objects ('ISOs') in an international context in the field of space activities.

Moreover, this chapter is being presented with an overall objective that while AI technology implementation in the space field might be at nascent stages, legal progress and international consensus in related and applied fields, such as cyber activities and cyber security, has been alarmingly slow. Thus, there is a need to increase awareness of issues (present as well as future)

so as to allow the international community to make gradual efforts to address these issues in all its intricacies and nuances, and in a gradual and phase-wise manner.

3.1 Uses of Artificial intelligence technologies in space activities or through space activities

The space field is also touched by the influence of AI. However, much like the early days of technological advancement in space activities, or nuclear energy sector or other forms of human activities that were, at some point in time, or still are being, considered as hazardous activities, implementation of AI systems and technologies in the space ecosystem remains largely a secretive affair. Despite this, through observing a few actions and announcements made by certain space actors as well as other public announcements, one can chalk out a few known uses of AI systems in, or through, space activities and conduct.

3.1.1 Use of AI systems in ground infrastructures

The March 2021 incident involving a close-approach of SpaceX and OneWeb satellites (a dangerous proximity of a miss of collision by 190 feet), nonetheless revealed that the collision avoidance system of SpaceX's satellite constellation is powered by AI. Although this specific incident occurred because its automated system was shut off to let the OneWeb satellite pass, this incident indicated to the world, an instance of use of AI systems, through the ground-based infrastructure of SpaceX (and without any machine extensions). Prior to this incident, in another notable incident in 2019, ESA Conducted a maneuver of its Aeolus Satellite where the probability of collision was 1 in 1000 (10 times higher than the threshold which requires a potential maneuver),[155] and SpaceX (or its collision avoidance system) refused to move its satellite.

In this, an AI powered collision avoidance system is constantly calculating and ascertaining the position of SpaceX satellites relative to other satellites in close-by neighbouring orbits. With limited transparency and public disclosures provided by SpaceX, it is yet unclear whether this AI system has the operational control to take action (or, in an appropriate situation avoid any maneuvers) without overall supervision of a human controller or human space operator. Criticisms regarding this by other satellite operators and space agencies have often been that the

[155] O'Callaghan, *supra* note 121.

system is unpredictable as they have no way of knowing which way a SpaceX satellite would be moved in the event of possible collision scenario.[156]

As we have seen in Chapter I above on discussions about theoretical aspects of Simple AI Phases I and II, if such AI systems are equipped with relevant locational space data (structured data) such as TLEs (two-line elements), an AI system or software would have the ability to predict satellite movements weeks in advance, and detect possible collision events as well as be able to intelligently perform space maneuvers (or, at the very least, alert its human operators to situations of possible collision); however, it would not have the capability of providing reasons or justifications for its actions – this is due to the fact that in ML phases, the AI systems are operating under high-level objectives and the systems are simply obeying. It does not yet have the ability of Contextual adaptation (Phase III of Simple AI) or abstraction (Phase IV), which phases provides an AI machine the ability to contextualize its actions and be able to provide justification for its action. Thus, implementation of AI technology in Phase I or Phase II ML would have likely resulted in the situation where the collision avoidance system is able to prevent a collision, however, unable to provide reasons for its action. This also translated into the actions of executives of SpaceX where they kept shut and did not provide any reasons for its actions, or a lack thereof, as to why it did not move its satellite to avoid a collision scenario with ESA's Aeolus satellite.

This is a simple example demonstrating the need for increased collaboration between AI creators and developers and space actors and agencies, including knowledge of its technical aspects. It also raises important issues, in the wake of application of machine intelligence, such as the need to collaborate more effectively, on an international level, possibly to renegotiate safety limits for collision avoidance maneuvers, amongst other things. More importantly, it requires increased transparency by space actors in their implementation of AI technology (checks and balances, safeguards, etc.) and about the level of their dependency in these technologies, such as whether AI machines have operational control, and can operate with or without human supervision.

SpaceX has, through its filings, claimed that due to its AI powered collision avoidance system, there is a zero probability of collision event in the low-earth orbits which it occupies. Typically aligned with SpaceX's views, the Federal Communications Commission and NASA, in light of the recent loss of 40 out of 49 satellites due to solar weather events, have finally disputed some of SpaceX's claim, in its most recent letter dated 8 Februrary 2022, to the extent:

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[156] See, for example, Roulette, *supra* note 122.

> "*The application states that the collision risk with large objects is zero because each spacecraft can maneuver. Zero risk is possible for any single maneuverable spacecraft if the event is mitigated down to zero probability of collision (Pc). However, considering multiple independent constellations of tens of thousands of spacecraft and the expected increase in the number of close encounters over time, the assumption of zero risk from a system-level standpoint lacks statistical substantiation...*
>
> *While SpaceX may be able to show that the auto-maneuver capability scales appropriately within the Starlink constellation, the concern remains that other vendors proposing large constellations would also use auto-maneuvering capability within altitude ranges occupied by Starlink, thereby requiring multiple autonomous constellations to maneuver out of each other's way without clearly defined rules of the road for such interactions...*"[157]

These newer risks and aspects in the use and operation of AI powered collision avoidance system requires rules of the road. As evident from NASA's observations, this also requires co-ordination and co-operation with other industry actors as well as States and governmental agencies.

3.1.2 Use of AI through a machine extension

In another example of application of AI technology, with machine extensions – whether the AI is installed in the machine extension itself or is being operated through a ground infrastructure, and in lines with the hypothetical conceptualized in Chapter I, although at very early stages of technological development, is the proposed use of CIMON (Crew Interactive Mobile Companion) in the International Space Station. CIMON is a spherical flying robot that looks like a smiling face, has an electronic brain gifted with artificial intelligence, and a vocabulary composed of over a thousand words and sentences. It was expected to arrive aboard the International Space Station, and has been designed to float and fly around the ISS, providing technical assistance, warning of system failures and possible dangers, but also to give some comfort to astronauts and to amuse them.[158]

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[157] FCC & NASA Letter to SpaceX, *supra* note 126.

[158] Marinescu, *supra* note 6, at 252.

3.1.3 Use of AI through the space segment and having potential effects on Earth or human activities

An applied (space-application based) example of AI use through space activities and its potential impact on human activities on Earth is highlighted by large-scale sharing of satellite images in the ongoing Russia Ukraine Military conflict. Satellites are often dual-use in nature, meaning that if need be, they could be employed for military purposes. More and more civilian satellites are now being fitted with high resolution cameras. For example, in the ongoing conflict, howsoever motivated by ethical and moral factors or compulsions, civilian space companies have been providing very high quality resolution pictures to the Ukraine military (some of these pictures, and other high resolution images, are annexed to this thesis as **Annex-I**).[159] There are also reports that these pictures, aided and assisted by AI technology, traffic camera pictures, tiktok videos, etc. have been able to pinpoint damages on either sides, including military personnel and generals.[160] Clearview AI technology, which is a facial recognition technology, is also being used to track 'people of interest'.[161] In general, ML is already being used to gather intelligence: it allows computers to identify patterns in large amounts of data sets and predict patterns, allowing computers to generate intelligence both for credibility as well as for deception.[162] Notably, the space ecosystem, with high resolution pictures from satellites, are fast becoming an integral part of this. All of this raises more issues than one, including the blurring of distinction between military and civilian uses. In the future, questions arise as to what prevents some States or multinational corporations to use satellite images for surveillance and tracking of civilians, in cases of civilian unrest situations or even in times of peace.

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[159] See, for example, Sam Meredith, "Satellite images show large Russian convoy regrouping near Ukraine's capital Kyiv" (11 March 2022), online: CNBC Europe < https://www.cnbc.com/2022/03/11/ukraine-satellite-imagery-shows-russian-convoy-regrouping-near-kyiv.html>; Peter Aldhouse & Christopher Miller, "How Open-Source Intelligence Is Helping Clear The Fog Of War In Ukraine: From high-resolution satellite images to TikTok videos, governments no longer control information from the front lines." (2 March 2022), online: Buzz feed News < https://www.buzzfeednews.com/article/peteraldhous/osint-ukraine-war-satellite-images-plane-tracking-social>.

[160] Jeremy Kahn, "A.I. is on the front lines of the war in Ukraine" (1 March 2022), online: Fortune <https://fortune.com/2022/03/01/russia-ukraine-invasion-war-a-i-artificial-intelligence/>, stating: "Machine learning can also be used to help detect disinformation. Some people have also suggested A.I. can help analyze the vast amount of open source intelligence coming out of Ukraine—everything from TikTok videos and Telegram posts of troop formations and attacks uploaded by average Ukrainians to publicly available satellite imagery".

[161] Charlie Osborne, "Ukraine reportedly adopts Clearview AI to track Russian invaders" (14 March 2022), online: <https://www.zdnet.com/article/ukraine-reportedly-adopts-clearview-ai-to-track-russian-invaders/>.

[162] The Conversation, "Technology is revolutionizing how intelligence is gathered and analyzed – and opening a window onto Russian military activity around Ukraine" (14 February 2022), online: The Conversation < https://theconversation.com/technology-is-revolutionizing-how-intelligence-is-gathered-and-analyzed-and-opening-a-window-onto-russian-military-activity-around-ukraine-176446>.

Before the Russia Ukraine military conflict had even begun, George Anthony Long and his collaborators had raised issues pertaining to surveillance, privacy, data protection laws and breach thereof, etc.[163] In all this, the emerging concerns are that the space ecosystem has now the potential, if not regulated in a timely manner, to conduct activities that might otherwise be prohibited by terrestrial-based laws of most countries, including those of surveillance and breach of privacy of civilians/citizens, data protection, etc. (please also see section 3.5.2 below). By way of a simple example, satellite images coupled with traffic cameras and AI technology have the capability of tracking and predicting the movement of civilians. This activity becomes even simpler if satellite images are taken of the backyard of a particular house, and thus people living in the house can be tracked and monitored (for example, US regulations prohibit release of commercial images better than 25 cms, while images for military or government use are of a resolution of 10 cms; new efforts point that commercial images upto 15 cms may be released while the military is attempting or already has access to 3 cms resolution pictures).[164]

More specifically, in the context of space law treaties, the liability regime in Liability Convention places an absolute liability for 'damages'[165] on Earth or to an aircraft in flight and caused by a 'space object'[166]. In the aviation industry, the concept of damages in private international aviation law was originally confined to physical damages only, and was gradually extended to provide for indirect damages or damages for mental or emotional injury through a plethora of litigation in courts. However, unlike the aviation industry, which is based on air space sovereignty[167], space domain has been made the province of all mankind.[168] Thus, litigations of the nature seen in the aviation industry should not be expected, or rather should be avoided. Moreover, so far, the space activity domain and its legal regulation largely remains dispute and litigation free. Thus, there is need for international consensus and collaboration in this sense to ascertain if the scope of 'damages' by way of, or through space activities, potentially through satellite images or other

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[163] George Anthony Long, et al, "Artificial Intelligence in Space", 22 June 2020, University of Luxembourg – Open repository and bibliography, online: < https://arxiv.org/abs/2006.12362>, at 2, 5.

[164] Jonathan O'Callaghan, "Trump Accidentally Revealed The Amazing Resolution Of U.S. Spy Satellites" (1 September 2019), online: Forbes < https://www.forbes.com/sites/jonathanocallaghan/2019/09/01/trump-accidentally-revealed-the-amazing-resolution-of-u-s-spy-satellites/?sh=12c9202b3d89>.

[165] Liability Convention, *supra* note 78, at art. I (a): "The term 'damage' means loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations."

[166] *Ibid.*, at art. II.

[167] International Civil Aviation Organization, *Convention on Civil Aviation*, 7 December 1944, 15 UNTS 295 [*Chicago Convention*], at art. I: "the Contracting States recognize that every State has complete and exclusive sovereignty over the air space above its territory."

[168] Outer Space Treaty, *supra* note 4, at art. I.

ways of indirect involvement of the space ecosystem or an activity occurring through the space segment, could be incorporated into the legal regime without necessarily going through court processes and channels. In the wake of an increasingly interoperable and open world, AI technology assisted by satellites, cyber activities and even drones have the potential to impact the notion of 'damages' under the space law treaties.

Likewise, the ITU itself has recognized some of the potential AI applications in the field of program production and exchange and broadcasting, without however defining or attaching any rights and interests or imposing any legal obligations for such activities,[169] also recognizing that AI is not a single technology but a family of technologies.[170] In this sense, as the developments in ITU for AI application is largely based on the user segment, and specifically to highlight areas where ML/AI algorithmic approaches are already affecting creation, process and distribution within the broadcast program and production pathway[171], a relevant analysis of these applications is largely being kept out of the scope of this thesis to make it precise and relevant and applicable to AI application in the space segment of space activities and conduct, or AI systems having impact on Earth and human beings through the space segment. However, some of the insights provided by ITU are interesting such as development of social media analysis systems (relevant to conversion of unstructured to structured data for Simple AI Phase I)[172], AI-driven announcers and automatic generation of manuscripts describing state of rivers,[173] video/audio detection and recognition,[174] as well as for face detection and recognition.[175]

3.2 Potential uses of AI in space activities:

3.2.1 Use of AI technologies in Space Situational Awareness and Space Traffic Management activities:

Space situational awareness (SSA) and space traffic management (STM) systems of the future are likely to be aided and assisted by AI technologies, whether or not through the ground

[169] International Telecommunication Union, *Artificial intelligence systems for programme production and exchange*, March, 2021, ITU-R BT.2447-1.

[170] ITU Report on AI, *supra* note 34, at 6.

[171] International Telecommunication Union, *supra* note 169, at 1.

[172] *Ibid*, at 6.

[173] *Ibid*, at 8, 11.

[174] *Ibid*, at 16.

[175] *Ibid*, at 17.

infrastructure, due to (i) speed of satellites (space objects) in earth-orbits; (ii) exponentially growing number of new satellites in the low-earth orbits; (iii) clustering of satellites of satellite constellations in specific orbits[176]; (iv) increasing and alarming rate of space maneuvers being needed now,[177] which is only likely to multiply itself many times over in the future; and (v) availability of Telemetry, Tracking and Command (TT&C) and TLE (space data pertaining to position of a satellite), which is currently available publicly on a lag of about 3-4-8 hours;[178] however, they can be predicted days or even a week in advance. In this backdrop, the capability of AI systems and technology to handle large amounts of data, including space data, and basis publicly available TLE data – to predict and charter the course of satellites, and thus create accurate and enhanced space simulations, point towards its almost certain use and involvement in these systems.

In a recent paper, the researcher, along with his supervisor and Dr. Joe Pelton,[179] has already averted to many aspects of the need for a robust SSA and STM regime in light of new large scale constellations, including *inter-alia*, the requirement of collection of satellite positioning data from various actors and dissemination of these data to STM systems i.e. a unified system of data and information sharing.[180] A co-constitutive model of legal consciousness approach was also suggested in the sense that SSA and STM activities could aptly be conducted by an international center or organization co-founded by international governmental agencies and private actors collectively.[181] However, in the meantime, commercial SSA service providers have been largely active in provision of satellite information. In this context, AI systems' ability to handle and

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[176] Darren McKnight, Jonathan Rosenblatt & Darren Garber, "Responsible behaviour for Constellations and Clutters" (16 January 2018),Space Traffic Management Conference: seeking sustainable solutions, online: Embry-Riddle Aeronautical University < https://commons.erau.edu/cgi/viewcontent.cgi?article=1175&context=stm>.

[177] European Space Agency, "Automating Collision Avoidance" (22 October 2019), online: ESA Safety and Security <https://www.esa.int/Safety_Security/Space_Debris/Automating_collision_avoidance>, stating further: "Because of this debris environment, it is now routine for operators in highly-trafficked orbits to spend time protecting their spacecraft from potentially catastrophic collisions with space junk, by performing 'collision avoidance manoeuvres' – basically sending the commands to their spacecraft to get out of the way."

[178] See, for example, CelesTrak, "Latest Starlink Supplemental TLEs", online: CelesTrak <https://celestrak.com/NORAD/elements/supplemental/table.php?tleFile=starlink&title=Starlink&orbits=0&pointsPerRev=90&frame=1>. See also, Ansys Government Initiatives, "Where Do I Get TLE Information, TLE Supplemental Data, And Other TLE Resources?", online: Ansys Government Initiatives < https://agiweb.secure.force.com/faqs/articles/HowTo/TLE-info>, stating: "How often is the TLE database updated? The AGI Satellite database is updated three times a day at approximately 0100, 0900, and 1700 ET".

[179] Ram Jakhu, Joe Pelton & Nishith Mishra, "Satellite Constellations and Orbital Pollution: Need for New Policies and Regulations, in Marietta Benko & Kai-Uwe Schrogl, eds, *Outer Space Future for Humankind: Issues of law and policy*, (Netherlands: Eleven Publications, 2021) 267.

[180] *Ibid*, at 277.

[181] *Ibid*, at 278.

disseminate large volumes of data, including space data, effectively and without any lag makes application of these systems an almost certainty in the space ecosystem of the near future.

3.2.2 Use of AI technologies in Active Debris Removal and On-orbit Servicing Activities

The issue of high volumes of space debris and requirements of active debris removal operations in congested low-earth orbits are the most urgent and foreseeable requirements of the future. Most recently, China became the second country after the United States to dock with a defunct satellite to drastically alter its geostationary orbit.[182] In time, many such debris removal ventures, spearheaded by mostly private corporations[183], are likely to engage in such activities with a view for removing defunct satellites or orbital debris from congested orbits and bringing them back to Earth or pushing them away to graveyard orbits. As explained in Chapter I above, lag between communications with a Mars rover currently ranges in the time span of about 5 – 20 minutes; such time lags also exist between communications from ground infrastructure to Earth orbits. Although the time frames are much shorter for communications with Low Earth orbit space objects, it always has been human endeavour to make technology better and more efficient. Herein lies one of the significant potential of AI systems, which would be able to collect and process large-scale space data in an increasingly congested environment, with the ability to take split second decisions in the conduct of these activities, initially with the overall supervision of human controllers and predictably in the foreseeable future, without such human involvement (but within the set high-level objectives in ML phase of Simple AI).

In the meantime, mission extension vehicles or on-orbit servicing of space objects are also being explored and incentivized.[184] For this, Brian Weeden, puts it this way: "Imagine you're going to go buy a car tomorrow. And you have to keep in mind that you're never going to be able to put more gas in it. You can never change the oil. You can never maintain or fix anything. And you have to use it for the next 10 years. Now, how expensive and how complicated do you think that

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[182] Andrew Jones, "China's Shijian-21 towed dead satellite to a high graveyard orbit" (27 January 2022), online: Space News < https://spacenews.com/chinas-shijian-21-spacecraft-docked-with-and-towed-a-dead-satellite/>.

[183] See, for example, Fortune Business Insights, "Space Debris Monitoring and Removal Market to Exhibit a 7.84% CAGR by 2028; Space Junk Concern to Result in Active Participation by Key Players, Says Fortune Business Insights" (25 August 2021), online: GlobeNewsWire <https://www.globenewswire.com/news-release/2021/08/25/2286469/0/en/Space-Debris-Monitoring-and-Removal-Market-to-Exhibit-a-7-84-CAGR-by-2028-Space-Junk-Concern-to-Result-in-Active-Participation-by-Key-Players-Says-Fortune-Business-Insights.html>.

[184] Jones, *supra* note 182, stating: "European and American entities are also working on On-Orbit Servicing, Assembly, and Manufacturing (OSAM) capabilities. Space Logistics, a wholly-owned subsidiary of Northrop Grumman, has launched two Mission Extension Vehicles (MEV-1 and MEV-2) and has released footage of rendezvous with target satellites."

car is going to be? That's exactly what we have been doing with satellites".[185] Thus, with a view to servicing such satellites, on-orbit servicing (OOS) capabilities are being developed and actively pursued. However, one of the issues facing application of these technologies, in the words of Weeden, "is the time lag between the robot and Earth. For a robot operating in geosynchronous orbit, about 35,000 kilometers up, distance and signal processing creates a communication delay of several seconds between the robot and its controllers on Earth. So the robot will need to handle the most crucial tasks on its own."[186] All of this points to the many requirements of AI assisted robot extensions to bring down the delay and time lag or perform functions on its own.

While all of this remains in the pipeline or are in their nascent stages, significant funding is being allocated to ramp up activities of these systems, aided and assisted by AI. By way of an example, NASA is only third on the list of governmental agencies of the United States by way of contractual spending on AI systems, with an allocation of about 159 million dollars in 2021.[187] Likewise, from the year 2000-2021, NASA is second on this list with an estimated allocation of 1.41 billion dollars.[188] The heavy economic activity almost points to a certain involvement of AI technologies in the space ecosystem.

3.2.3 Need for AI assisted or developed space models and simulations

A legal consciousness approach, as is being urged by this researcher, requires a lot of attention to the actions of private industry space actors, concerned scientists and associations working towards space sustainability, including the increasing role of international organizations. In a series of recent workshops and conferences held to address issues of 'light pollution' emanating from reflectivity of sunlight from upcoming and large satellite constellations[189], private space actor industry representatives as well as concerned scientists and associations came together to take up the issue and discuss possible resolutions. In this, while discussing the problem, it was common industry opinion that they would require computer models and simulations to understand the nuances of the problem and to find ways of resolving the issue. Perhaps this is a relevant example of discussions and resolutions of new issues arising out of the space environment or domain,

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[185] Kurt Kleiner, "Groundbreaking New Robots could solve the Space Junk problem" (7 March 2022), online: Inverse <https://www.inverse.com/science/space-junk-robots>.

[186] *Ibid.*

[187] Zhang, et. al, *supra* note 24, at 193.

[188] *Ibid.,* at 194.

[189] Satcon2, *supra* note 109; Dark and Quiet Skies, *supra* note 110.

without active involvement of State governments. As space environment is vast, uncertain and even hazardous, in the future, it is likely that such computer models and simulations, due to the need for processing of large amounts of space data, would be assisted and aided by AI technologies.

Moreover, a vulnerable space weather environment most recently effectuating a crash of 40 out of 49 satellites of SpaceX,[190] hints at the increasing need for AI models and simulations for space weather events. Regarding this, for example, the Guidelines for the Long-term Sustainability of Space Activities[191] has incorporated a couple of guidelines highlighting the need for States and international organizations as well as industry players to develop and simulate, in the form of space weather models, space weather events and its effects.[192] It is likely that such space weather models would be aided and assisted, or even completely generated and operated by AI systems and technologies.

The involvement of space models and simulations are also extremely critical in the conduct and operation of space activities as they could potentially fill a lacunae in space operations which has significantly hindered many implementational aspects of international space law. As detailed in Chapter II, typically, space-faring States have rather adopted a hegemonial approach, and this domain has seen little-to-no transparency. Thus, unlike terrestrial laws and their implementation, international space law has suffered in the sense that the most dominant actors (State governments, and now multinational corporations), in the event of an adverse space event or collision, are exclusively in possession of all data (likely being equated here to 'evidence'), which may prove valid and legitimate claims of other affected entities or other States. This disability to prove an otherwise legitimate claim, for lack of evidence, is violative of principles of natural justice, and the equally applicable principle of equity.[193] Space environment has inherited this deficiency right from the beginning of the space age. In this context, if objective AI simulations

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[190] Corryn Wetzel, "Solar Storm Knocks 40 SpaceX Satellites Out of Orbit" (14 February 2022), online: Smithsonian Magazine < https://www.smithsonianmag.com/smart-news/solar-storm-knocks-40-spacex-satellites-out-of-orbit180979566/#:~:text=As%20part%20of%20SpaceX's%20mission,straight%20into%20a% 20solar%20storm.>.

[191] Long-term Sustainability Guidelines, *supra* note 99.

[192] *Ibid.*, at Guidelines B.6(1), (6), (7), B.7.

[193] Jakhu, Freeland & Chen, *supra* note 84, at 633, stating: "Equity, a 'legal concept' the ICJ adjudged as being 'a general principle directly applicable as law', is often cited as a general principle of law that attempts to take into account and bridge the diverging (or, perhaps, conflicting) interests of States in different stages of economic development, and the needs of the present and future generations. The conduct of space activities and space applications rest on equitable participation and international cooperation of all States in the international community ... In both hard and soft space law instruments, the peculiar and specific circumstances and interests of each (relevant) State must be considered so as to ensure that activities do not unduly prejudice any one State's interest."

and models could be presented and adopted, this has the potential to usher in an era of increased and enhanced transparency and co-ordination in space activities, including in their implementational aspects, by providing much needed 'evidence' to the international community in support of, or either to prove or disprove, assertions of actors or other affected entities in the space environment.

3.3 A brief analysis of debates surrounding attaching a legal personality to AI machines in the context of space activities:

Remarkably, debates and arguments surrounding the attachment of a legal personality for AI technology and machines have been present since the year 1992.[194] Generally, the term person refers to a human being, while, in legal jurisprudence, the term 'legal person' refers to an entity, howsoever constituted, incorporated or organized, if certain duties and obligations could be imposed on it and certain rights accorded to it,[195] with the added ability that both the rights could be granted and obligations could be meaningfully enforced upon it, if circumstances so dictate. In addition, in specific circumstances, law also recognizes personhood (imposes legal rights and duties) for certain inanimate objects like ships, land, good, etc., which results in such objects being subject to judicial jurisdictions as well as being subject to a judgment rendered for or against it.[196] However, in such cases, the legal rights granted and duties imposed on inanimate objects flow from the ultimate actions or conduct of human beings. Even in the field of space activities, a spacecraft or a space object (launched into outer space) has been made subject to the jurisdiction of the State on whose registry such object is placed (or, registered).[197] In this specific context, the term 'space object' does not add any further value, and only specifies that a space object would include its component parts as well as the launch vehicle.[198]

At current levels of technological progress in Simple AI Phase I, the conversion of unstructured data to structured data and its applications are dependent on expert knowledge i.e. specialized knowledge of human beings, both of its technical underpinnings and nuances, and as per the arguments of this researcher in Chapter I above, desirably of the legal field. In Phase II or ML,

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[194] Solum, *supra* note 7, at 1238.

[195] Solum, *supra* note 7, at 1238; Long, *supra* note 5, at 4.

[196] See, generally, Long, *supra* note 5, at 4.

[197] Outer Space Treaty, *supra* note 4, at art. VIII, read with, Registration Convention, *supra* note 79, at art. II.

[198] Registration Convention, *supra* note 79, at art. I(b).

the operations of the AI technologies and machines are still supervised in the sense that they operate under high-level objectives set forth by the creator, developer, actor or operator of this technology, which again can be attributed to human conduct or that of 'legal person(s)'. Phase III contextual adaptation is extremely new and in early research phases with no practical application yet. Even in Phases III and IV, an intelligent machine can provide justifications for its actions, which could further result in a likely 'evaluation' scenario by State governments, legal entities or human beings. That is to say, basis justifications provided by AI machines or technologies and systems, it may be prudent for States or entities or legal persons to assess and analyze if the 'high-level' objectives being set on and from Phase II (ML) need to be revised or revisited. Thus, till Artificial intelligence technologies, systems and machines surpass Phases III and Phase IV, and move to the domain of General AI or full autonomy, all of the existing debates about assignment of a legal personality is at best moot, and it is likely appropriate to be dealt with at a later point in time.

Most importantly, at least in the foreseeable future, there is no likely scenario in which legal rights or obligations, independent of the entity or 'actors' which created the AI system or is operating it, could be meaningfully enforced on an intelligent machine technology or system alone. In similar light, there is no international agreement or consensus on bestowing an independent identity to such AI technologies. In the context of use and operation of AI technologies in space activities, it is also very important to comprehend the fact that the core of *corpus juris spatialis*, or even the broader global space governance framework, places rights and obligations on a State, and to a very limited extent, on international organizations. Except in the context of the ITU framework, even private entities and multinational corporations do not have a legal standing in this international framework so far. While this researcher has attempted to make some cogent arguments in Chapter II on the need to revisit this regime through adoption of legal consciousness approaches, it is unlikely that this could be achieved on a top-down approach. Thus also, any debates or arguments or attempts to create a separate identity for AI technologies or intelligent machines, even in the field of space activities and conduct, *sans* the involvement of States, is without any basis, or for that matter, without any foreseeable benefit for the international community.

3.4 Legal presence, as distinguished from Legal personhood, for AI technologies in space activities:

A legal consciousness approach, as is being urged by this researcher through this submission, would necessarily, despite the legal status of AI machines and technologies, look into the effects of introduction of this technology in the field of space activities. AI technologies and systems have the potential both to do good as well as cause harm. That is to say, without space-specific high-level objectives (please see Chapter IV) set-forth through a nuanced evaluation of objectives of sustainable development of space activities (as contrasted with economic progress, profitability and dominance motives), any conduct of AI machines would likely repeat a bias of its creator or developer or operator, even in its application in the space domain and whether it be to promote or assert or perpetuate issues of sovereign or corporate dominance, profitability, control, etc.

Thus, while space technologies and activities have often been developed in a national context, meaning a State (or its incorporated entities) which develop space technologies have operated, often to the exclusion of other States, such technologies in the space domain – this is likely to change significantly with AI technologies and systems. First, it is likely that AI technologies and systems created or developed in any part of the world, through open source technologies and systems as well as due to an increasing internet and cyber technologies dependent inter-operable and open world, could be made available to anyone else in any other part of the world. Second, the dependance and availability of structured data is already raising many issues on account of such conversion being (i) financially exorbitant, and most importantly (ii) environmental cost associated with it. Third, relatedly, there is currently little-to-no coordination amongst technical experts developing and creating AI technologies with legal experts of the specific field(s) in which those systems are being designed to operate (in this case, legal and/or policy experts in the field of space activities). Fourth, while Simple AI Phase II or ML is being developed and improvized, with early research in Phase III (and likely evolution of Phase IV in the future), it is critical to ensure that AI technologies developed for any terrestrial domains must not simply be placed as is in the space domain, without crafting some specific 'high-level objectives' for its use in the space domain. Fifth, it is no longer a few players or actors which engage in activities in the space domain i.e. with the exponential increase of cubesats and other technologies, which could simply be launched into space by paying a relatively nominal fees to private launch operators, the use of AI systems and technologies placed on it or used to operate it in space requires careful monitoring, constant supervision as well as due diligence by all concerned stakeholders.

Thus, in order for sustainable development in the field of AI technology for space systems, with an overall objective that (a) liability must not be affixed on the user or operator of an AI technology (or even on its creator or developer on a blanket basis) just on the basis of its decisions to install such technologies for use and operation in the space domain, and/or (b) AI technology, being developed to aid and assist human being must not, in the foreseeable future, be used to supplant or remove human decision making; it would be prudent that the international space law and policy community begin directing their attention towards AI specific import control laws (i.e. laying down conditions under which a specific AI technology, out of the family of AI technologies, could be imported for use in the space domain). Simply put, any component or an AI system or at any stage of an AI life cycle proposed to be imported for use in the space domain may need to be scrutinized on the basis of whether such technology was developed or created keeping space domain specific high-level objectives in mind. Thus, in this context and for the foreseeable future, international space law and policy community must also focus their attention towards developing, solidifying and cementing 'high-level objectives', within which Phase II AI or ML softwares and technologies must be developed for its use in the space domain and ecosystem.

Specificities of AI use in outer space (and how such AI use is distinct from AI use in terrestrial domains) must acknowledge and conform to needs of the space ecosystem. In the new space age 4.0, the space ecosystem is rapidly evolving to be a service and needs oriented market, driven by demand and competitive industry logistics,[199] and without a main centralized regulatory authority to govern or regulate the actions of space actors. Moreover, space domain is hazardous and it's hard to conduct activities without AI powered systems, softwares and machines. AI technologies would likely also assist significantly in protection of space assets and in minimization or reduction of space debris or space junk. In an increasing inter-operable world, the links of the space ecosystem is connected with cyber activities (and internet of things) as well as applications of space systems are increasingly being connected with a vast array of terrestrial activities. Thus, in order for improvised, channelized and fast uplink and downlink of data (with potential ability for appropriate selection of data for uplink and downlink) and classification and selection of huge amounts of space data[200], AI technologies are likely to significantly aid, assist and engage in such

[199] Long, et al, *supra* note 163, at 2.

[200] For example, see, Anne-Sophie Martin & Steven Freeland, "The Advent of Artificial Intelligence in Space Activities: New Legal Challenges", (2021) *55* Sp Pol 1, at *5*: "Data analytics, including policy and regulatory issues inherent in collecting massive amounts of information, and how that information can be used ... Hence, the use of AI in space programmes is creating, and will continue to generate, new business opportunities but simultaneously gives rise to policy and legal challenges with respect to many different uses of space ... This is evident, for example,

activities, including in effective communication of big space data. All of this requires transparency as well as directives or 'high-level objectives' under which such functions could be accomplished by AI machines and systems.

However, one important point of observation arises from literature in the context of AI and space activities and their legal regulation, etc. The point in issue is regarding the analysis of 'fully autonomous machines' in space activities, with a few scholars analyzing the need for changes in policy and regulation, basis the fact that "AI in space is igniting a gradual shift from 'computer-assisted human choice and human-ratified computer choice' to non-human analysis, decision-making and implementation of action." These observations need to be analyzed from a technological progress point of view, and hence this researcher's focus on the need to imbibe legal consciousness research (or socio-legal elements of research) into the framework of regulation of space activities. As has been described in Chapter I and preceding sections, till we surpass full-fledged developments in Phases II, III & IV, and move towards General AI, the concept of fully autonomous space objects or machines or technology is really a misnomer.

The confusion arises in the sense that in Simple AI phase II (or ML), the AI software (with or without machine extensions) is learning and evolving within the high-level objectives set-forth by the creators. Thus, the input and output of the machines are fixed, while the softwares or intelligence in the machines are constantly running programs or performing actions to get the stated and desired output, all within the framework of such objectives. In the bygone years, a separate command was needed and generated for each and every maneuver of a particular machine in outer space from its ground infrastructure. As opposed to such traditional ways of operating machines, ML technology ensures that simple mechanical functions of the machine are being internally run and done by the intelligent machines. However, this must not be equated with full autonomy where machines can supplant human decision-making (which brings in concepts of attributability of actions to machines, independent of its human creators or operators; attachment of a legal personality, etc.). In this sense, there is a need for legal experts in the field of technology, including space technology, to interact and collaborate with technical experts (developers, creators, actors and/or operators) of AI technology to better understand these

in the case of cloud platforms, which provide storage and easy access to the Earth Observation (EO) data market and are expected to play a major role in the coming decade ... For instance, the Copernicus programme itself currently generates up to 8 petabytes of data per year ... Therefore, space imagery processing that used to take humans hours, days or weeks to review and analyse will be automated by AI components that strategically determines what kind of data and images are important enough to collect and which can simulate a human understanding of thousands or millions of images."

nuances, and be able to develop legal policies and frameworks for effective use and implementation of AI technology in a phase-wise manner.

In the interim, for an effective introduction and use of AI technology, in and through space activities, it is rather appropriate that for the foreseeable future, mankind and international community look at those provisions in international space laws which would, with certain adaptations and modifications, be able to subsume the legal regulation of AI technology and Intelligent space objects in, and for, the space ecosystem.

3.5 Analysis of *Corpus Juris spatialis*, or more broadly, the global space governance framework, in view of introduction and implementation of AI technology

The 1963 Declaration of Legal Principles[201] as well as the Outer Space Treaty[202] is unique in the sense that it has sought to develop a *lex specialis* regime (along with the Rescue and Return Agreement, the Liability Convention, the Registration Convention as well as the Moon Agreement) for conduct of space activities. Principally within its peaceful purposes framework[203] as well as a desire for conduct of exploration and use of outer space for the benefit of all peoples,[204] and in the benefit and interest of all countries[205], it makes outer space the province of all mankind[206], with freedom of exploration and use as well as providing for free access to all areas of celestial bodies.[207] The principle of non-appropriation[208] as well as the visionary insight of application of international law, including the Charter of the United Nations, and with a view to maintaining international peace and security[209], makes the Outer Space Treaty an ever-evolving and forward looking international agreement. There are also certain useful principles such as non-nuclearization of space (or other weapons of mass destruction – prohibition only applicable to orbits around the Earth), and this framework also includes a provision that the moon and

[201] 1963 Declaration of Legal principles, *supra* note 4.

[202] Outer Space Treaty, *supra* note 4.

[203] Peaceful purpose, *supra* note 33.

[204] Outer Space Treaty, *supra* note 4, at preamble, para 3: "Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,."

[205] Outer Space Treaty, *supra* note 4, at art. I.

[206] *Ibid.*

[207] *Ibid.*

[208] *Ibid*, at art. II.

[209] *Ibid*, at art. III.

other celestial bodies be used exclusively for peaceful purposes (Article IV, Outer Space Treaty). Astronauts have been regarded as envoys of mankind, and top priority is accorded to their safe return to the State of registry of their space vehicle in the event of an accident, distress, etc. (Article V, Outer Space Treaty). Given the context and the time in which these principles were developed and agreement(s) concluded, it has often been hailed as exemplary by many scholars in the past.

3.5.1 International State responsibility:

Before the Articles on State Responsibility for Internationally Wrongful Acts[210] was enacted, developed and laid down, the provision for international responsibility of States was captured in Para 5 of the 1963 Declaration[211] as well as under Article VI of the Outer Space Treaty.[212] As it happens, this provision was also an essential compromise to align the differing views held by the US as well as the then USSR.[213] In its relevant part, Article VI of the Outer Space Treaty, states:

> *"States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty..."*

This provision thus provided for non-State actors participation ('national activities') in outer space activities, subject to State bearing international responsibility and for assuring that such national activities are carried out in conformity with the provisions of the Outer Space Treaty, and subject further to requirements of an appropriate State's authorization and continuing

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[210] Articles on State Responsibility, *supra* note 69.

[211] 1963 Declaration of Legal Principles, *supra* note 4, at para 5.

[212] Outer Space Treaty, *supra* note 4, at art. VI.

[213] For a general discussion, and acceptance by the delegate of USSR of the final position i.e. allowing non-State/non-governmental (private) actors to engage in space activities subject to (i) authorization and continuing supervision of the 'appropriate state', and (ii) State Responsibility of the 'appropriate' State for all space activities of its non-governmental participants: See United Nations General Assembly, Committee on the Peaceful Uses of Outer Space, Legal Sub-Committee Second Session, *Summary Record of the Twenty-second Meeting*, held on 24 April 1963, UN Doc. A/AC.105/C.2/SR.22 (26 April 1963) at 4-5; United Nations Committee on the Peaceful Uses of Outer Space, Legal Sub-Committee, Fifth Session, *Summary Record of the Sixty Seventh Meeting*, held on 25 July 1966, UN Doc. A/AC.105/C.2/SR.67 (21 October 1966) at 3, statement of Mr. Morozov, USSR."

supervision. Later, when the Articles on State responsibility were enacted as general principles of international law, responsibility for an internationally wrongful act committed by such State's 'national(s)' was stipulated to be determined if the national(s) conduct (an action or omission): (i) is attributable to the State (Articles 4 – 11), and (ii) constitutes a breach of an international obligation of the State.[214] Similarly, international jurisprudence concerning which non-governmental entities are to be considered as 'nationals' of a particular State varies.[215] The general rule of thumb in asserting the nationality of a non-governmental entity is to look at the applicable national law.[216] In previous instances of a determination in this regard by the International Court of Justice ('ICJ'), a test of 'genuine connection' has been used;[217] and so has been the requirement to have 'effective control'.[218]

And thus, the usefulness of the provisions in Article VI of the Outer Space Treaty, so far, is in the essence that it essentially provided a framework within which State legislations could be enacted. In fact, subsequently, a number of State legislations has been enacted concerning and covering (i) what activities are considered as space activity, (ii) who are its nationals, (iii) what are

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[214] Articles on State Responsibility, *supra* note 69, at art. 2.

[215] See, for example, United Nations General Assembly, *Recommendations on national legislation relevant to the peaceful exploration and use of outer space*, UNGA Res. 68/74, UNGAOR, 68th Sess, UN Doc. A/RES/68/74 (2013), at para 2. There are usually three well-known and internationally recognized possible circumstances to establish the nexus between a non-governmental entity and a specific State. These circumstances depend on whether the entity has a territorial nexus to the State; whether the activity of a natural or juridical national, has been conducted in accordance with specific national legislation of the State concerned; and whether the conduct of the entity can be attributed to the State in question. Moreover, in relation to personal jurisdiction, the predominant view is that any space activity, which is elsewhere carried on by a State's nationals, would be its national activity.

[216] League of Nations, *Convention on Certain Questions relating to the conflict of Nationality Laws*, 13 April 1930, League of Nations, Treaty Series, vol 179, no 4137 (entered into force on 01 July 1937) 89, art 1: "It is for each State to determine under its own law who are its nationals. This law shall be recognised by other States in so far as it is consistent with international conventions, international custom, and the principles of law generally recognised with regard to nationality". See also *Nottebohm Case* (second phase) (Liechtenstein v. Guatemala), 06 April 1955, 1955 ICJ Rep 4, at 20: "It is for Liechtenstein, as it is for every sovereign State, to settle by its own legislation the rules relating to the acquisition of its nationality, and to confer that nationality by naturalization granted by its own organs in accordance with that legislation".

[217] See generally *Barcelona Traction, Light and Power Company, Limited* (Belgium v. Spain), 05 February 1970, Judgment, [1970] ICJ Rep 3.

[218] *Case concerning the Military and Paramilitary activities in and against Nicaragua* (Nicaragua v. United States of America), 27 June 1986, Merits, [1986] ICJ Rep 14, at 65 (Para 105): "For this conduct to give rise to legal responsibility of the United States, it would in principle have to be proved that that State had effective control of the military or paramilitary operations in the course of which the alleged violations were committed"; Also, see *Application of the Convention on the Prevention and Punishment of the Crime of Genocide* (Bosnia and Herzegovina v. Serbia and Montenegro), 26 February 2007, Judgment, [2007] ICJ Rep 43, at 210: "406 ... In this regard the "overall control" test is unsuitable, for it stretches too far, almost to breaking point, the connection which must exist between the conduct of a State's organs and its international responsibility.", thus also rejecting the "overall control" test laid down by *Prosecutor v. Dusko Tadic a/k/a "Dule"* (Decision on the Defence Motion for Interlocutory Appeal on Jurisdiction), 02 October 1995, ICTY, IT-94-1 at 49.

the conditions of authorization, and, (iv) in a limited sense, any continual reporting requirements, to ensure supervision over space activities, etc.

Beyond this, and from a legal consciousness approach, the usefulness of this provision has waned over the years in the sense that these legislations more often than not have not provided for what would constitute an internationally wrongful act or how the States, in their turn, are effecting compliance or requirements set forth in the Outer Space Treaty i.e. what are their obligations to the international community under the *lex specialis* of corpus juris spatialis, and how they are ensuring compliance of such requirements through their national laws and regulations. As examples, despite prohibitions to the effect, recent efforts such as Artemis Accords, at least in part, is likely to invade in the protections regarding 'free access to all areas of celestial bodies' in the event of likely establishment of moon bases and 'safety zones'. Likewise, the satellite constellations are being alleged by many to be violative of the principles of non-appropriation. In this context, while orbital slots are typically allocated for a limited period, their ability to be renewed indefinitely[219] raises issues pertaining to appropriation by 'use'.[220] As is already being seen, preferable low Earth orbits being occupied by SpaceX, for example, would not be able to be used by any other State or private entity.

In addition, actions of a few States, through intentional creation of space debris, are already signifying their lack of commitment towards the common benefits principle or space being the province of all mankind. With the space debris issue becoming a substantial and challenging issue, the difficulty in tracking and monitoring of debris elements is making the space domain even more unpredictable and risker than before.[221] If not anything else, this is making operations in the space domain even harder and cost prohibitive for many States which are at the initial phases or are beginning their own space activities, including issues of complications in command and control over such space activities. In this context, while commercial SSA companies are offering their services for a fee, a unified SSA (or even STM) system for the benefit of all countries has yet not been effected which could be offered on a free basis to new entrants or States entering the space domain. This, in a way, substantiates the argument that the space domain and its actors are allowing a purely capitalist and economic progress based hegemonial and dominant approach of a few, even at the cost of sustainable and longevity issues. This is

[219] Njeri Purity, "Spectrum & Orbital Slotting – A case for African Countries" (3 December 2020), online: Space in Africa < https://africanews.space/spectrum-orbital-slotting-a-case-for-african-countries/>.

[220] Outer Space Treaty, *supra* note 4, at art. II: "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."

[221] Jakhu, Pelton & Mishra, *supra* note 179.

being done to a domain which is the common province of all mankind, and without consultation of views of all States and peoples who have a legal interest in matters concerning space activities.

Moreover, owing to the needs of the time, early scholarship and literature focused on the requirements of authorization for space activities which led to the adoption of national legislations. No attention was paid to the implementational aspects – thus, the remedies or efficacies of implementation of remedial measures under the Articles of State Responsibility have rarely been examined.

> For instance, owing to the specificities of the space domain as well as its hazardous nature, what would a measure of reparation,[222] a countermeasure[223] or retorsion[224] even look like in the space domain? Could such activities or retaliatory responses be enforced without further affecting or hurting the interests of the entire international community, or without affecting a breach of their own international obligation?[225] In appropriate circumstances, would such measures be successfully employed to effect a cessation of an internationally wrongful act?

In this sense, the concept of international state responsibility needs to be reinvigorated by using socio-legal approaches (preferably, a legal consciousness approach, beginning with at the very least, a co-constitutive model; however, progressing slowly towards evaluation and assignment of responsibility of each and individual actor i.e. individual stakeholder model) to move away from the dominant notion that state responsibility is an ex-post facto event, or that States have

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[222] Articles on State Responsibility, *supra* note 69, at arts. 34, 35, 36, 37.

[223] *Ibid.*, at arts. 49, 52.

[224] Retorsions are "lawful measures", which involves no breach of any international obligation of the State undertaking it, taken by States, within the ambit of sovereign rights that every sovereign State enjoys, which allows it to determine freely the course of its international relationships and thus its own interests, within the framework of international law. Even though it may be undertaken as a response to an "unfriendly" act, or even as a response to an internationally wrongful act, the measure of Retorsion has to be a "lawful act". See, International Law Commission, *Draft articles on Responsibility of States for Internationally Wrongful Acts, with commentaries*, UN Doc A/CN.4/SER.A/2001/Add.1 at 128: "Countermeasures are to be contrasted with retorsion, i.e. "unfriendly" conduct which is not inconsistent with any international obligation of the State engaging in it even though it may be a response to an internationally wrongful act. Acts of retorsion may include the prohibition of or limitations upon normal diplomatic relations or other contacts, embargoes of various kinds or withdrawal of voluntary aid programmes. Whatever their motivation, so long as such acts are not incompatible with the international obligations of the States taking them towards the target State, they do not involve countermeasures and they fall outside the scope of the present articles."

[225] Thus, for instance, even if intentional destruction of a State's own satellites is officially considered as an internationally wrongful act, wouldn't a retaliatory measure (in similar terms) by an injured State or a group of States (in the space domain, an injured State or group of States acting for an injured State is more often than not, at least on paper, could be the entire international community as all obligations by a State, except for the provision under Article IX, Outer Space Treaty, are owed in general to all the countries) further hurt the interests of international community? Moreover, could financial or other forms of sanctions be considered as an appropriate retaliatory measure or countermeasure, etc.

dispensed with their obligations by enacting national legislations in limited terms. An evolving concept would thus need more focus on the requirement(s) of maintaining 'continual supervision' over the activities of non-State actors, especially in the new space age 4.0, where a majority of all space activities are being conducted by private entities. In this sense, Guidelines for the Long-term sustainability of Outer Space Activities[226], has made some progress by stressing, through its Guideline A.3, that the obligation to maintain supervision includes the 'need to establish and maintain all the necessary technical competencies required to conduct the outer space activities in a safe and responsible manner',[227] and also includes components of socio-legal approaches by stressing the need to encourage advisory input from 'affected national entities' during the process of developing, adopting, revising national regulatory frameworks.[228]

Moreover, in the context of introduction and use of AI technologies and systems, as per the wordings contained in most national legislations, the term 'space activity'[229] involves the

[226] Long-term Sustainability Guidelines, *supra* note 99.

[227] *Ibid.*, Guideline A.3(2).

[228] *Ibid.*, Guideline A.2(h).

[229] See, as examples, Austria, Austrian Federal Law on the Authorization of Space Activities and the Establishment of a National Space Registry (Budesgesetz über die Genehmigung von Weltraumaktivitäten und die Einrichtung eines Weltraumregisters – Weltraumgesetz; or, the Austrian Outer Space Act 2011), Bundesgesetzblatt I Nr. 132/2011 of 27 December 2011, adopted by the National Council on 6 December 2011, entered into force on 28 December 2011, § 2.: "1. "Space activity": the launch, operation or control of a space object, as well as the operation of a launch facility;"; Belgium, Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects, 17 September 2005, as revised by 'the Law of 1 December 2013', 15 January 2014, art 2: " §1. This law covers the activities of launching, flight operations and guidance of space objects carried out by natural or legal persons in the zones placed under the jurisdiction or control of the Belgian State or using installations, personal or real property, owned by the Belgian State or which are under its jurisdiction or its control."; Denmark, The Danish Outer Space Act (Unofficial Translation), 11 May 2016, Act No. 409, s. 4: "1) "Space activity" means: Launching space objects into outer space; operation, control and return of space objects to Earth; as well as other essential activities in this connection."; Finland, Act on Space Activities 2018, entered into force on 23 January 2018, Act No. 63 of 2018, Ministry of Economic Affairs and Employment, s. 4: "1) space activities means launching a space object into outer space, operation and other control of the space object in outer space, as well as measures to return the space object and its return to the earth;"; France, The French Space Operation Act, Act No. 2008-518 of 2008, 03 June 2008 (adopted by Sentate on 22 May 2008), entered into force on 10 December 2010, art 1(Unofficial English translation by Centre National D'Etudes Spatiales for UNOOSA): "Space Operation – any activity consisting in launching or attempting to launch an object into outer space, or of ensuring the command of a space object during its journey in outer space, including the Moon and other Celestial Bodies, as well as during its return on Earth"; and includes: art 1.5: "Command Phase: the period of time starting as part of a space operation at the moment when the object to be put in outer space is separated from its launch vehicle and ending when the first of the following events occur: - when the final maneuvers for de-orbiting and the passivation activities have been completed; - when the operator has lost control over the space object; - the return to Earth or the full disintegration of the space object into the atmosphere."; Netherlands, Rules Concerning Space Activities and the Establishment of a Registry of Space Objects (Space Activities Act), Minister of Economic Affairs, 24 January 2007, s. 1: "b. space activities: the launch, the flight operation or the guidance of space objects in outer space;" South Africa, Space Affairs Act, Statutes of the Republic of South Africa – Trade and Industry No. 84 of 1993 (as amended by the Space Affairs Amendment Act, 1995, No. 64 of 1995, 06 October 1995), assented to 23 June 1993, commencement 06 September 1993, s. 1; Sweden, Act on Space Activities (Unofficial Translation), 18 November 1982, Act No. 1982:963, s. 1; United Kingdom, Space Industry Act, 2018 (2018 Chapter 5), 15 March 2018, s. 1.; and so on.

command, control and operational phases of such activity, and thus includes its ground based infrastructure.[230] In the foreseeable future, it is likely that AI technologies and systems could increasingly be used for launch, operation, command and control of space activities through intelligent systems. SpaceX's AI powered collision avoidance system is a very recent example of use of AI systems in operational phases of space activities. In view of such developments, for effective regulation of AI technologies and systems being used or to be used, it would be advisable for States to direct their focus and efforts on the requirement of maintaining 'continuing supervision' over the activities of its non-governmental entities.

As is being suggested through the course of this entire submission, (i) reporting requirements for use of AI, including transparency and awareness mandates, with a socio-legal approach involving concerned scientists, technical experts as well as social scientists, (ii) enactment of high-level objectives i.e. if and only if AI technologies, and specifically in Simple AI Phase II or ML, are developed under high-level objectives specific to the space domain (see also, Chapter IV below), it could be imported for use in the space domain, and (iii) import control laws regulating specificities and technicalities of AI use in the space ecosystem; are the urgent needs of the day, and potential likely candidates or requirements to be considered within the ambit of a State's obligation of 'continuing/continual supervision' over space activities of its nationals. An evolving application of Article VI in this sense would require active involvement of all stakeholders, whilst placing the primary responsibility on States to regulate such use. Adoption of a 'rules of the road' approach is desired and appropriate, a fact which is being re-iterated by space agencies in light of increasing space debris issue as well as use of AI in space activities[231].

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[230] The ground segment is composed of ground-based (terrestrial) facilities, earth stations, launch facilities, etc. as well as any and all equipment supporting or directly engaged in the command and control of a space segment resource(s) (a space segment resource would be a satellite, or any other space object). It also includes, *inter-alia*, mission management facilities, ground-based processing equipment (used for transmitting command, radio signals as well as other information to the space segment, equipment or space objects; and also includes instruments which receive and process raw data from space objects or the space segment), Earth terminals or earth (terrestrial – fixed or mobile) stations, user equipment, space situational awareness sensors, and the interconnectivity between two or more ground segment facilities in which this equipment is housed.

[231] For example, see, FCC & NASA Letter to SpaceX, *supra* note 126, at 2: "... While SpaceX may be able to show that the auto-maneuver capability scales appropriately within the Starlink constellation, the concern remains that other vendors proposing large constellations would also use auto-maneuvering capability within altitude ranges occupied by Starlink, thereby requiring multiple autonomous constellations to maneuver out of each other's way without clearly defined rules of the road for such interactions."

3.5.2 State Liability:

As opposed to State responsibility, international liability is not solely predicated on the wrongfulness of an action, but it finds its legal basis on (a) 'damages' being caused by a State, whether directly or indirectly, through its private or non-state actors, and (b) even if a State causing a potential 'damage' scenario was pursuing a legitimate [space] activity. However, much like the process of ascertainment of state responsibility, state liability also remains an *ex-post facto* event. Although, much of the submissions in this thesis is being presented to highlight the need to develop a 'rules of the road approach', adopting a precautionary and preventive approach, (i) owing to the hazardous nature of space activities, (ii) the space domain being congested, with issues of space debris reaching a tipping point, and (iii) the potential of AI technologies and systems to aid in the sustainable development of space activities; a brief discussion on the liability issue is being presented herein under to secure the introduction and operation of AI technologies, and to deal with unforeseen eventualities and possibilities. However, it is trite knowledge that the notion of liability has not usually meant much in the space ecosystem as (i) damages being caused are often irreversible, with no monetary sum being able to aptly present a sustainable solution or remedy to irresponsible and callous state actions, and (ii) without appropriate evidence, and such evidence – owing to the hegemonial nature of conduct of space activities is usually in possession of a State or its entity which causes a potential liability event in the first place – the notion of international state liability does not really offer much by way of an effective remedy in the space ecosystem.

Moreover, in the space age 4.0, monetary compensation terms to a 'claimant' state need to be balanced against the rights of the entire international community as a whole. An erring space event or action, in an age where large satellite constellations seek not only to occupy entire orbital levels in space but also a potential negligent action could threaten sustainable use of space for all times to come and for all of mankind, would have untold consequences for all of mankind's actions in space. And thus, a question is presented as to if the provisions of liability, specifically for the space domain, which has been barely used and rarely invoked in any event, could be seen as responsible international reaction of the international community towards potential erring actions of a State and its private entities. This debate continues even in the context of introduction of newer technologies such as cyber involvement and use of AI technologies and systems.

Under general international law, international liability for damages has often been introduced in various terms such as 'liability without fault', 'liability for risk', 'objective liability', 'causal liability',

'absolute liability' as well as 'strict liability'.[232] All these terms, in turn, have been used to describe a specific liability regime, which is neither a part of customary international law nor codified in a single international treaty applicable to all regulated activities.[233] The need for liability regimes arises in connection with conduct of hazardous activities or high-risk activities, wherein potential for damage is present, even due to purely accidental occurrences. Thus, despite lawful action, compensation is often presented, even for conducts which does not necessarily violate international law. In further support of this, ILC, in regard to 'International liability for injurious consequences arising out of acts not prohibited by international law' provides that 'international liability is premised upon the occurrence of significant harm or damage and not on any violation of an international obligation or subjective international right of a State'.[234] Moreover, as the existence of international liability is not predicated on breach of an international obligation, it has, in most cases, mostly been captured as a treaty based regime(s).

For historical reasons related to the development of international space law, legal regulation of the exploration and use of outer space is characterized by a much greater degree of involvement of states. Thus, under the *lex specialis* regime, liability has been imputed on a 'launching state' i.e. on states that launch or procure launchings of space objects and states from whose territory or facility space objects are launched.[235] The Liability Convention is seen as *lex specialis*, when it comes to relational arrangements between the Outer Space Treaty and the Liability Convention. It introduces the term 'launching state' in similar terms as the Outer Space Treaty.[236] Moreover,

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[232] M. Montjoie, "The concept of liability in the absence of an internationally wrongful act", in J. Crawford, A. Pellet & S. Olleson, eds, *The law of international responsibility* (Oxford, UK: Oxford University Press, 2010), at 503.

[233] Elina Morozova & Alena Laurenava, "International Liability for commercial space activities and related issues of debris" (23 February 2021), online: Oxford Research Encyclopedias – Planetary Science <https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-63>, at 2.

[234] See International Law Commission, *International liability for injurious consequences arising out of acts not prohibited by international law*", Yearbook of the International Law Commission, c V, Liability and Responsibility: Duality of Regimes, UN Doc. A/CN.4/SER.A/2000/Add.1 (Part 1, Vol. II) (2000), at 121, para 27: "international liability is premised upon the occurrence of significant harm or damage and not on any violation of an international obligation or subjective international right of a State". See also, ILC, *Survey of State practice relevant to international liability for injurious consequences arising out of acts not prohibited by international law*, UN Doc. A/CN.4/384 (1984).

[235] Outer Space Treaty, *supra* note 4, at art. VII: "Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air or in outer space, including the moon and other celestial bodies."

[236] Liability Convention, *supra* note 78, at art. I(c).

'damages'[237] caused by a 'space object'[238] has been considered and laid down in the provisions of Liability Convention. The operational provisions of the Liability Convention are captured in the following terms:

> "*Article II*
>
> *A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft flight.*
>
> *Article III*
>
> *In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.*"

Onset of AI technologies and systems have the potential to provide newer forms of challenges as well as unique solutions to such challenges. For example, as opposed to liability for damage caused in space which is predicated on damages caused by one space object to another space object, the absolute liability standard in Article II of the Liability Convention provides for no such conditionality. That is, as long as the cause for damage on the 'surface of earth' originate from a 'Space Object', it could potentially be covered under this absolute liability regime, and is likely to also cover for damages caused in any terrestrial domain and affecting any people, person, property, etc. The definition of 'Space Object' does not define the term appropriately, however, if we look at draft conventions and travaux préparatoires, we can likely assume that satellites and satellite constellations, as well as their activities, would be covered. For instance, travaux préparatoires, containing a draft agreement to the Liability Convention had provided "that a space object should mean "space ships, satellites, orbital laboratories, containers and any other devices designed for movement in outer space and sustained there otherwise than by the reaction of air, as well as the means of launching of such objects".[239] Even though this draft and definition was not accepted then, similar endeavours on similar terms (or, even in more detailed terms) and

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[237] *Ibid.*, at art. I(a): "The term "damage" means loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations."

[238] *Ibid.*, at art. I(d).

[239] See, travaux preparatoires for Liability Convention: United Nations General Assembly, *Report of the Legal Sub-Committee on the work of the second part of its third session (5-23 October 1964) to the Committee on the Peaceful Uses of Outer Space*, 23 October 1964, UN Doc. A/AC.105/21, Annex II, at 3.

modalities may find common ground today in view of the increasing challenges and complexities being presented in Space era 4.0.

Thus, this absolute liability basis for damages caused on surface of earth appears to be a very useful provision, provided the notion of damages could be more broadly interpreted by the international community, as briefly discussed in preceding sections of this Chapter. This broadening of concept of 'damages', as is being urged by this researcher, should preferably be done without the involvement of subjective judicial processes and legislative mechanisms by application of subjective standards of national laws of various States, but rather, is required to be approached on an international basis. For this, discussions and negotiations on an international level, and adopting a co-constitutive model of legal consciousness approach (at the very least) would likely be a good start.

Newer possibilities and eventualities where very high resolution satellite images coupled with AI technology (both for processing of space data as well as through other terrestrial mediums such as traffic cameras, face detection and recognition softwares, etc.) could likely or potentially be used for civilian surveillance, breach of privacy laws, including data privacy issues, an international attempt to redefine and reinterpret the notion of 'damages' caused through the space ecosystem (and potentially involving other aspects of damages, such as for mental or emotional injury, or even for indirect damages) can likely equip this absolute liability regime towards regulation of space-based activities affecting the interests of all people on Earth.[240] This approach would further ensure that differing, varied or lax data protection and privacy laws of a few States, with subjective differing standards along with their own set of loopholes, lacunae, etc. are not used to otherwise conduct activities, through the space domain, which activities would be considered unlawful and illegal by most States if they were conducted through terrestrial based technologies and systems. In addition, as distinguished from strict liability – where liability is imputed but with certain defensible exceptions, an absolute liability regime, as found in the Liability Convention, ensures that there is no way out for erring actions or conducts of a few space faring States, or their private entities, to evade liability. For this to meaningful develop, and for the space liability regime to be able to meaningfully avoid, or absorb into its framework (or, in applicable cases – work in tandem with) differing and various standards present in terrestrial laws of different States, supplementary protocols or a 'rules of the road' approach is likely required for the foreseeable future. Along with legal expertise, views of technical experts such as

[240] For a general discussion on how international space laws is set to interact with other national laws, especially European Laws, pertaining to data privacy, surveillance, etc., see: Long, et al, *supra* note 163, at 11-18.

AI developers and creators is required to guage the actual impact on the lives of common people, including for providing protection to fundamental rights in the context of surveillance, data protection, privacy laws and its potential breach, etc.

As regards the notion of 'fault-based' liability in outer space for damages caused by one space object to another[241], the Liability Convention does not define the term 'fault'. However, after extremely long-drawn negotiations on the Liability Convention, lasting for over a decade, the notion of absolute liability for damages caused on Earth was considered as the major achievement.[242] For, owing to the technology present at that time, damages caused on Earth was considered to be the only foreseeable and 'real' damages. Fault-based liability, in this sense, was considered too far-fetched at a time when mankind was only beginning its activities in space environment, and thus it was seen by some as a compromise to put the Liability Convention into effect. Over a period of time since then, various interpretations and reinterpretations have been accorded to the term 'fault' in the space context by scholars and academicians.

The ordinary meaning of 'fault' is *mistake*, *error*. In a legal context, 'fault' is defined as: "*1. An error or defect of judgment or of conduct; any deviation from prudence or duty resulting from inattention, incapacity, perversity, bad faith, or mismanagement. 2. The intentional or negligent failure to maintain some standard of conduct when that failure results in harm to another person.*"[243] There have been suggestions to consider fault on tortious notions of reasonableness, foreseeability, causal chain, etc. There have also been suggestions to consider objective international standards, as borrowed from other international regimes of liability applicable to activities other than space activities. However, as stated in brief earlier, the concept of international liability for hazardous activities have often been enacted as a domain-specific, and a complete and whole regime for activities that it seeks to regulate. Moreover, space activities have evolved since the early days, and technologies of a space faring State operating in outer space, including on orbits around the Earth, now pose a serious threat or challenge to space assets of other States. Thus, any attempts to import subjective notions of 'fault' from terrestrial legal regimes, or even international standards from other liability regimes applicable to other domains, would not, in the view of this researcher, serve the purpose(s) for which the drafters

[241] Liability Convention, *supra* note 78, at art. III.

[242] Ioana Bratu, Arno Lodder & Tina van der Linden, "Autonomous Space Objects and International Space Law: Navigating tbe Liability Gap", (2021) 18:3 Indonesian JIL 423 at 439.

[243] Michael Chatzipanagiotis, "Whose fault is it? Artificial Intelligence and Liability in International Space Law", 71st International Astronautical Congress (IAC) – The CyberSpace Edition, 12-14 October 2020.

might have incorporated this provision i.e. a flexible and approachable standard of liability which could be interpreted as per the needs of the time and basis relevant technological sector.

In this regard, an analysis of relevant legal provisions of the Liability Convention, reveals:

- In orbital environments and outer space region, liability is currently being affixed on the basis of 'fault' of 'persons' for which a State is responsible. This has led to some scholars acknowledging the relatability of the Outer Space Treaty with the Liability Convention, with some suggesting that an appropriate State be regarded as a launching state.[244] Article III of the Liability Convention can be seen as further emphasizing that a state is also liable for damage caused due to the fault of commercial private operators of space objects for which such a state is the launching state, and for which such State may also be an appropriate State ('fault of persons for whom the State is responsible'). This links the Liability Convention with the Outer Space Treaty, and further makes a strong case for effecting space-specific standards or duty of care.
- In terrestrial domains, concepts and notions of state sovereignty and supremacy prevail. Thus also, terrestrial laws, such as law of torts, etc. vary from jurisdiction to jurisdiction. For example, even in the application of AI technologies and systems, liability standards in driverless cars is being affixed on negligence standards, including design defect and products liability, etc. in the United States.[245] However, Canada is looking at law of torts and foreseeability as an avenue to address the same issue.[246] Similarly, standard of care for application of AI technology differs on the basis of whether such technology is used in the legal profession, or the medical profession,[247] or in driverless cars, etc. Thus, national laws would only differ based on a State's sovereign right to enact national laws and regulations. Any attempt to import differing standards and principles into the space

[244] See, Liability Convention, *supra* note 78, at art. III.

[245] See, for example, Iria Giuffrida, "Liability for AI Decision-Making: Some Legal and Ethical Considerations", (2019) 88 Ford L Rev 439, at 443. See, also, Long et al, *supra* note 163, at 21: "However, either theory necessitates a determination of fault based on human conduct. Negligence necessitates human involvement. Products liability concerns a defect in software design or manufacturing and failures to warn of reasonable foreseeable injury. A design defect occurs when a foreseeable risk of harm exists and the designer could have avoided or reduced the risk by utilizing a reasonable alternative design. A manufacturing design occurs when a product is not produced according to specifications. Failure to warn arises when the responsible party fails to 'provide instructions regarding how to safely use the software'."

[246] For example, see, Cynthia Khoo, "Missing the Unintended Forest despite the Deliberately Planted Trees: Reasonable Foreseeability and Legal Recognition of Platform Algorithm- Facilitated Emergent Systemic Harm to Marginalized Communities", online: University of Ottawa < https://techlaw.uottawa.ca/werobot/papers>.

[247] Michael Froomkin, Ian Kerr & Joelle Pineau, "When AIs Outperform Doctors: Confronting the Challenges of a Tort-Induced Over-Reliance on Machine Learning", (2019) 61 Ariz L Rev 33.

domain, which is considered as the province of all mankind[248], is only going to create confusion and chaos.

- The Vienna Convention on the Law of Treaties specifies that a provision of law in a treaty has to be interpreted in its context and in the light of its object and purpose, as per its ordinary meaning and in good faith.[249] In a potential liability event, as liability claims are to be presented within the Liability Convention, Article XII of this Convention states "The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State ...".[250] The emphasis on application of 'international principles' in itself, as per which damages may be determined, gives an insight that a determination of 'liability' need also be based on international principles, as is required for interpretation of the Liability Convention as a whole. This in itself effectively disbars import of subjective notions of 'fault' from national laws.
- Moreover, if no settlement is arrived at between parties to a liability claim within one year through diplomatic channels[251], Article XIV further requires the establishment of a claims commission. Every tribunal or court or even special commissions are governed by their set of substantive as well as applicable procedural laws. Owing to the nature of the space domain and conduct of activities, (and, as stated in preceding chapter, the hegemonial nature in conduct of space activities), evidence likely to substantiate a claim is almost always present with a party which might likely be at fault. This deficiency or defect is inherent in the manner space activities have been, and still are being, conducted. Thus, a party with likely the most space-based evidence (for example, with relevant locational space data through TT&C, TLEs, SSA systems or other information required to establish fault) would, in the absence of international consensus or agreements get to dictate and decide all procedural and substantive laws, as without relevant evidence, any interpretation of fault is of no consequence whatsoever. Evidence is a also necessary pre-requisite to establish elements of the 'causal chain', that likely results in a potential liability

[248] Outer Space Treaty, *supra* note 4, at art. I.

[249] VCLT, *supra* note 33, at art. 31.

[250] Liability Convention, *supra* note 78, at art. XII.

[251] Liability Convention, *supra* note 78, at art. XIV.

> event. If such conduct is allowed, this would result in scenarios previously seen in terrestrial domains and application of laws such as the issue of forum *non-conveniens*. In order to avoid such situations, and provide a basis for principles of equity to apply, it is essential that 'fault' standards in space are objectively defined, in an international manner, and in line with the specificities of space actions and conduct.

Thus, considering the technological progress as well as specificities of the new space age 4.0 as well as the urgent needs of the day, such as severely adverse impacts of space debris, etc., scholars and academicians in recent times have attempted to examine likely fault-standards that are objective, could be ascertained and applied in an international context, and most importantly, rejects any import of subjective and differing terrestrial notions of 'fault'. Doucet, a technical expert in the field, for example, places his interpretation of fault on the basis of due regards principle contained in Article IX of the Outer Space Treaty along with the due diligence obligation. He also places reliance on the importance of the space debris problem and likely solutions as contained in the IADC and UNCOPUOS space debris mitigation guidelines, and suggests that IADC guidelines should be globally accepted as standard required for due regard established under Article IX of the Outer Space Treaty, and these standards (or its non-adherence) should likely form the basis for interpretation of the notion of fault under Article III of the Liability Convention.[252] Likewise, Morozova also assess this concept basis the space debris context and relatability of the Outer Space Treaty and the Liability Convention.[253] In the context of AI technologies and systems, and as liability is affixed on breach of a standard of care, Long and his collaborators have further put forth that the dual responsibility of 'authorization and continuing supervision' by the appropriate State party'[254], within the meaning of Article VI of the Outer Space Treaty, arguably establishes a standard of care which a launching State must comply with, especially in connection with an intelligent space object.[255] Further, they note that by analogizing to the 'due diligence' standard under international law, a determination of whether a launching State exercised sufficient authorization and supervision involves a flexible and fluid standard.[256] 'Due diligence', as per them, is not an obligation to achieve a particular result; rather

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[252] Gilles Doucet, "Fault in Space: A Proposed Approach for Liability Assessments in the Event of Accidental Collisions in outer Space", (2017) 42 Ann A&S L 293, at 308.

[253] Morozova & Laurenava, *supra* note 233, at 9.

[254] Outer Space Treaty, *supra* note 4, at art. VI.

[255] Long et al, *supra* note 163, at 9.

[256] *Ibid.*

it is an obligation of conduct which requires a State to engage in sufficient efforts to prevent harm or injury.

In the context of this submission and in light of introduction of AI technologies and systems, such technologies could be modelled and simulated to provide objective international evidence through a potential SSA system. In the future, indicative examples of 'fault' may lie on any failure of any space actor to act in accordance with warnings generated by AI models and simulations, such as an omission to make a space maneuver. Moreover, as is being urged, AI technologies and systems (being not a single technology, but a family of technologies) must be imported for use in the space ecosystem as long as these technologies, specifically in Simple AI Phase II (ML), have been developed under high-level objectives which are specific to the space domain (please see Chapter IV below). Thus, any failure to adhere to these standards of care must also likewise, in a potential collision event in space or other damage scenario, be interpreted to constitute 'fault', and thus a basis for State liability. Approaching interpretation of 'fault' basis such socio-legal approaches is the requirement of the day. Perhaps, with more technical involvement and knowledge, (i) specific standards of due diligence for specific space conduct(s) as well as objective international standards of duty of care, specific to AI technology and systems, and (ii) increasing number of space specific high-level objectives, and in detailed terms, technical as well as legal; could be formulated, thus forming a potential basis or objective international standard(s) for determination of fault.

Lastly, there can be multiple launching State(s) due to the four separate criterion provided for both in the Outer Space Treaty as well as the Liability Convention. With relatively safer launchings, and AI technologies likely to be used not only for automated launch and re-entry processes but also for in-orbit regulation of space activities (AI technologies deployed in the ground infrastructure of space activities, in view of automation, are likely to control major aspects of space activities in the future), it is worthwhile to also note that perhaps the 'facility' criterion is likely to gain more significance in the future. This is also because of the fact that private launch operators now launch multiple payloads in a single launch, and from various jurisdictions, and any other State (or its private entity) can procure such launches by paying a relatively less fee. Thus, liability, in the wake of specialized and private launch operators, would also depend a lot on whether the space object itself is intelligent (ISOs) or whether it is controlled by intelligent softwares based on the ground infrastructure. If the space object itself is intelligent, and it controls all its payload including deployment of these payloads, it would be safe to fasten liability on the launch operator itself, including for and till its deployment stages. However, if the payloads are

intelligent, in the sense that payloads are controlled by intelligent softwares and machines, whether on-board or through the ground infrastructure of such specific payloads, then, in the context of liability, the 'facility' criterion could be accorded priority to determine which launching state should be the actual state to be made liable for the activities of intelligent softwares and machines operating and controlling the respective payloads (satellites, cubesats, etc.) in earth orbits. This may need to be done in the sense that jurisdiction and control (in a legal sense) is attached to registration provisions in international space law, which could simply be done by choosing to avoid registration or not accurately reporting which entity (out of potentially many ground infrastructures) actually has jurisdictional control or operational control over a specific space object.

However, this researcher wants to reiterate and emphasize again that (i) in view of the myriads of developments in space activities, including introduction of new technologies such as cyber activities and AI systems and technologies, (ii) specificities of space age 4.0 with ever-increasing participation from private actors, (iii) increased involvement of other related stakeholders, such as social scientists, sustainability experts, technical experts, associations and other constituted groups, etc. and (iv) desirability for sustainable actions in the space domain; any ex-post facto approach at dealing with challenging and complex situations (including the notion of 'state liability') is a less-than-preferable approach at tackling the issues and challenges that lie ahead.

3.5.3 Limitation of international space law:

As has been discussed throughout the previous chapters of this thesis, weak implementational aspects of international law in itself has been one of its most glaring limitations. Even more, in international space law, and often due to the hegemonial behaviour of space powers, effectiveness of international space law has been weakened due to lack of transparency by and amongst all space players. There is lack of effective and reliable evidence, and there is no unified system of SSA or STM yet. Moreover, national legislations have often regulated basic aspects, while often not providing for appropriate mechanisms for compliances with a State's international obligations under *corpus juris spatialis*. As international space law, for historical reasons, has seen more involvement of a State than comparable international laws, the progress, development and implementation of these set of laws have also been effected due to economic, geo-political and social factors. The broad treaty provisions further ensure that States have been able to mould and re-interpret its terms as per what suits their own sovereign agendas.

Provisions providing for involvement of the entire international community, for example, the provisions in Section 11 of the Moon Agreement, has often been thwarted by lack of participation and involvement from major space players. Moreover, the preventive provisions in the Outer Space Treaty, such as its Article IX of the Outer Space Treaty,[257] for example, is one of the least relied upon and implemented provisions in the treaty. Apart from lack of exchange of information to effectuate this provision, a related issue for non-use of this provision may also lie in the term 'appropriate international consultation', which at a minimum, requires States to provide affected States sufficient information to take appropriate action to avoid potentially harmful interference, harmful contamination or adverse changes to earth, and to mitigate effects. However, this provision does not provide the affected (or to be affected) States any actual or practical ability to limit, prevent or prohibit: (i) such harmful interference in the space domain; or (ii) a State from conducting space activities that are deemed to cause such potential harmful interference in the first place.

Moreover, in the context of introduction of AI technologies and softwares, the provisions regarding jurisdiction and control of a space object are likely to gain significance. These legal provisions, in international space law, has been assigned to the act of registration of the space object.[258] However, the information required to be provided is currently set to a few basic parameters, and this act of registration itself is largely seen to be voluntary in nature. In this context, Long notes that States may, in the absence of a well-defined and expanded registration framework, simply choose to not register intelligent space objects.[259] Martin and Freeland note that concepts such as 'State of registry' and the launching State(s) will be relevant and may require further elaboration or refinement in the development of a workable and consistent legal

[257] Outer Space Treaty, *supra* note 4, at art. IX: "In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. 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, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.".

[258] Outer Space Treaty, *supra* note 4, at art. VIII; Registration Convention, *supra* note 79, at art. II.

[259] Long, supra note 5, at 5.

framework for AI use in space activities, since further research may conclude that it might be appropriate to alter their scope depending on the precise circumstances.[260] In this context, they further propose the development of a 'special registry' to specify and capture unique features of spacecraft having onboard AI items.[261] It is also important to note here that in the context of introduction and use of AI technologies and systems, 'control' in 'law' needs to be distinguished from aspects such as 'control' in 'fact'. Control in factual terms may be denoted to entities which are in actual operational control of a space mission through AI systems and technologies, and having the ability to generate commands, exercise human control or supervision over AI systems, effectuate space maneuvers, conduct on-orbit servicing, etc.

Further, there is no international regulatory authority for space activities, and no international organization, with a collective mandate of ensuring sustainable developments in space activities. Likewise, even though almost two-thirds of all activities in the space domain are now being conducted by private entities, there is no forum to address their grievances for harm flowing from space activities, with the exception of the ITU model, which regulates only a specific aspect of space activities and also requires State's involvement in addressal of grievances. As these private entities do not have direct obligations under international space law, there is no basis for international jurisdiction for its activities, [262] even while this domain is set to witness a rapid introduction of AI technologies and systems.

International space law yet does not provide for any provision or protection for AI related activity in the space domain. Thus, it is also likely that national laws and regulations enacted for space activities will also be used to govern AI activities and technologies being used in such space activities, unless 'rules of the road' approach (in the form of guidelines, resolutions, etc.) is taken up by the international community. As also stated in preceding sections, the applicability of an appropriate substantive law, for example – even for potential claims under the Claims Commission, is set on a path, unless something is done to change its course, to see differing elements of State jurisdiction. Similar choice of substantive law arises if a potential dispute involves a space-based injury which is not subject to the Liability Convention or if an injured non-

[260] Martin & Freeland, *supra* note 200, at 6.

[261] *Ibid.*, at 7.

[262] Long et al, *supra* note 163, at 19.

governmental entity decides to directly pursue a remedy – likely in the form of international arbitrations, etc.[263]

All of these point towards the need for increasing involvement from all stakeholders of both space technologies and systems as well as from the domain of AI technologies and systems being designed for use and operation in the space domain, to address and cater to the limitations inherent in international space law. In the meantime, issues of expert legal knowledge and expert technical knowledge for Simple AI Phase I as well as space specific high-level objectives for development of ML phase need to be addressed by the space law and policy community, and the next chapter attempts to provide some preliminary insights into what is needed to achieve objectives of sustainable development of the space ecosystem, in light of introduction of AI systems and technologies.

[263] *Ibid.*, at 20, also stating, for example: "The judiciary in Belgium and the United States have each adopted customary international law principles embodied in an international treaty as the substantive law for resolving a dispute between two private parties arising in the international arena of the high seas."

Chapter IV

Space-specific high-level objectives for AI systems and ongoing legal and ethical issues

"It's human nature to stretch, to go, to see, to understand.

Exploration is not a choice, really; it's an imperative."[264]

With a view of presenting avenues for sustainable developments in space activities, Chapter I highlighted the need for the space law and policy community to consider and imbibe, within its framework, technical nuances present in the creation, development and operation of AI systems and technologies. In the most dominant phase of evolution of AI technologies, Phase II Simple AI or ML phases require high-level objectives under which such technologies could operate, as essentially the output of such machines are dependent on these objectives – what the technology is doing is to run programs and conduct actions which will achieve the desired output(s) already fed to such systems in advance. Chapter II presented a need to adopt socio-legal approaches, preferably the relational legal consciousness continuum, which, applied in the space context, would likely involve moving away from a State-centric modus operandi to co-constitute models, and further advocated to laying of foundations towards the 'individual stakeholder' model in the legal consciousness continuum. This approach looks at, devices mechanisms and constitutes frameworks (legal or otherwise) supporting a seat at the table to each and every stakeholder involved in a particular activity/domain, even in the context of activities in the space domain. This Chapter would thus, in support of this, present or initiate discussions on areas which have the potential of being converted to or being recognized as high-level objectives for development, incorporation and use of AI technologies and systems in the space domain. These could, in turn and with time, also become the basis for import control laws and regulations, providing an overall framework for ascertaining which particular AI technology or systems (out of the entire family of such technologies) could be imported for use in the space domain, and specifically keeping in mind that sustainability of space activities and of the space domain has become the most urgent need of our times.

Before presenting such preliminary points of discussions in the space-context, it also becomes essential to briefly allude to some of the general principles under which AI technologies and systems (as well as developers, creators and operators of such technologies) are being encouraged to conduct their operations and activities. Thus, irrespective of its legal status, and specifically

[264] Michael Collins, Gemini and Apollo astronaut.

keeping in mind that the individual stakeholder model/approach of the relational legal consciousness continuum envisages paying attention to the actions of each and every individual stakeholder, this researcher seeks to introduce some general elements/principles captured in a lesser-known, yet to be internationalized document, referred to as the Montreal Declaration.[265] This has been formulated and launched through participation of various stakeholders scientific, legal economic and political spheres of human activities. Some of the relevant principles contained therein are:

- Well-being: The development and use of artificial-intelligence systems (AIS) must permit the growth of the well-being of all sentient beings.[266]
- Respect for autonomy and Responsibility: AIS must be developed and used with respect for people's autonomy, and its development and use of AIS must not contribute to diminishing the responsibility of human beings when decisions must be made.[267]
- Protection of privacy and intimacy: Privacy and intimacy must be protected from intrusion by AIS and by data-acquisition and archiving systems.[268]
- Equity: The development and use of AIS must contribute to the creation of a just and equitable society.[269]
- Sustainable development: The development and use of AIS must be carried out so as to ensure strong environmental sustainability of the planet.[270]

Likewise, some of its related recommendations include (i) organization of independent citizen scrutiny and consultation to ensure democratic participation, (ii) education of all stakeholders for the design, development and use of AI technologies and systems, (iii) adherence to a non-predatory model of international development without abusing low and middle income countries, and (iv) a public private partnership as well as strategies for ensuring that such

[265] *The Montreal Declaration for the Responsible Development of Artificial Intelligence*, online: Canada ASEAN Business Council < https://www.canasean.com/the-montreal-declaration-for-the-responsible-development-of-artificial-intelligence-launched/> [*Montreal Declaration*].

[266] *Ibid.*, Principle 1.

[267] *Ibid.*, Principles 2, 9.

[268] *Ibid.*, Principle 3.

[269] *Ibid.*, Principle 6.

[270] *Ibid.*, Principle 10.

development and use are compatible with robust environmental sustainability issues, including for advancement of solutions to the environmental crisis.[271]

In turn, the next section of this Chapter seeks to engage in a preliminary discussion of what some of these space specific high-level objectives would look like in the context of development, use and operation of AI systems in the space ecosystem, especially for advance developments in ML phase (or, Phase II of Simple AI). However, before alluding to such discussions, it is important to note that in a relational legal consciousness continuum, currently focusing on a co-constitute model, while making initial attempts at laying the foundation for the 'individual stakeholder' model, the role of soft law[272] in space law is set to assume an even larger component for legal guidance and many aspects of regulation of AI systems. This approach is already being seen in the domain of cyber involvement, activities and security, where international consensus (in part, and in a divisive manner; yet the best we have so far) has only been captured in the form of soft law instruments, in the form of reports and consensus being formed by UN Group of Governmental Experts (please see Chapter II for more details). In an earlier paper presented as an internal paper to McGill University, the researcher had analyzed some of the roles and functions of soft law instruments in space law,[273] arguing that the most important aspects of soft law instruments lies not in its legal value but in its functional contribution to the international community.

Ralf Michaels argues, for example, that objects of legal regulation must be understood in the light of their functional relation to the society,[274] irrespective of difference in their doctrinal structures.[275] He builds on the idea advocated by Zweigert, and states that different societies face similar problems but take different measures to address it ('*praesumptio similitudinis*').[276] Thus, in view of the overarching problems in implementation in international space law, and in its mechanisms and mannerisms, at the core of which lies the ever-present issues of unreliability in (a) use of

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[271] *Ibid.*

[272] Steven Freeland, "The Role of 'Soft Law' in Public International Law and its Relevance to the International Legal Regulation of Outer Space" in Irmgard Marboe, ed, *Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law* (2012: Vienna, Böhlau) 9 at 19, defining soft law instruments as "written instruments that might purport to specify standard of conduct, but do not emanate from the traditional 'sources' of public international law"

[273] Nishith Mishra, "Soft Law in Space Law", Space Law Course – McGill University (2019).

[274] Ralf Michaels, "The Functional Method of Comparative Law" in Mathias Reimann & Reinhard Zimmermann, eds, *The Oxford Handbook of Comparative Law* (Oxford, UK: Oxford University Press, 2006) 339, at 341.

[275] *Ibid.*, at 369.

[276] *Ibid.*

outer space for the common benefit of mankind, and (b) sustainable development and exploration of outer space. In this background, soft law instruments serve functional purposes of (i) clarification of hard law, or to update the law[277]; the UNCOPUOS Guidelines for the Long-term Sustainability of Outer Space Activities'[278] is an important example of this; (ii) its systemizing function or its ability to build a system i.e. its ability to channelize the positive intent of member states into actionable agendas, as part of an international institutional framework; an important example of this is the UNCOPUOUS and IADC Space Debris Mitigation Guidelines[279]; (iii) the evaluative function[280] i.e. determining the better law; an important example of which is seen in the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters[281]; and/or (iv) its prescriptive function i.e. prescribing the law (or, soft law's role in the development of a sustainable international law regime i.e. for harmonization of national rules and regulations).[282]

In this backdrop, it is worthwhile to note that some of these potential space specific high-level objectives for development, creation and use of AI systems and technologies in the space ecosystem is derived not only from binding treaty provisions but also from widely accepted and acknowledged soft law instruments.

4.1 Space Specific 'High-level objectives' for the development and incorporation of AI systems in the space ecosystem:

Phase II Simple AI or ML development represent one of the most current technological developments in the field of AI technologies and systems. In this phase, the output of machine intelligence is already fixed through high-level objectives set forth by creators, developers and/or users of such AI technology. And thus, this section presents an introduction of and discussions on what some of these high-level objectives could be for the space domain.

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[277] See, generally, Christain Brünner & Georg Königsberger, " 'Regulatory Impact Assessment' – A Tool to Strengthen Soft Law Regulations" in Irmgard Marboe, ed, *Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law* (Vienna: Böhlau, 2012) 87, at 88.

[278] Long-term Sustainability Guidelines, *supra* note 99.

[279] Space Debris Guidelines, *supra* note 94.

[280] José Angelo Estrella Faria, "Future Directions of Legal Harmonisation and Law Reform: Stormy Seas or Prosperous Voyage" (2009) 14 Unif Rev 5, at 15.

[281] *Charter On Cooperation To Achieve The Coordinated Use Of Space Facilities In The Event Of Natural Or Technological Disasters,* online: <https://disasterscharter.org/web/guest/home;jsessionid=38D383636DA7D74676C9DDDBA7375F79.jvm1> [*Charter for Cooperation in Disasters*].

[282] Setsuko Aoki, "The Function of 'Soft Law' in the Development of International Space Law" in Irmgard Marboe, ed, *Soft Law in Outer Space: The Function of Non-binding Norms in International Space Law* (Vienna: Böhlau, 2012) 57, at 57.

4.1.1 AI systems used in space ecosystem must accord highest priority to human lives

Flowing from (i) in the context of AI technology, Principle I of the Montreal Declaration[283], and (ii) in space domain, Article V of the Outer Space Treaty[284] as well as from the Rescue and Return Agreement;[285] it follows that AI technologies and systems must be designed for well-being and protection of human lives in the space ecosystem. While treaty regimes have traditionally accorded protections to 'astronauts' (who have been regarded as envoys of mankind), growth in commercial space tourism requires that AI systems are designed and employed to protect all human lives in space, including that of spaceflight participants.

Likewise, for protection of human lives on Earth, AI systems and technologies are needed to be designed and employed with a view to strengthening implementation of instruments and mechanisms such as the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters,[286] which provides for national organizations and space agencies to supply free satellite earth observation (EO) data to States for the immediate relief efforts following major disaster events,[287] and for strengthening of its mechanisms such as the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER). In automating detection and alerts, through setting of high-level objective of protection of human lives, the compliance rates as well as humanitarian objectives of this highly useful instrument and mechanism could be further enhanced and sustainable objectives be truly met.

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[283] Montreal Declaration, *supra* note 265, at Principle I: "Well-being: The development and use of artificial-intelligence systems (AIS) must permit the growth of the well-being of all sentient beings."

[284] Outer Space Treaty, *supra* note 4, at art. V: "States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas ... In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.".

[285] Rescue and Return Agreement, *supra* note 77, at art. I.

[286] Charter for Cooperation in Disasters, *supra* note 281.

[287] Nathan E. Clark, "Gauging the Effectiveness of Soft Law in Theory and Practice: A Case Study of the International Charter on Space and Major Disasters" (2018) 43:1 A & Sp L 77, at 78.

4.1.2 AI systems must be deployed to minimize, reduce and mitigate the impact of space debris

An undeniable high-level objective for development, use and operation of AI technologies and systems in the space ecosystem must necessarily be to tackle the problem of space junk or space debris, including for promotion of conjunction alerts, in automated space maneuvers as well as in active debris removal missions. As an example, apart from AI use in ESA's clearspace mission, UK based Futiju, in collaboration with Astroscale UK, University of Glasgow and AWS is using quantum-inspired computing and AI for removing space junk, with AWS providing Cloud and AI, ML tools for the project.[288] This is also related to objectives of protection of human lives, astronauts, spaceflight participants, etc. as in recent times, astronauts aboard the International Space Station have been forced to take refuge in a couple of space capsules due to the threat of space debris.[289] The increasing threat of space debris has been further magnified due to launch and operation of satellite constellations.

To address this issue , the IADC as well as UNCOPUOS Space Debris Mitigation Guidelines have been formulated.[290] Scholars, technical experts as well as concerned scientists in recent times have advocated to use the standards developed through these documents not only to provide for and advocate establishment of due regard and due diligence standards in space activities as per Article IX of the Outer Space Treaty, but also as a potential basis for formulation of objective international standards for ascertainment of fault-based liability as well as to promote the increasing need for States to indulge in their 'supervision' role enshrined in Article VI of the Outer Space Treaty.

In the absence of 'space disputes' and appropriate adjudication by the International Court of Justice, although a formal determination to the effect that these guidelines have passed into the domain of customary international law is yet to be acknowledged, this researcher is of the view that these guidelines indeed present customary norms which are applicable to all space actors.

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[288] See generally, Prajaktha Gurung, "How AI is helping Debris Removal Efforts" (31 July 2021), online: AIM < https://analyticsindiamag.com/how-ai-is-helping-space-debris-removal-efforts/#:~:text=The%20spacecraft%20will%20use%20the,based%20on%20real%2Dspace%20data.>.

[289] Denise Chow & Andrea Mitchell, "Astronauts take shelter as debris passes dangerously close to space station" (15 November 2021), online: NBC News < https://www.nbcnews.com/science/space/astronauts-take-shelter-debris-passes-dangerously-close-space-station-rcna5617>.

[290] Space Debris Guidelines, *supra* note 94.

In identification of customary norms, a rule of customary international law may be said to exist where there is 'a general practice' that is 'accepted as law'.[291] Out of the two elements, a general practice (often referred to as the 'material' or 'objective element') has been equated to State practice and it is it primarily the practice of States that contributes to the creation, or expression, of rules of customary international law.[292] The second element – acceptance of the 'general practice' as law – is commonly referred to as opinio juris (or "*opinio juris sive necessitatis*"). That is, a general practice be accepted as law means that the practice in question must be accompanied by a sense of legal obligation.[293] This subjective element must contain, *inter-alia*, a feeling of legal obligation, and an "actual consciousness of submitting to a legal obligation" or a "consciousness of the binding nature of the rule".[294] Thus, clearest forms of evidence in this regard are contained in the large number of States, accepting the obligations under the Guidelines, and through adoption of national legislations, provisions as well as mechanisms to effectuate these provisions.[295]

The 'no persistent objector' principle has often been used to ascertain the customary status of legal obligations.[296] Moreover, in brief, many scholars and academicians have also averted to instances pertaining to accelerated formation of customary international law. As an example, soon after its adoption, in 1965, Prof. Bin Cheng had opined that the 1963 Declaration has

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[291] *Jurisdictional Immunities of the State* (Germany v. Italy: Greece intervening), 03 February 2012, Judgment, [2012] ICJ Rep. 99, at 122 (para 55): "It follows that the Court must determine, in accordance with Article 38 (1) (b) of its Statute, the existence of 'international custom, as evidence of a general practice accepted as law' ... To do so, it must apply the criteria which it has repeatedly laid down for identifying a rule of customary international law. In particular, as the Court made clear in the *North Sea Continental Shelf cases*, the existence of a rule of customary international law requires that there be "a settled practice" together with opinio juris (*North Sea Continental Shelf (Federal Republic of Germany/Denmark; Federal Republic of Germany/Netherlands), Judgment, I.C.J. Reports 1969, p. 44, para. 77*)."

[292] *Continental Shelf* (Tunisia v. Libyan Arab Jamahiriya), 24 February 1982, Judgment, [1982] ICJ Rep 18, at 46 (para 43): "The actual practice of States ... is expressive, or creative, of customary rules."

[293] *Concerning Right of Passage over Indian Territory* (Portugal v. India), 12 April 1960, Merits, [1960] ICJ Rep 6, at 120 (Dissenting Opinion of Judge Chagla): "It is not enough to have its external manifestation proved; it is equally important that its mental or psychological element must be established. It is this all-important element that distinguishes mere practice or usage from custom. In doing something or in forbearing from doing something, the parties must feel that they are doing or forbearing out of a sense of obligation. They must look upon it as something which has the same force as law ... there must be an overriding feeling of compulsion – not physical but legal".

[294] *North Sea Continental Shelf Cases* (Federal Republic of Germany v. Denmark; Federal Republic of Germany v. Netherlands), 20 February 1969, [1969] ICJ Rep 3, at 104, 130 (Separate Opinion of Judge Ammoun).

[295] For a detailed list, See United Nations Office for Outer Space Affairs, *Compendium of space debris mitigation standards adopted by States and international organizations*, Part 1: National mechanisms, online: United Nations Office for Outer Space Affairs <http://www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html>.

[296] Michael P. Scharf, "Accelerated Formation of Customary International Law", (Case Western Reserve University, 2014) 305, at 317.

passed into the domain of customary international law.[297] The International Court of Justice has itself relied upon the importance of 'no persistent objector' principle to highlight that passage of a short period of time, in itself, is no bar to formation of customary international law.[298] In this context, one would hardly find any State which has objected to acceptance of these obligations, or the need to prevent multiplication of space debris elements.

Lastly, even otherwise, and taking the view that a true acknowledgement of these principles as customary international norms in the space domain has not yet crystallized or could not be stated with certainty, setting space debris mitigation or reduction standards as a core high-level objective for development of AI technologies and systems has many added advantages if we approach the subject matter from a legal consciousness and socio-legal point of view. Phase I Simple AI models and simulations could be developed keeping in view these objectives. In Phase II Simple AI or ML phases, if these core objectives are set by AI developers and creators and operators, many derivative advantages could likely occur, such as a robust SSA and STM systems and mechanism, robust rules of the road for space maneuvers in light of automation of collision avoidance systems (NASA acknowledges the current problem as:

> "*While SpaceX may be able to show that the auto-maneuver capability scales appropriately within the Starlink constellation, the concern remains that other vendors proposing large constellations would also use auto-maneuvering capability within altitude ranges occupied by Starlink, thereby requiring multiple autonomous constellations to maneuver out of each other's way without clearly defined rules of the road for such interactions*"[299],

sustainable automation in launches and re-entries as well as sustainable operations in outer space or sustainable in-orbit regulation of space activities. In this, the ever-present debates and arguments regarding economic progress vs. sustainable solutions could be resolved without

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[297] See generally, Bin Cheng, "United Nations Resolution on Outer Space: Instant International Customary Law?", (1965) 5 Indian JIL 23. He opines that customs are solely developed by opinio juris of States and that an acceptable rule can evolve as a custom instantly. In this backdrop, through his analysis, he concludes that the 1963 UNGA Declaration on space activities, along with all of its principles, became customary law almost immediately after its adoption, even though United Nations General Assembly resolutions are usually not legally binding.

[298] *North Sea Continental Shelf Cases* (Federal Republic of Germany v. Denmark; Federal Republic of Germany v. Netherlands), 20 February 1969, [1969] ICJ Rep 3, at 104, 124 ((Separate Opinion of Judge Ammoun); and 230 (Dissenting Opinion of Judge Lachs): "the passage of only a short period of time is not necessarily, or of itself, a bar to the formation of a new rule of customary international law ... [yet] an indispensable requirement would be that within the period in question, short though it might be, State practice, including that of States whose interests are specially affected, should have been both extensive and virtually uniform ... and should moreover have occurred in such a way as to show a general recognition that a rule of law or legal obligation is involved".

[299] FCC & NASA Letter to SpaceX, *supra* note 126, at 2.

prioritizing one above the other; and space activities could truly be conducted for the common benefit of all countries; and the inherent ability of multinational corporations to often prioritize and protect their own assets, even at the cost of larger harm to the international community, could be sustainably dealt with. The important point to note here, in this context, is that:

> all that we see around us, all technologies, machines, etc. and everything that we have developed or are developing with a view of making human lives comfortable, have only come out of human being's harnessing, on an average, 3 – 10 percent of their minds full potential. With advance developments in ML phases as well as rapid progress and strides in machine-based neural networks, the full potential of human mind's capability could be truly harnessed. Along the way, we may discover and uncover happy surprises and may yet find truly global and sustainable solutions and insights for the conduct of space activities.

For this to happen, mankind has to ensure that it is approaching this tremendous technology, and dealing with all its nuances, right from the very start.

4.1.3 AI systems must be developed and incorporated to provide common benefits to all mankind

As a derivative of the preceding section, and also in light of Article I of the Outer Space Treaty, it is essential that we use intelligent technologies for creating or providing common benefits to all of mankind and to conduct space activities in the interest of all countries. Unrestricted freedom has the effect of denying equality of opportunity to late entrants and States with limited technological capabilities.[300] Thus, in the context of space activities, 'common benefit' principle acts as a reasonable restriction to the principle of freedom of use and exploration of outer space.

Approaching this subject from a socio-legal point of view, it may further include: (i) duty not to use space resources or develop space activities to the detriment of the international community, and (ii) duty to prevent one-sided gains to space powers vis-à-vis new space actors or players. Likewise, the 1996 Benefits declaration[301] provides some useful insight, by further adding (a) particular needs of the developing countries should be taken into account[302], (b) all States, and

[300] Ram Jakhu, "Developing Countries and the Fundamental Principles of International Space Law". in Rafael Giradot, et al, eds, *New Directions in International Law*. (Frankfurt/ New York: Campus Verlag) 351, at 356.

[301] Benefits Declaration, *supra* note 81.

[302] *Ibid.*, Annex, at Principle I.

particularly space powers should promote and foster international cooperation on an equitable and mutually acceptable basis,[303] (c) international cooperation be conducted in the modes that are considered most effective[304], and (d) international cooperation be conducted, including promoting goals of, developing space science [including AI technology in space] with a view of facilitating exchange of expertise and technology.[305] Moreover, legal consciousness approaches are already encapsulated in this Declaration in the sense that national and international agencies, research institutions, organizations for development are directed towards appropriate use of space applications considering international cooperation in view.[306]

Thus, in this sense, AI technologies and systems are required to be developed and incorporated for use into the space domain through application of the common benefits principle. In view of the plethora of issues and challenges that lie ahead in the new space age 4.0, AI technologies and systems, if applied with care and diligence, have the potential of providing a peek or insight, through AI models, simulations as well as conduct, into sustainable approaches that could potentially benefit all of mankind.

4.1.4 AI technology must be employed to promote and advance use of space ecosystem in lines of long term sustainability guidelines

Irrespective of legal status, legal consciousness approaches would look into the effectiveness or functionality of an instrument as well as the stakeholders who participated, garnered consensus, prepared, accepted and have applied or are applying the said instrument. Guidelines on the Long Term Sustainability of Space Activities[307] is a document that is gaining worldwide attention (it being developed along the lines of UN Sustainable Development Goals 2030, albeit for the space ecosystem). Adopted on a voluntary basis,[308] with some States having acknowledged its significance in their national space policies,[309] some of its provisions have the potential to

[303] *Ibid.*, at Principle III.

[304] *Ibid.*, at Principle IV.

[305] *Ibid.*, at Principle V(a), (c).

[306] *Ibid.*, at Principle VI.

[307] Long-term Sustainability Guidelines, *supra* note 99.

[308] *Ibid.*, preamble, at para 15.

[309] See, for example, National Space Policy of the United States of America, 09 December 2020, page 14: "Preserving the Space Environment to Enhance the Long-term Sustainability of Space Activities Preserve the Space Environment. To preserve the space environment for responsible, peaceful, and safe use, and with a focus on minimizing space debris the United States shall: Continue leading the development and adoption of international and industry standards and policies, such as the Guidelines for the Long-term Sustainability of Outer Space Activities

effectively lay down rules of the road or an international agreed upon norms for use of AI technologies and systems, such as:

- Space activities are essential tools for realizing the achievement of the Sustainable Development Goals[310]; and the need for outer space to remain an operationally stable and safe environment that is maintained for peaceful purposes and open for exploration, use and international cooperation by current and future generations, in the interest of all countries, irrespective of their degree of economic or scientific development, without discrimination of any kind and with due regard for the principle of equity;[311]
- The greater technical and other relevant capabilities that a State has, the greater emphasis is laid on implementation of the guidelines;[312]
- Need for States to consider impact of potential development of their national space sector [arguably, including introduction and use of AI technology], and envisage appropriate, timely regulation in order to avoid legal lacunae;[313]
- In developing, revising or amending national regulatory frameworks, States must (i) consider risks to people, property, public health and the environment associated with the launch, in-orbit operation and re-entry of space objects,[314] (ii) promote regulations and policies with a view to minimize impact of human activities on Earth as well as the outer space environment,[315] and (ii) consider costs, benefits, disadvantages and risks of a range of alternatives [potentially, laying down foundations towards increasing adoption of impact assessment activities prior to induction of a particular AI technology or system for use in the space domain];[316]

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and the Space Debris Mitigation Guidelines of the United Nations Committee on the Peaceful Uses of Outer Space."

[310] Long-term Sustainability Guidelines, *supra* note 99, preamble, at para 2.

[311] *Ibid.*, at para 4.

[312] *Ibid.*, at para 17.

[313] *Ibid.*, at Guideline A.1(3).

[314] *Ibid.*, at Guideline A.2(2)(c).

[315] *Ibid.*, at Guideline A.2(2)(d); Moreover, through this, an attempt has been made for consideration of newer avenues such as 'impact of human activities', howsoever conducted, and space as a separate domain needing protection from such activities.

[316] *Ibid.*, at Guideline A.2(2)(g); AI technologies and systems as well as AI models and simulations could be effectively used to assess the 'range of alternatives'.

- In supervision of space activities, States are asked to (i) establish and maintain all the necessary technical competencies,[317] (ii) develop specific requirements and procedures to address safety,[318] and (iii) assess all risks;[319]
- Establish appropriate means to enable timely coordination to reduce the probability of and/or to facilitate effective responses to orbital collisions, orbital break-ups and other events;[320]
- Requirement of conjunction assessment for all spacecraft capable of adjusting trajectories during orbital phases,[321] including for screening current and planned trajectories of relevant space objects for potential collisions;[322]
- Develop space weather models and tools[323];
- promote and support research into and the development of sustainable space technologies, processes and services and other initiatives.[324]

All of these guidelines, recommendations, suggestions, etc. have some element of usage or potential for application of AI technologies and systems as well as delineate potential foundation for some of space-specific high level objectives under which AI technologies and systems are required and desired to be imported for use in the space ecosystem. If approached in a systemic and evaluative manner, they also have the potential of initiating, discussing and approaching the subject of AI use in the space ecosystem with a view of forming international consensus or with a view of formulating and adopting 'rules of the road'.

4.1.5 AI technologies must be incorporated keeping in view transparency measures

In order to prevent a situation where subjective and differing standards are used, for example: varying standards of duty of care like reasonableness, foreseeability, design defect, fault-liability, etc. into the space domain which has been regarded as province of all mankind; as well as for transparency measures pertaining to use of AI systems and technologies in the space domain, it

[317] *Ibid.*, at Guideline A.3(2)(a).

[318] *Ibid.*, at Guideline A.3(2)(b).

[319] *Ibid.*, at Guideline A.3(2)(c).

[320] *Ibid.*, at Guideline B.1(2).

[321] *Ibid.*, at Guideline B.4(1).

[322] *Ibid.*, at Guideline B.4(2).

[323] *Ibid.*, at Guideline B.7.

[324] *Ibid.*, at Guideline D.1.

becomes essential that transparency measures as well as dissemination of information regarding AI usage is approached in an objective and internationalized manner. As averted to briefly earlier, whether these constitute due regard (with due diligence obligations) under Article IX of the Outer Space Treaty or whether they are regarded as standard of care of ascertainment of liability or in any other manner deemed fit by international community through international consensus, some of the specificities in AI technology and systems usage, requiring transparency and dissemination of information are as follows:

- Quality and quantity of the data used to train the algorithm, in its initial Phase-I Simple AI, given that an algorithm's performance depends on the data it uses for its operation. Issues of subjective and separate training of algorithms need to be addressed because as seen in Chapter I, such separate training and simulations are often cost prohibitive and also includes an added environmental cost.
- Sufficient testing of the system, including interaction with other system components, to minimize errors during operation, and identify potential vulnerabilities and limitations, and availability of such testing and system reports to the general public.[325]
- Transparency in updates to fix potential flaws and improve performances, including dissemination of appropriate information regarding security updates to minimize the effect of unlawful interferences.
- Usage of clear instructions and warnings on the use and limitations of systems.
- Possibilities and scope for manual overrides to the systems, at least to some essential or critical functions of the system.
- Resilience in contingencies such as solar storms and functionality in low power mode, including redundancy of such systems.[326]

This is not an exhaustive list, and it is worthwhile to note that more such technical standards are required to be adopted by involving all relevant stakeholders. Moreover, there is a requirement for these standards to provide guidance (even if they are non-binding) and that these standards are performance based, to ensure flexibility as to compliance, and thus gain greater acceptability.[327] Given the more recent developments of 'rules of the road' approach for space activities, one of the ways to proceed internationally in this regard, as suggested by Martin & Freeland, is adoption of transparency and confidence building measures (TCBMs) related to AI

[325] Chatzipanagiotis, *supra* note 243.

[326] *Ibid.*

[327] *Ibid.*

in space activities.[328] In space activities, TCBMs represent essential instruments that have been designed and intended to create a more positive cooperative environment for the carrying out of outer space activities by various countries, even though there may exist terrestrial geopolitical tension viz-a-viz each other.[329] In this sense, TCBMs can take two different forms – those dealing with capabilities and those dealing with behaviour.[330] In addition, the international community seems to have encouraged these measures, over the years, towards development of best practices, codes of conduct, rules of the road, etc. to maximize stability and avoid misconduct and misperceptions.[331]

4.1.6 AI technology must not be employed to weaponize space, and must be employed to protect space assets

The dual-use nature of most satellites is well known. Apart from sporadic, yet deeply concerning, instances of kinetic use of force in space, recent issues of increasing GPS signal jamming, spoofing, etc. is already increasing many potential issues. Satellites are also being fitted with laser technology, potentially making it capable of performing more functions than one. Moreover, the use of cyber technology, as noted earlier, is making these satellites a 'device' on the internet of things. And thus, instances of cyber security and cyber-attacks are more prevalent, even in the conduct of space activities. Most of international consensus on issues of cyber security include making UN Charter provisions applicable to potential attacks, with some recent headway into attributability issues. Thus also, most of these international provisions are already applicable to the space domain by virtue of Article III of the Outer Space Treaty, including the UN Charter prohibition on threat or use of force.[332] AI technologies and systems present even risker avenues in this regard. As opposed to cyber-attacks, which are carried by human beings (subject to burn-out or fatigue issues, emotion and discretion, as well as subjectivity in ethics), AI programs could potentially be trained and simulated to carry out constant, unrelentless and recurring attacks to

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[328] Martin & Freeland, *supra* note 200, at 7.

[329] *Ibid.*

[330] Peter Martinez, et al, "Criteria for developing and testing Transparency and Confidence-Building Measures (TCBMs) for outer space activities", (2014) 30:2 Sp Pol 91.

[331] Martin & Freeland, *supra* note 200, at 7.

[332] *Charter of the United Nations*, 26 June 1957, 1 UNTS XVI, (entered into force 24 October 1945), Art 2(4). See also, *Declaration on Principles of International Law concerning Friendly Relations and Cooperation among States in accordance with the Charter of the United Nations*, UNGA Resolution 2625 (XXV), UN Doc. A/RES/2625 (XXV) (1970), Principle 1.

space assets, and in general, to and from the space ecosystem. Martin & Freeland, for example, discuss a plethora of potential issues and applications in this regard, including the potential for military uses.[333]

The Outer Space Treaty is clear on the prohibition on nuclear technology and weapons of mass destruction, while also stating that moon and other celestial bodies are to be used exclusively for peaceful purposes.[334] This prohibition becomes less clear when it comes to weapons other than weapons for mass destruction. However, States (and their private entities) are still obliged to base their actions on the 'purposes'[335] stipulated in the Outer Space Treaty, including appropriate interpretations of the peaceful purposes provision, which lays down limitations concerning weaponization of space activities. Moreover, any potential use may also be subject to scrutiny of the 'due regards' principle under Article IX of the Outer Space Treaty. Even without any specific motive or intention, according priority to protection of its own space assets by any one particular entity may, in the event of a potential collision event, cause grave harm and injury to the international community. Thus, as also stated earlier, collective preservation of space assets of the international community as a whole may likely be made preferable to (and also supercede) the capitalist motivations of a single (or group of) commercial private entity(ies).

4.2 Ethics of AI and its environmental impact

Any discussion on any subject matter in recent times cannot be disassociated without consideration of its environmental impact. At a time when the world is focusing on accelerating zero carbon transition, the development of AI technologies and systems come at a cost. As briefly stated in Chapter II, training a large language model, for instance, can emit 284 tons of carbon dioxide, which is 57 times as much CO2 as a human being is estimated to be responsible for releasing into the environment in a year, or 125 round-trip flights between New York and

[333] Martin & Freeland, *supra* note 200.

[334] Outer Space Treaty, *supra* note 4, at art. IV.

[335] See, Peaceful purpose, *supra* note 33. Also, such 'purposes', as have been expressly stipulated in the preamble of the Outer Space Treaty is: "*Recognizing* the common interest of all mankind in the progress of the exploration and use of outer space for *peaceful purposes"*, and "Desiring to contribute ... as the legal aspects of the exploration and use of outer space for *peaceful purposes";* in Article III of the OST "in the interest of maintaining international peace and security and promoting international co-operation and understanding"; and, likewise, the purposes, or aims and objectives under which the UN Charter operates, are: "to maintain international peace and security, and to that end: to take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace.

Beijing.[336] The space domain already has many environmental concerns pertaining to environmental cost of rocket launches and disposal, environmental costs associated with its ground-based infrastructure, etc. AI technologies and systems have the potential to add a major component to the already significant issues of pollution in the context of space launches.

Principle 21 of the 1972 Stockholm Declaration lays down one of the fundamental principles of international environmental law by stating: "that States have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction". Principle 2 of the 1992 Rio Declaration re-affirms this principle. Various resolutions of the General Assembly of the UN, including the Report of the United Nations Conference on the Environment (G.A. Res. 47/190, U.N. Doc. A/RES/47/190, 16 March 1993) endorses these principles and urges States "to take the necessary action to give effective follow-up".[337]

In the backdrop of high-risk activities that have the potential of effecting the environment and its sustainability, the preventive principle and the precautionary principle have tremendous value and application. The UN Report by the Secretary General of the UN titled "*Gaps in international environmental law and environment-related instruments: towards a global pact for the environment*"[338] was published on 30 November 2018 ('SG Report') in response to General Assembly resolution 72/277 entitled "*Towards a Global Pact for the Environment*", which had desired a technical and evidence-based report that identifies and assesses possible gaps in international environmental law and environment-related instruments with a view to strengthening their implementation. Upon a review and analysis of the corpus of international environmental law and environment-related instruments as well as the governance structure and implementation of international environmental law[339], the SG Report states the following on the 'Precautionary' Principle and the 'Prevention' Principle:

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[336] Ray, *supra* note 72.

[337] Similarly, International agreements bespeak a set of similar commitments. The 1993 Convention on Biological Diversity echoes the States' responsibility "to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." The U.N. Framework Convention on Climate Change carries forwards parallel language, noting that the statement is "in accordance with the Charter of the United Nations and the principles of international law".

[338] United Nations General Assembly, Report of the Secretary General, *Gaps in international environmental law and environment-related instruments: towards a global pact for the environment*, 30 November 2018, UN Doc. A/73/419.

[339] *Ibid.*, at 1: Although, the primary purpose of this Report was to reveal gaps and deficiencies at multiple levels, this Report analysis all relevant principles of international environmental law and confirms its findings on different levels based on an evidence based modality.

[Precautionary Principle]

"*12. This principle stipulates that States are required to adopt a precautionary approach when taking decisions or in regard to potential omissions which may harm the environment. Such a duty remains intact irrespective of the absence of scientific certainty as to the existence or extent of such risk. While the principle as formulated in Principle 15 of the Rio Declaration reflects other critical principles, such as the effective implementation of international environmental law, the legal basis of precaution as a principle is a matter of some controversy and debate. However, the exercise of precaution in this respect is expressed in other foundational instruments of international environmental law, regional instruments, texts drafted by civil society and rulings of the International Tribunal for the Law of the Sea.*"[340]

[Preventive Principle]

"*Since it first appeared in the 1938 Trail Smelter arbitration, the prevention of transboundary harm has been framed as a principle in foundational instruments of international environmental law, United Nations instruments, regional instruments, texts drafted by civil society and the decisions of the International Court of Justice. This principle is intrinsic to a core preference in international law for preventing environmental harm rather than compensating for harm that has already occurred. The prevention principle is well established as a rule of customary international law, supported by relevant practice in many environmental treaties and major codification initiatives. In practice, this principle is also related to due diligence obligations, particularly the duty to undertake an environmental impact assessment prior to engaging in activities which pose a potential risk of transboundary harm.*"[341]

Environmental impact of many human activities, including the carbon cost of such activities, have unfortunately become *res ipso loquitor* i.e. the thing speaks for itself. The rampant and destructive changes and occurrences are in fact affecting each and every area of human settlements and involvement, and are quite well documented.[342] Similarly, for example, while the

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[340] *Ibid.*

[341] *Ibid.*, at 7,8.

[342] See, for example, Sarah Kaplan & Brady Dennis, "The world is running out of options to hit climate goals, U.N. report shows" (4 April 2022), online: The Washington Post < https://www.washingtonpost.com/climate-environment/2022/04/04/climate-change-report-united-nations-ipcc/>, stating: "The science has been ever more consistent and ever more clear ... What's needed now is 'political courage', she added. 'That is what it will take — the ability to look beyond current interests.' ... Human carbon pollution has already pushed the planet into unprecedented territory, ravaging ecosystems, raising sea levels and exposing millions of people to new weather

development of AI technologies and systems can effectively help minimize the environmental changes and adverse events by identifying patters, clusters, etc. in human behaviour, it must likewise, be approached be precaution (even in instances where scientific certainty is not available; although, much of the documented evidence already points to the fact that there is tremendous amount of scientific evidence available), with a view that the environmental cost of development and use of AI must not, at any cost, supercede the benefits that we derive from this technology.

Likewise, it remains to be seen whether the international community classifies the widespread international ramifications of climate change, etc. as environmental 'harm' or 'damage'. Even if the bare minimum threshold is used, i.e. causation of environmental 'harm' (not amounting to damage), the principles contained in the Articles on Prevention of transboundary harm from hazardous activities, as published by the International Law Association and as recommended by the UN General Assembly, through its Resolution 62/68 titled *Consideration of prevention of transboundary harm from hazardous activities and allocation of loss in the case of such harm*"[343], defining in its Article 2(a) "*Risk of causing significant transboundary harm" includes risks taking the form of a high probability of causing significant transboundary harm and a low probability of causing disastrous transboundary harm*", is required to be inculcated, expanded or conceptualized as regards the development and use of AI systems and the often high carbon cost associated with its development

In this context, the researcher notes and presents a humbling excerpt from the judgment of the International Court of Justice, in Gabčíkovo-Nagymaros Project (Hungary/Slovakia), Judgment (ICJ, at p 7, para. 140):

> "*Throughout the ages, mankind has, for economic and other reasons, constantly interfered with nature. In the past, this was often done without consideration of the effects upon the environment. Owing to new scientific insights and to a growing awareness of the risks for mankind - for present and future generations - of pursuit of such interventions at an unconsidered and unabated pace, new norms and standards have been developed, set forth in a great number of instruments during the last two decades. Such new norms*

extremes. At the current rate of emissions, the world will burn through its remaining "carbon budget" by 2030 — putting the ambitious goal of keeping warming to 1.5 degrees Celsius (2.7 degrees Fahrenheit) irrevocably out of reach."

[343] United Nations General Assembly, *Consideration of prevention of transboundary harm from hazardous activities and allocation of loss in the case of such harm*, UNGA Res. 62/68, 6 December 2007, UN Doc. A/RES/62/68, Annex.

have to be taken into consideration, and such new standards given proper weight, not only when States contemplate new activities but also when continuing with activities begun in the past. This need to reconcile economic development with protection of the environment is aptly expressed in the concept of sustainable development."

4.3. UNESCO – Recommendations on the ethics of Artificial Intelligence

Precepts of 'mobilization school of legal consciousness' as well as increasing need for application of the 'relational legal consciousness continuum', (involving stakeholders from all aspects of human activities) are best highlighted in the fact that the only internationally agreed upon document (on ethics of AI), and first ever of its kind[344], comes from its acceptance by the Member States of United Nations Educational, Scientific and Cultural Organization, and not in other legal forms and mechanisms. In the backdrop of a tacit recognition that AI technologies and systems have a 'winner takes it all' dynamic, UNESCO's 'Recommendations on the ethics of Artificial Intelligence'[345] present mankind with recommendations, and they could be equally made applicable to AI systems development and use in the space ecosystem. Some of its important recommendations are:

- AI technologies can be of great service to humanity and all countries can benefit from them, but it also raises fundamental ethical concerns regarding the bias they can embed and exacerbate, potentially resulting in discrimination, inequality, digital divides, exclusion and a threat to cultural, social and biological diversity and social or economic divides. There is a need for transparency and understandability of the working of algorithms and the data with which they have been trained, as well as their potential impact, including but not limited to human dignity, human rights and fundamental freedoms, ..., democracy, social, economic, political and cultural processes, ... and the environment and ecosystems;[346]

[344] United Nations Educational, Scientific and Cultural Organization, "UNESCO member states adopt the first ever global agreement on the Ethics of Artificial Intelligence", 25 November 2021, online: UNESCO <https://en.unesco.org/news/unesco-member-states-adopt-first-ever-global-agreement-ethics-artificial-intelligence>.

[345] UNESCO Ethics of AI, *supra* note 13.

[346] *Ibid.*, at 1.

- AI technologies have the potential to be beneficial to the environment and ecosystems, and in order for those benefits to be realized, potential harms to and negative impacts on the environment and ecosystems should be addressed;[347]
- Globally accepted ethical standards for AI technologies, in full respect of international law, in particular human rights law, can play a key role in developing AI-related norms across the globe;[348]
- Strengthening of global cooperation and solidarity, including through multilateralism, is needed to facilitate fair access to AI technologies;[349]
- Member States engage all stakeholders, including business enterprises to ensure that they play their respective roles ... and bring the recommendations to the attention of the authorities, bodies, research and academic organizations, institutions and organizations in public, private and civil society sectors involved in AI technologies;[350]
- Aims and objectives include simulating peaceful use of AI systems;[351] and adherence to principles of proportionality and do no harm;[352]
- Values and principles must comply with international law, including the UN Charter, Member States' human rights obligations and internationally agreed social, political, environmental, educational, scientific and economic sustainability objectives, such as the United Nations Sustainable Development Goals,[353] and continuous assessment of human, social, cultural, economic and environmental impact of AI technologies are required to be carried out keeping sustainable agendas, such as the United Nations Sustainable Development Goals;[354]
- All actors involved in the life cycle of AI systems must comply with international law and domestic legislation, standards and practices, such as precaution, designed for environmental and ecosystem protection and restoration, and sustainable development.

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[347] *Ibid.*

[348] *Ibid.*, at 2.

[349] *Ibid.*, at 3.

[350] *Ibid.* See, also, para 2(b): "Ethical questions regarding AI systems pertain to all stages of AI system life cycle, ranging from research, design and development to deployment and use, including operation, ..., monitoring and evaluation, validation, end of use, disassembly and termination; likewise, AI actors can refer to both natural and legal persons, such as researchers, programmers, engineers, data scientists, end-users, business enterprises, universities and public and private entities."

[351] *Ibid.*, at para 5.

[352] *Ibid.*, at paras 25, 26.

[353] *Ibid.*, at para 9.

[354] *Ibid.*, at para 31.

They should reduce the environmental impact of AI systems, including but not limited to its carbon footprint;[355]

- At the international level, the most technologically advanced countries have a responsibility of solidarity with the least advanced to ensure that the benefits of AI technology such that access to and participation in the AI system life cycle for the latter contributes to a fairer world order;[356]
- Respect to privacy and data protection;[357] and States are required to put in place appropriate safeguards to protect the right to privacy in accordance with international law, including addressing concerns such as surveillance,[358] and to ensure that individuals retain rights over their personal data;[359] and
- Ethical responsibility and liability for the decisions and actions based in any way on an AI system should always ultimately be attributable to AI actors corresponding to their role in the life cycle of the AI system,[360] and appropriate oversight, impact assessment, audit and due diligence mechanisms, including whistle-blowers' protection should be developed to ensure accountability;[361]
- International law and national sovereignty must be respected in the use of data;[362] and involvement of all stakeholder;[363]
- Member States should introduce incentives to ensure development and adoption of rights-based and ethical AI powered solutions for disaster risk resilience; the monitoring, protection and regeneration of the environment and ecosystems; and preservation of the planet.[364]

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[355] *Ibid.*, at para 18.

[356] *Ibid.*, at para 28.

[357] *Ibid.*, at paras 32, 33, 34.

[358] *Ibid.*, at para 72.

[359] *Ibid.*, at para 73.

[360] *Ibid.*, at para 42.

[361] *Ibid.*, at para 43.

[362] *Ibid.*, at para 44.

[363] *Ibid.*, at para 47: "[all stakeholders include] governments, intergovernmental organizations, the technical community, civil society, researchers and academia, media, education, policy-makers, private sector companies, human rights institutions and equality bodies, anti-discrimination monitoring bodies, and groups for youth and children";

[364] *Ibid.*, at para 85.

The final provisions further state that the recommendations needs to be understood as a whole, and that foundational values and principles are complementary and interrelated. In all of this as well, one can certainly see a move towards involvement of different stakeholders (as specified above) i.e. a move away from state-centric form of regulation and legal consciousness approach towards a more nuanced and balanced approach, with hints towards a potential framework of implementation of the individual stakeholder model in relational legal consciousness approach i.e. to address this technology at the level of each and individual actor in the life system of an AI cycle. Moreover, the emphasis on the United Nations Sustainable Development Goals are also noteworthy and critical.

CONCLUSION

> The way AI technology is evolving is not very different from the way human beings and our societies have evolved in the past. It's just that instead of human effort, and now increasingly human mind's efforts, it could be intelligent computer systems, with or without machine extensions, that are likely to and could potentially handle logistical, mechanical as well as operational aspects of any activity, including for space ventures.

Humanity and all lives around us have, historically and going back to the very evolution of the human minds, have been rooted in the notion or idea of '*vasudheva kutumbakam*', meaning the whole world is one large family. However, modern day societies and associations and States evolved because human beings could not agree to central ideas, notions and a way of life, which was acceptable to all. Thus, divisions and resultant organization have happened in the lines of values and morals held dear by one group of people or the other.

When we approach a technology which seeks to develop and impart the capabilities of a human mind onto a machine, it is also likely that such divisions are likely to repeat itself. However, as opposed to development of human societies, when a few people decided our way of lives, evolution of AI systems in this age of global connectivity and age of information is presenting us an opportunity to involve various stakeholders and from all aspects of its technological, legal, political, ethical, social, economic and other fronts. If we are to avoid repeating the mistakes of our past, a holistic involvement of all views and applied nuances is appropriate to deal with the many obstacles, complexities and challenges that AI technology is presenting and likely to keep presenting in the future. In this, a legal consciousness approach is only a mere tool to organize ourselves in a way which could potentially be beneficial to all.

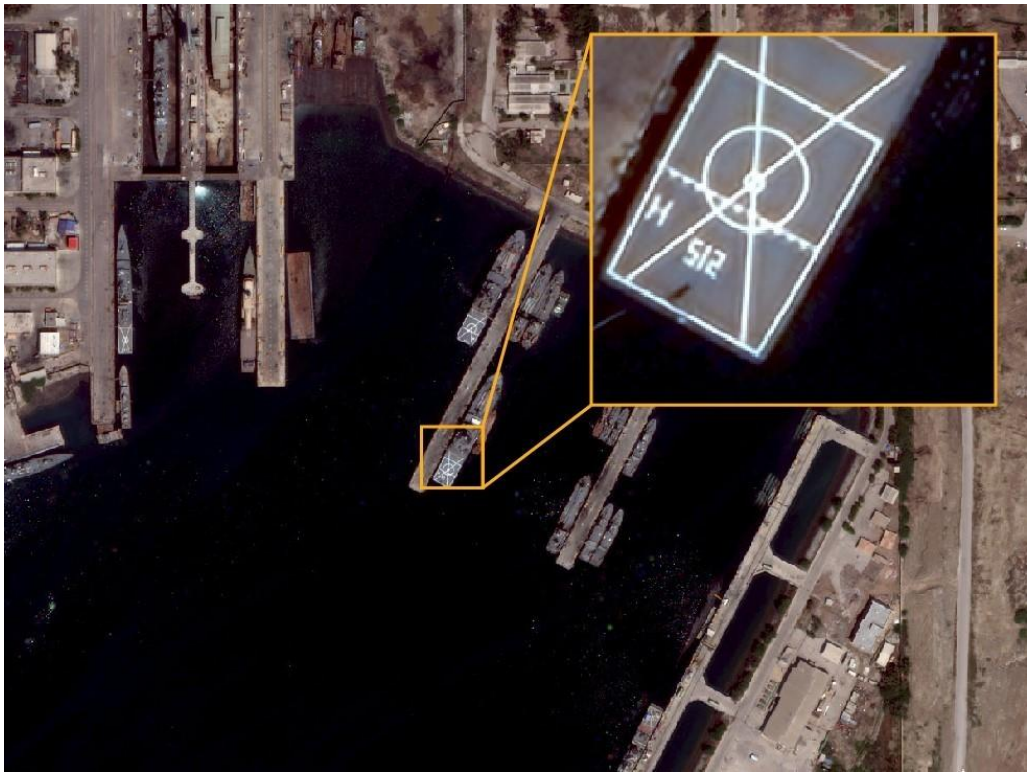
Central ideas behind international space law and AI systems are being designed in similar manner, including provision of common benefits, peaceful purposes, etc. However, like space law, the implementational aspects of AI systems is likely to present, by far, the severest of challenges and complexities. In this, one can only hope that mankind approaches this technology and its regulation in a flexible, fluid and dynamic manner. While the geo-political scenario in the world of today points towards desirability of many structural changes, including in the way legal systems have been designed and operated, specifically at the international level, AI systems and

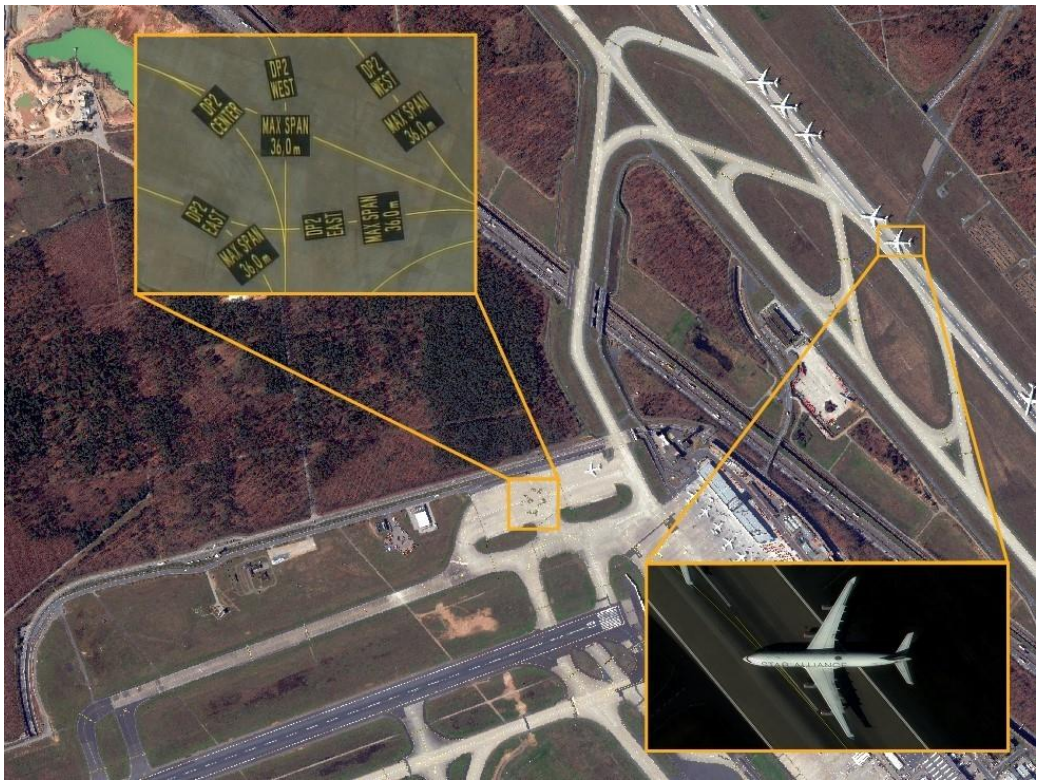
their induction into human activities may yet offer us a second chance to re-evaluate ideas, notions, concepts, mechanisms and mannerisms, instrumentalities, etc. of the whole concept of law, a legal system and its regulation itself.

> In looking at the idea of law itself through a third person perspective, may we empower ourselves to redefine and correct our views towards its functionality and effectiveness. This is imperative to correct the imbalance which we have caused to the environment of the Earth and all lives around us. For, if we keep walking this path of wanton destruction, we surely are headed towards our own doom. For, if in exploitation, we destroy the very source of our lives, then it would all have been for nothing. For, in sustainability, lies the great reckoning of our times. For, in involvement lies our humanity.
>
> Nishith Mishra

ANNEX – I

1.1 Capabilities displayed by Maxar Technologies





1.2 Images released to public during the Russia-Ukraine Military Conflict:

Maxar closeup satellite imagery of resupply trucks and probable multiple rocket launch deployment Berestyanka, northwest of Kyiv, on March 10, 2022.

Part of the Russian military convoy near Ivankiv, Ukraine, on Feb. 28, 2022.

Maxar closeup satellite imagery of destroyed vehicles and bridge damage in Irpin, Ukraine, northwest of Kyiv. Satellite image ©2022 Maxar Technologies.

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