The Big Bang of Space Governance:
Towards Decentralized Regulation of Space Activities

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Abstract

This thesis investigates the nature and architecture of space governance and how it evolved and can and will evolve further, given the absence of a global government or supreme authority. In other words, it investigates how human space activities are steered, notably how the principles and rules applicable to these activities are established, implemented and reformed. The thesis demonstrates that after an initial period of successful development of space governance featuring institutions building and the adoption of space law treaties, from the early days in the late 1950s to the mid-1970s, space governance, as developed by those institutions, has largely been stagnated. This long stagnation is a result of the decline in the rule-making capacity of the main institutions, comparable with the general trend in global affairs. The consequence is that even the most important issues, *e.g.,* space debris, militarization, and utilization of space natural resources, are left insufficiently addressed. The thesis then provides the necessary historical background and the theoretical and methodological tools for the discourse on space governance and its reform. It reviews the emergence and development of global governance and the birth and evolution of the study thereof. The thesis follows with analysis of the structure of space governance and reviews theories of decentralized governance, aiming to suggest a feasible, effective and dynamic model for space governance that will enable a continuous evolution thereof. The thesis is therefore about the *architecture* of global space governance and not about the *content of the norms*.

The thesis reviews three versions or conceptualizations of decentralized governance from three disciplines: (i) the concept of polycentric governance, studied within political economy (institutional analysis), in particular Elinor Ostrom's Nobel Prize winning study on the governance of common-pool resources (CPRs); (ii) the concept of regime complexes, studied within international relations (regime theory); and (iii) the concept of fragmentation, studied within international law. E. Ostrom's study provided strong empirical proof, across States and sectors, supporting the theory of polycentric governance and its merits as developed by the Bloomington School of Political Economy. The transdisciplinary nature of inquiry thus anchors the conclusions of the thesis in both theory and empirical findings.

The thesis takes the current knowledge further by comparing the three concepts and demonstrating cross-disciplinary convergence of the insights from the respective literatures. It further builds on the cumulative insights and by that it applies the empirically tested knowledge on the governance of CPRs to governance in global affairs. Moreover, the thesis introduces and applies this new knowledge to space law and launches a discussion on the *architecture* of space governance. The thesis concludes that the only way to break the governance gridlock is by space governance becoming polycentric, allowing it to evolve in a decentralized and incremental manner. Thus, a separate forum for each sub-issue-areas (*i.e.*, specific issue-areas within the issue-area of space activities, such as militarization of space and space debris), led by stakeholders (active actors) and experts, would establish forums, create rules for that issue, and possibly monitor their application. The aggregate of all forums' work would be feasible and efficient governance, flexible to adapt to changes. In fact, space governance is already on track to become polycentric,

increasingly and inevitably, as stakeholders and experts establish forums that suggest, adopt or push for rules and standards. The result is a gradual emergence of numerous decision-making centers (governance centers) producing numerous, partially overlapping, issue-specific regimes. Still, further action is required to transform space governance to a polycentric system. Moreover, polycentric systems are complex systems and 'complexity studies' demonstrate the necessity of analyzing complex systems as such, since the whole is different than the sum of its parts and the dynamics of the whole, shape the behavior of its parts. Therefore, only perceiving and analyzing space governance as a system in transition to a complex system of polycentric governance, would enable proper understanding of space governance as a whole and each of its parts. A polycentric structure would enable the development of governance under the existing constraints that prevent it from developing otherwise. Furthermore, polycentric governance is characterized by flexibility and adaptability, which are important given the expected changes and disruptions in technologies and commercial models. While adverse effects may be associated with polycentric governance systems, the advantages of polycentric governance exceed the adverse effects, which may be further mitigated in ways, which the thesis discusses. This thesis takes a policy-oriented approach and establishes what may constitute a feasible and effective governance model for human space activities, considering the realities of global politics and the trends in general global governance. In terms of policy recommendations, the thesis suggests that instead of trying to fix the monocentric system, the policy should be to embrace and facilitate a decentralized, polycentric governance system, *i.e*., to relay to and rely on the work of separate governance centers; to divert governance-building efforts to be invested in support of the establishment and operation of these governance centers;

to acknowledge the major role of stakeholders and experts, *i.e.*, in the linkage between activities and voice; and to mitigate the adverse effects of polycentric governance.

After presenting the case for polycentric space governance, the thesis continues to analyse the governance of two sub-issue-areas: space natural resources and space warfare. The thesis discusses the alleged status of space as "global commons" and suggests an approach for the governance of space natural resources that is based on a separate governance center for each resource or area. The thesis analyzes the governance of space warfare as a regime complex and draws a roadmap for the governance of this sub-issue-area.

In conclusion, the thesis builds on the historical background, the theories and the supporting empirical studies to suggest embracing a polycentric model for space governance. It further suggests a key role for stakeholders and experts in space governance, portrays how polycentric space governance may look like in practice and discusses ways to maximize the benefits and mitigate the adverse effects of polycentric governance systems. The normative recommendations for space governance may also suit the governance of other issue-areas in global affairs.

Keywords: space law, global governance, space governance, regulation of space activities, polycentric governance, regime complex, fragmentation, complex systems

Le Big Bang de la Gouvernance Spatiale: Vers une Régulation Décentralisée des Activités

Résumé

L'objectif de cette thèse est d'explorer la nature et l'architecture de la gouvernance spatiale, son évolution passée et future, étant donné l'inexistence d'un gouvernement mondial ou d'une autorité suprême. En d'autres termes, elle vise à étudier comment sont dirigées les activités humaines dans l'espace, notamment comment les principes et les règles applicables à ces activités sont établis, mis en place et réformés. Cette thèse démontre, qu'après une période initiale de développement prolifique, avec la création d'institutions et l'adoption de traités relatifs au droit de l'espace, depuis la fin des années 1950 jusqu'au milieu des années 1970, la gouvernance spatiale, telle que développée par ces institutions, a finalement peu évolué. Cette longue stagnation est une conséquence du déclin de la capacité des principales institutions à réguler, semblable ainsi à la tendance générale observée dans les affaires mondiales. La résultante en est que, même les problématiques les plus importantes, telles que les débris spatiaux, la militarisation, et l'utilisation des ressources naturelles spatiales, n'ont pas été traitées de manière suffisamment efficace. La thèse fournit par la suite le contexte historique nécessaire, ainsi que les outils théoriques et méthodologiques pour une discussion sur la gouvernance de l'espace et sa réforme. Elle se penche sur l'émergence et le développement de la gouvernance mondiale, ainsi que la naissance et l'évolution de son étude. Ensuite, la thèse se poursuit avec l'analyse de la

structure de la gouvernance spatiale, en passant en revue les théories de la gouvernance décentralisée, visant à proposer un modèle réaliste, efficace, et dynamique de celle-ci, lui permettant d'évoluer continuellement. Cette thèse traite donc de l'architecture de la gouvernance mondiale de l'espace, et non du *contenu de ses normes*.

Cette thèse étudie trois formes de conceptualisation de la gouvernance décentralisée, s'inspirant de trois disciplines: (i) le concept de la gouvernance polycentrique, à travers l'économie politique (analyse institutionnelle), et notamment l'étude d'Elinor Ostrom sur les ressources communes, récompensée d'un prix Nobel; (ii) le concept des complexes de régimes (« regim complexes »), dans le cadre des relations internationales (théorie des régimes); et (iii) le concept de la fragmentation, étudié à travers le droit international. L'étude de E. Ostrom fournit une preuve empirique forte, tous Etats et secteurs confondus, militant pour la théorie d'une gouvernance polycentrique en vantant ses avantages, tels que développés par la Bloomington School d'Economie Politique. Le caractère transdisciplinaire de l'investigation de cette thèse établit ainsi ses conclusions dans des éléments à la fois théoriques et empiriques.

La thèse pousse un peu plus loin l'état des connaissances actuelles en comparant les trois concepts, et en démontrant la convergence interdisciplinaire des connaissances issues des différentes sources. En développant davantage les enseignements accumulés jusqu'ici, elle étend les enseignements validés empiriquement en matière de gestion des ressources communes à la gouvernance des affaires mondiales. De plus, elle introduit et étend ces nouvelles connaissances au droit de l'espace et ouvre ainsi une discussion sur *l'architecture de la gouvernance spatiale*. La thèse conclut que le seul moyen de résoudre le problème de

la gouvernance spatiale est de la rendre polycentrique, lui permettant ainsi de poursuivre une évolution décentralisée et progressive. Ainsi, un forum dédié à chaque sous-domaine (c'est-à-dire un domaine spécifique au sein même des activités spatiales, tels que la militarisation de l'espace ou les débris spatiaux), dirigé par des parties prenantes (acteurs actifs) et des experts, établirait des forums, permettrait d'instituer des règles propres à ce domaine, et potentiellement de veiller à leur application. La compilation des travaux de chacun de ces forums pourrait donner lieu à une gouvernance réaliste et efficace, et suffisamment flexible pour s'adapter aux changements. Dans les faits, la gouvernance spatiale est déjà de plus en plus en passe de devenir polycentrique, et ce, de manière inévitable, à mesure que les parties prenantes et les experts créent des forums qui suggèrent, adoptent ou font pression pour l'adoption de règles et de normes. On observe ainsi une émergence progressive de nombreux centres de décision (centres de gouvernance) produisant de nombreux régimes spécifiques, se chevauchant parfois partiellement. Néanmoins, d'autres types d'actions sont nécessaires pour pouvoir transformer la gouvernance spatiale en un système totalement polycentrique.

Par ailleurs, les systèmes polycentriques étant des systèmes complexes, il convient de les analyser en tant que tels, selon la règle qui veut que le tout n'est pas simplement la somme des parties, et que la dynamique de l'ensemble détermine le fonctionnement de chacun de ses éléments, comme le démontrent les « études de complexité ». Par conséquent, faire évoluer la réflexion sur la gouvernance de l'espace d'un système en transition à un système complexe de gouvernance polycentrique nécessite une connaissance approfondie de la gouvernance spatiale, que ce soit de l'ensemble ou de chacune de ses composantes. Aussi, Une structure polycentrique permettrait le développement de la gouvernance en dépit des

contraintes existantes, qui l'empêchent actuellement de se développer. Par ailleurs, la gouvernance polycentrique se caractérise par sa flexibilité et son adaptabilité, qui constituent des éléments importants compte tenu des multiples changements et bouleversements à venir dans le domaine des technologies et des modèles commerciaux. Bien que l'on prête parfois des effets néfastes aux systèmes de gouvernance polycentriques, leurs avantages surpassent ceux-ci, ces derniers pouvant par ailleurs être réduits, comme cela sera exposé dans la thèse. Cette thèse adopte une démarche orientée vers l'action politique et définit comment constituer un modèle de gouvernance réaliste et efficace pour les activités humaines dans l'espace, en tenant compte des réalités de la politique mondiale et des tendances en termes de gouvernance globale. En termes de recommandations politiques, la thèse propose que, plutôt que de tenter d'améliorer le système mono centrique, la politique devrait se concentrer sur la poursuite et la facilitation d'un système de gouvernance décentralisé et polycentrique, c'est-à-dire transmettre et s'appuyer sur les travaux de centres de gouvernance distincts; diversifier les efforts de soutien de la gouvernance, qui doivent être investis dans le but de soutenir la création et le fonctionnement de ces centres de gouvernance; reconnaître le rôle majeur des parties prenantes et des experts, dans leur lien entre les activités et les paroles; et enfin, tenter de réduire les effets néfastes de la gouvernance polycentrique.

Après la présentation des arguments en faveur d'une gouvernance polycentrique, la thèse continuera d'analyser la gouvernance de deux sous-domaines: les ressources naturelles de l'espace et la guerre dans l'espace. La thèse discute du statut implicite de l'espace en tant que « patrimoine commun de l'humanité » et propose un système de gouvernance des ressources naturelles spatiales par ressource ou par zone, avec un centre de gouvernance

dédié. La thèse analyse la gouvernance de la guerre spatiale en tant que complexe de régime et établit une feuille de route pour la gouvernance de celle-ci.

Pour conclure, la thèse s'appuie sur le contexte historique, les théories et les études empiriques à l'appui pour suggérer l'adoption d'un modèle polycentrique de gouvernance de l'espace. Elle souligne en outre le rôle clé que doivent jouer les parties prenantes et les experts en gouvernance spatiale, dépeint une gouvernance spatiale polycentrique dans la pratique, et présente les différents moyens d'en maximiser les avantages et d'en réduire les effets néfastes. Les recommandations normatives pour la gouvernance de l'espace sont également transposables à la gouvernance d'autres domaines d'activités dans les affaires mondiales.

Mots clés: droit de l'espace, gouvernance mondiale, gouvernance spatiale, régulation des activités spatiales, gouvernance polycentrique, complexe de régime, fragmentation, systèmes complexes

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I bear the sole responsibility for all the mistakes, errors,and misconceptions and for the recommendations of this thesis.

Short Table of Contents

Chapter 1: Introduction
This chapter presents the theme of the thesis - space governance. It portrays the evolution of space governance from the early days until now, and the rise and demise of the monocentric structure thereof. The chapter then presents the problem that this thesis addresses: How can space governance reform and evolve within an international system characterized by anarchy? Finally, the chapter outlines the full thesis that follows in the next chapters.

Chapter 2: The Evolution of Global Governance and of the Study Thereof
This chapter provides a historical background to the thesis. It presents the emergence and development of global governance, mainly from the 17th century until the present. It also elaborates on the concept of global governance and its various definitions over the years. It then presents the birth and evolution of the academic study of global governance from the first days and up to the current and emerging trends in the study of global governance.

Chapter 3: Methodology and Theoretical Framework
This chapter presents the methodology and methods employed to address the research question. It further presents the theoretical approach of the thesis. It explains the choice of the theories and concepts that serve as the pillars of the theoretical approach and provides a literature review thereof. Furthermore, it demonstrates their convergence and builds on the cumulative insights from the respective literatures.

Chapter 4: The Case for Polycentric Space Governance
This chapter builds on the previous chapters to suggest a feasible and effective model for space governance *i.e.,* polycentric governance. It provides the transition from the theoretical inquiry to policy recommendations. It further presents what it identifies as a slow-motion big bang of space governance, as space governance is already on track to become polycentric. It explicates why we need to think of and analyze space governance as a system in transition to polycentric governance. Finally, it points to ways to maximize the advantages and mitigate the adverse effects of polycentric governance and suggests a policy to further promote polycentric governance of human space activities.

Chapter 5: The Governance of the Space Commons
This chapter critically reviews the renewed debate on space being 'global commons', held in the context of the utilization of space natural resources. It suggests that the debate is crippled by misunderstanding and use of the concepts of commons and global commons. The chapter then provides a critical analysis of the 'commons' feature of outer space and

outer space natural resources, based on economic analysis and legal theory. The chapter notably differentiates between (i) commons as an *economic* term; and (ii) commons as a *legal* regime, and demonstrates that the concept of 'global commons' is of limited or unclear meaning and it does not imply the property rights regimes in the domains and resources it presumably describes, including outer space. Finally, the chapter discusses the architecture of the governance of space natural resources and its place within a polycentric system of space governance.

Chapter 6: The Governance of Space Warfare

This chapter analyses the governance of space warfare as a 'regime complex'. It maps the regime complex and discusses the various theaters for space warfare and the respectively applicable rules and mandated institutions. It finally provides a roadmap for the governance of space warfare under the constrains of global politics. In terms of policy recommendations, it calls for working within the regime complex: expanding its elements and introducing new ones, leading to gradual development of a flexible network of regimes, covering in the aggregate a large part of the issue area of space warfare.

Chapter 7: Conclusion

This chapter summarizes the main conclusions and insights of the entire thesis.

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List of Acronyms

A	
APSCO	Asia-Pacific Space Cooperation Organization
ASAT	Anti-satellite
ATS	Antarctica Treaty System
B	
BCE	Before Common Era
BIRPI	United International Bureaux for the Protection of Intellectual Property
BIS	Bank of International Settlement
C	
CD	Conference on Disarmament
CHM	Common heritage of mankind
CRAMRA	Convention on the Regulation of Antarctic Mineral Resource Activities
CRASL	McGill Centre for Research in Air and Space Law
CPR	Common-pool resource
CSIS	Center for Strategic and International Studies
CUSMA	Canada-United States-Mexico Agreement
D	
E	
ECSL	European Centre for Space Law
ESA	European Space Agency
ESIL	European Society of International Law
ESPI	European Space Policy Institute
EUTELSAT	European Telecommunications Satellite Organization
EU	European Union
F	
G	
GAL	Global administrative law
GATT	General Agreement on Tariffs and Trade
GEO	Group on Earth Observations
GGE	Group of Governmental Experts
GONGO	Government-organized non-governmental organizations
GPS	Global Positioning System

H

I

IAASS	International Association for the Advancement of Space Safety
IASL	McGill's Institute of Air and Space Law
IATA	International Air Transport Association
IAD	Institutional analysis and development
IADC	Inter-Agency Space Debris Coordination Committee
IATA	International Air Transport Association
IBWM	International Bureau of Weights and Measures
ICAN	International Commission for Air Navigation
ICAO	International Civil Aviation Organization
ICC	International Chamber of Commerce
ICC	International Criminal Court
ICG	International Committee on Global Navigation Satellite Systems
ICJ	International Court of Justice
ICoC	International Code of Conduct for Outer Space Activities
ICT	Information and communications technology
IDAC	Inter-Agency Space Debris Coordination Committee
IGO	Intergovernmental organization
ILC	International Law Commission
ILO	International Labor Organization
IMF	International Monetary Fund
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
INTERPOL	International Criminal Police Organization
IO	International organizations
IPE	International political economy
IR	International relations
IRCA	International Railway Congress Association
ISO	International Organization for Standardization
ISS	International Space Station
ITU	International Telecommunication Union

J

JAXA	Japan Aerospace Exploration Agency

K

L

LOAC	Laws of armed conflict

M

MILAMOS	McGill Manual on International Law Applicable to Military

	Activities in Outer Space
MTCR	Missile Technology Control Regime
N	
NAFTA	North American Free Trade Agreement
NATO	North Atlantic Treaty Organization
NFP	No first placement
NGO	Non-governmental organization
NIE	New Institutional Economics
O	
OECD	Organisation for Economic Co-operation and Development
OEWG	Open-Ended Working Group
OST	Outer Space Treaty
P	
PAROS	Prevention of an arms race in outer space
PCIJ	Permanent Court of International Justice
PGR	Plant genetic resources
PORBOS	Principles of responsible behavior in outer space
PPWT	Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects
PTBT	Partial Test Ban Treaty
Q	
R	
R&D	Research and development
RTU	Radiotelegraph Union
S	
SES	Société Européenne des Satellites
SNA	Social network analysis
SSA	Space situational awareness
SSOD	Special Sessions on Disarmament
STM	Space Traffic Management
SWF	Secure World Foundation
T	
TCBM	Transparency and confidence-building measures
U	
UAE	United Arab Emirates
UIC	International Union of Railways
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDIR	United Nations Institute for Disarmament Research

UN-COPUOS	UN Committee on the Peaceful Uses of Outer Space
UNGA	UN General Assembly
UNODA	United Nations Office for Disarmament Affairs
UNOOSA	UN Office for Outer Space Affairs
UPU	Universal Postal Union
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
UNRCSSTE	UN Regional Centers for Space Science and Technology Education
V	
VCSS	Voluntary consensus standard setting
W	
WHO	World Health Organization
WTO	World Trade Organization
X	
Y	
Z	

Preface

This thesis is the second major research project under my research agenda of transnational cooperation involving States and non-State actors.

The previous major research project focused on international cooperation in general and in space activities in particular, and it was titled "International Cooperation in Space Activities: Legal Imperative and the Chinese Perspective"[1]. In a nutshell, it reviews (i) the status of the principle of 'international cooperation' in international law and in Space Law; and (ii) the Chinese perception and policy regarding international cooperation, in general and in space activities in particular. The research concluded that 'international cooperation' is one of the basic principles of international law, defining modern international law as the 'international law of cooperation'. 'International cooperation', as the research found, is also a structural principle and legal duty under Space Law, but not under general international law. Furthermore, the research demonstrated that China's expressed policy is consistently supportive of international cooperation, as a matter of ideology and national interest, as evidenced in official statements in international *fora* and domestically as well as in policy papers.

In the absence of a supreme authority, global governance is made by way of international cooperation and by (mutual) adjustments of the actors in global affairs. This second major research project is therefore the natural continuance of the previous one. Together they

[1] Eytan Tepper, *International Cooperation in Space Activities: Legal Imperative and the Chinese Perspective* (Springer forthcoming).

represent a coherent research agenda, which envisions transnational cooperation in space research and activities, promoting technological development and commercial expansion for the benefit of humankind. The two major research projects are complementing parts of a quest for feasible and effective mechanisms and governance structures facilitating cooperative and collective action related to space activities.

The undersigned (E.T.) wrote each and every chapter of this thesis as a single author.

Eytan Tepper
Montréal, August 2019

Chapter 1
Introduction

> *Questions come no grander than asking how the world is governed, how we have ended up with the global governance that we currently have, and what kind of order we ought to put in place to correct the myriad ills that afflict humanity and the planet that we so willfully neglect.*[2]

This chapter presents the theme of the thesis - space governance. It portrays the evolution of space governance from the early days until now, and the rise and demise of the monocentric structure of space governance. The chapter demonstrates that space governance is at a crossroad; that the attempt to create a central governance of space activities has reached an impasse, owing to structural deficiencies that result in the failure to properly and effectively address even the most pressing challenges in space. The chapter then presents the problem that this thesis addresses, that is, the search for a model of governance that would enable the evolution of space governance, given an international system characterized by anarchy. Finally, the chapter outlines the full thesis that follows in the next chapters.

[2] Thomas G. Weiss and Rorden Wilkinson, 'Global Governance to the Rescue: Saving International Relations?' (2014) 20 Global Governance 19, 20.

1.1 What is Space Governance

The concept of space governance, or global space governance, is derived from the concept of global governance. Global governance is a wide term that is open to multiple elucidations and versions and "notoriously slippery."[3] Many have struggled and grappled to define it[4] and others criticized the concept for allegedly having an underlying agenda, ignoring the South or being analytically misleading[5]. Chapter 2 will elaborate on the different definitions of global governance from the introduction of the concept in the 1990s until today. This section provides my definition of global governance and of (global) space governance.

The word 'governance' comes from the Greek word "*kubernaein*" which means to steer, to guide. It is defined in dictionaries as the "action or manner of governing"[6] or "the way that organizations or countries are managed at the highest level, and the systems for doing this"[7]. I define global governance as *the steering of global affairs*,[8] which is made mainly by *guiding the behavior of actors in global affairs*. What guides the behavior of actors in global affairs, and therefore steers global affairs, is mainly the cumulative effects of the repertoire

[3] Thomas G Weiss and Rorden Wilkinson, 'Rethinking Global Governance? Complexity, Authority, Power, Change' (2014) 58 International Studies Quarterly 207.

[4] James N Rosenau, 'Governance in the Twenty-First Century' (1995) 1 Global Governance 13; Lawrence S. Finkelstein, 'What Is Global Governance?' (1995) 1 Global Governance 367; Commission on Global Governance, *Our Global Neighbourhood: The Report of the Commission on Global Governance* (Oxford University Press 1995); United Nations Development Programme (UNDP), *Human Development Report* (Oxford University Press 1999); Thomas G, Weiss and Ramesh Thakur, *Global Governance and the UN: An Unfinished Journey* (Indiana University Press 2010); Adil Najam, Mihaela Papa and Nadaa Taiyab, *Global Environmental Governance: A Reform Agenda* (International Institute for Sustainable Development 2006).

[5] Henk Overbeek and others, 'Forum: Global Governance: Decline or Maturation of an Academic Concept?' (2010) 12 International Studies Review 696.

[6] Oxford English Dictionary, '"governance" (Definition)' (*Oxford Dictionaries | English*) <https://en.oxforddictionaries.com/definition/governance> accessed 18 April 2019.

[7] Cambridge English Dictionary, '"governance" (Definition)' <https://dictionary.cambridge.org/dictionary/english/governance> accessed 18 April 2019.

[8] This definition draws from a definition associated to Adil Najam, a beautifully simple definition - that global governance is "the management of global processes in the absence of global government". I did not find any direct quote of Najam, only several other sources noting his purported definition, without a direct quote. See, for example, Malcolm D. Childress, 'International Natural Resources Governance Initiatives' in Grenville Barnes and Brian Child (eds), *Adaptive Cross-scalar Governance of Natural Resources* (Routledge 2014) 56.

of applicable norms, principles, rules, policy instruments and other applicable instruments and the work of organizations, institutions and other *fora*. Unilateral actions also influence global affairs, especially those of powerful States, as well as other non-multilateral actions and agreements by and between the various actors and fora, to the extent that they influence the behavior of other actors in global affairs. This definition views governance as dynamic in nature – a *process* - and not as a static picture which is the aggregate or sum of norms, rules etc., captured in a single moment in time[9]. Global governance is a continous process, like the steering of a ship without a captain, where the ship never stops. The process is stirred by a combination of norms, principles, rules, policies, institutions and fora that all influence the behavior of the actors in global affairs.

Global space governance, or simply space governance, is the governance of an issue-area in global affairs, the issue-area of human space activities and of outer space. It includes (i) the governance of human space activities; (ii) the governance of human installations in space, *e.g.,* the International Space Station (ISS). In future, it will further include (iii) the governance of areas and resources in space that are used or claimed by humans; and (iv) the governance of human colonies in space. Whereas States have jurisdiction on human installations registered with them, the areas and resources in space are beyond national jurisdictions and are considered by many to be 'global commons'. Whether or not these areas and resources are actually 'global commons', will be discussed in chapter 5. Space governance is stirred by multilateral institutions and international treaties but also, as discussed herein, by other factors.

[9] Weiss and Thakur define global governance as "the sum of laws, norms, policies, and institutions that define, constitute, and mediate relations among citizens, society, markets, and the state in the international arena—the wielders and objects of international public power" (Thomas G Weiss and Ramesh Thakur, *Global Governance and the UN: An Unfinished Journey* (Indiana University Press 2010)).

1.2 The Rise, Demise and Possible Reform of Space Governance

1.2.1 The Emergence of Space Governance

The governance of space activities had a promising beginning. The first two decades following Sputnik1 saw a burst of norms creating UN General Assembly (UNGA) declarations, space law treaties and institutions building. Those were the glory days of space governance, when all the principles and rules we have today (and still try to make sense of) were adopted. Within a year from the Soviet launch of the first artificial earth satellite, Sputnik1, in October 1, 1957, the UNGA adopted a declaration introducing basic principles[10] and a year later established the UN Committee on the Peaceful Uses of Outer Space (UN-COPUOS)[11]. UN-COPUOS, in turn, was "instrumental"[12] in the preparation and adoption of the 1963 UNGA Declaration setting the principles of space law[13] and the five space law treaties introduced between 1967 and 1979. The treaties were all initially negotiated in and adopted by UN-COPUOS – with negotiations being led by the US and USSR – and later adopted by the UNGA and ratified by States. Of the five treaties, the 1967 Outer Space Treaty (OST)[14] is the most important as it established the basic norms and principles of space law and may be regarded as the "constitution" of space law. The OST was followed by four treaties, each expanding on specific provisions of the OST: one on the rescue of

[10] UNGA Resolution RES 1348 (XIII): Question of the Peaceful Use of Outer Space, adopted 13 December, 1958.

[11] http://www.unoosa.org/oosa/en/ourwork/copuos/index.html.

[12] As the committee's website phrases: Committee on the Peaceful Uses of Outer Space <http://www.unoosa.org/oosa/en/ourwork/copuos/index.html> accessed 20 January 2017. See also Manfred Lachs, *The Law of Outer Space: An Experience in Contemporary Law-Making* (Martinus Nijhoff Publishers 1972) p. 30 onwards.

[13] UNGA Res. 1962 (XVIII): Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, adopted 13 December 1963.

[14] Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies 1967 (Jan 27, 1967, 18 UST 2410; 610 UNTS 205; 6 ILM 386).

astronauts and space crafts[15], one on liability,[16] one on the registration of space objects with the UN,[17] and one on the utilization of natural resources on celestial bodies in the solar system. Unlike the first four treaties, which gained wide acceptance and ratification, this fifth and so far last space law treaty, known as the Moon Agreement of 1979[18] gained ratification from merely 18 States, none of them are the main spacefaring nations.[19] The treaty gathered enough ratifications to enter into force but it is not binding on most States, though there is a recent renewed interest in the Agreement, with possible future ratifications by Germany and Russia, that may bring to life an agreement widely considered a failed treaty. While the Moon Agreement is often used in legal analysis, its ratifications status mandates caution with such use, as it does not represent, so far, wide agreement on what States see, or willing to see, as applicable rules. All in all, there are four widely accepted and binding space law treaties.

There are five major UNGA declarations on space issues that although not legally binding[20], provide widely accepted normative framework on several issues, namely: the above mentioned 1963 Declaration of legal principles governing States' space activities, the 1982 Declaration on the use of satellites for direct television broadcasting, the 1986 Declaration

[15] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space 1968 (672 UNTS 119).

[16] Convention on International Liability for Damage Caused by Space Objects 1972 (961 UNTS 187).

[17] Convention on Registration of Objects Launched into Outer Space 1974 (1023 UNTS 15).

[18] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies 1979 (1363 UNTS 3).

[19] UN Committee on the Peaceful Uses of Outer Space, 'Status of International Agreements Relating to Activities in Outer Space as at 1 January 2019' (2019) A/AC.105/C.2/2019/CRP.3 <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html> accessed 15 April 2019.

[20] Gaetano Arangio-Ruiz, *The United Nations Declaration on Friendly Relations and the System of the Sources of International Law* (Sijthoff & Noordhoff 1979); Stephen M. Schwebel, 'The Effect of Resolutions of the U.N. General Assembly on Customary International Law' (1979) 73 Proceedings of the Annual Meeting (American Society of International Law) 301.

on remote sensing, and 1992 Declaration on the use of nuclear power sources in space, and the 1996 Declaration on international cooperation and space benefits.[21]

The main factors in the process of space governance, *i.e*., in the steering of space activities, or in guiding the behavior of actors in space affairs, are: UN-COPUOS and the United Nations Office for Outer Space Affairs (UNOOSA)[22], including their sub-committees, working groups and activities; the principles set in the five major UNGA declarations on space issues; the rules set in the four widely-accepted space law treaties, first and foremost the OST; soft law instruments, such as the 2007 Space Debris Mitigation Guidelines [23]; and to a lesser extent the UNGA resolutions on space related issues[24]. Further, space governance includes the effects of the activities of multilateral *fora*, NGOs, research institutes and national governments (especially of major powers), which affect, to a certain extent, the expectations and behavior of actors in the realm of space. It therefore includes the impacts of *fora* such as UN-SPIDER[25], UNRCSSTE[26], GEO[27], IDAC[28], ICG[29] and APSCO[30];

[21] Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (1963); The Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting (1982); The Principles Relating to Remote Sensing of the Earth from Outer Space (1986); The Principles Relevant to the Use of Nuclear Power Sources in Outer Space (1992); 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 (1996). A list of declarations and their full version is available online at <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html> accessed 16 January 2017.

[22] <http://www.unoosa.org/oosa/en/aboutus/index.html>.

[23] UNOOSA, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (Vienna, 2010) <http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 16 January 2017. On the space-related soft law instruments see: UNOOSA, Compendium on mechanisms adopted in relation to non-legally binding United Nations instruments on outer space <http://www.unoosa.org/oosa/en/ourwork/spacelaw/nlbcompendium.html> accessed 16 January 2017.

[24] A list of the resolutions and their full version is available online at <http://www.unoosa.org/oosa/en/ourwork/spacelaw/resolutions.html> accessed 16 January 2017.

[25] The United Nations Platform for Space-based Information for Disaster Management and Emergency Response < http://www.un-spider.org>.

[26] UN Regional Centers for Space Science and Technology Education (UNRCSSTE), established under a UN initiative. See United Nations General Assembly Resolution 45/72 of 11 December 1990 <http://www.unoosa.org/oosa/en/SAP/centres/index.html> accessed 4 March 2015.

[27] The intergovernmental Group on Earth Observations <https://www.earthobservations.org>.

the impact of the activities of NGOs such as the Secure World Foundation[31]; the institutes of (air and) space law in several universities across the world (Cologne, McGill, Leiden, Beijing Institute of Technology, Harbin Institute of Technology), the European Space Policy Institute (ESPI)[32], and the European Centre for Space Law (ECSL)[33]; it also includes the activities of the major actors in space, *e.g.,* the US, Russia, China, India and the European Space Agency (ESA). While the above is not an exhaustive list, it covers the main factors guiding actors' expectations and behavior.

It is UN-COPUOS and its legal sub-committee that are entrusted with the development of space law. The UNGA resolution establishing the committee has stipulated its mandate which includes: "…[t]o study the nature of legal problems which may arise from the exploration of outer space".[34] The paralysis in UN-COPUOS is a major factor in the crisis of space governance, together with the conditions of global politics that contributed to paralysis in UN-COPUOS in the first place. The next section reviews the crisis in space governance.

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[28] The Inter-Agency Space Debris Coordination Committee <http://www.iadc-online.org>.

[29] The International Committee on Global Navigation Satellite Systems <http://www.unoosa.org/oosa/SAP/gnss/icg.html>.

[30] The Asia-Pacific Space Cooperation Organization <http://www.apsco.int>.

[31] <https://swfound.org>.

[32] <http://www.espi.or.at>.

[33] <http://www.esa.int/About_Us/ECSL_European_Centre_for_Space_Law>.

[34] UNGA Resolution 1472(XIV): International Co-operation in the Peaceful Uses of Outer Space, adopted December 12, 1959 provides: "The General Assembly...[e]stablishes a Committee on the Peaceful Uses of Outer Space... [t]o review... the area of international co-operation... including...[t]o study the nature of legal problems which may arise from the exploration of outer space".

1.2.2 A Four Decade Stagnation

As the Chair of UN-COPUOS noted, "the rules that have been codified in the series of treaties signed and ratified almost 60 years ago. . . are showing their age"[35]. Yet, no legally binding treaty was adopted since 1979[36], and none is expected in the foreseeable future. Instead, several soft law instruments were adopted in the form of UNGA resolutions and declarations[37], which are not legally binding. The legally binding space law rules, unchanged since the 1970s, fail to sufficiently address even the most important or pressing challenges, notably military uses of space, space debris, and the utilization of space natural resources. Furthermore, it is unlikely that a new treaty will be introduced in the foreseeable future. Treaty-based space law can no longer evolve to meet the emerging challenges of space exploration and utilization. According to the procedure at UN-COPUOS, decisions are made by consensus, which provides them wide acceptance but also stalls or even prevents decision-making.[38] The committee is practically paralyzed[39], devoid of the

[35] David Kendall, 'Second Foreword' in Ram S Jakhu and Joseph N Pelton (eds), *Global Space Governance: An International Study* (Springer International Publishing 2017).

[36] Except UNIDROIT's 2012 Berlin Space Assets Protocol (Protocol to the Convention on International Interests in Mobile Equipment on Matters specific to Space Assets) to the 2001 Cape Town Convention on International Interests in Mobile Equipment <http://www.unidroit.org/instruments/security-interests/space-protocol> accessed 16 January 2017.

[37] See, for example, UN General Assembly Resolution 37/92: Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting, adopted 10 December 1982 (A/RES/37/92); UN General Assembly Resolution 41/65: Principles Relating to Remote Sensing of the Earth from Outer Space, adopted 3 December 1986 (A/RES/41/65); UN General Assembly Resolution 47/68: Principles Relevant to the Use of Nuclear Power Sources in Outer Space, adopted 14 December 1992 (A/RES/47/68); UN General Assembly Resolution 51/122: 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 adopted 13 December 1996 (A/RES/51/122); UN General Assembly Resolution 73/30: Prevention of an arms race in outer space, adopted December 5, 2018 (A/RES/73/30); UN General Assembly Resolution 69/32: No First Placement of Weapons in Outer Space, adopted 2 December 2014 (A/RES/69/32).

[38] Francis Lyall and Paul B Larsen, *Space Law, A Treatise* (Ashgate 2009), 18–22.

[39] Ram S. Jakhu, 'Sixty Years of Development of International Space Law' (2016) in Proceedings of the Symposium Celebrating the 90th Anniversary of the Cologne Institute of Air and Space Law.

capacity to continue to develop space law[40]. (Hard) space law, and with it the existing system of space governance, based on UN-COPUOS multilateral rulemaking, has been stagnating for nearly four decades, with no signs of change. The prolonged gridlock puts the system of space governance at risk of gradually losing its relevance. *There is a widespread acknowledgment of the need for change, but there is no emerging consensus on what kind of change and how to accomplish it*[41].

Governance gaps are already starting to be filled in various ways. Some States have already resorted to unilateral action, whether by developing space weapons and executing anti-satellite (ASAT) tests, and national legislation, in what may become a trend of retreat from multilateral arrangements. Notably, in 2015 the US adopted a law granting US companies property rights in space natural resources they obtain[42], an example Luxemburg has already followed in 2017[43] and the UAE intends to follow[44]. Another response for the governance gap is a retreat from the wide multilateral forum of UN-COPUOS to a small,

[40] Tare Brisibe, 'Parliamentary Diplomacy in the United Nations and Progressive Development of Space Law' (2016) 18 European Journal of Law Reform 6; Eilene M. Galloway, 'Consensus Decisionmaking by the United Nations Committee on the Peaceful Uses of Outer Space' (1979) 7 Journal of Space Law 3; Rajeswari Pillai Rajagopalan, 'Space Governance' [2018] Oxford Research Encyclopedia of Planetary Science <http://oxfordre.com/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-107> accessed 17 February 2019.

[41] Kai-Uwe Schrogl, 'The New Debate on the Working Methods of the UNCOPUOS Legal Subcommittee' (2014) 105 Acta Astronautica 101; Tare Brisibe, 'Parliamentary Diplomacy in the United Nations and Progressive Development of Space Law' (2016) 18 European Journal of Law Reform 6.

[42] H.R.2262 U.S. Commercial Space Launch Competitiveness Act of November 25, 2015. Public Law No: 114-90, the bill and official texts available online <https://www.congress.gov/bill/114th-congress/house-bill/2262> accessed 31 July 2016. See Chapter 513 of the Act - Space Resource Commercial Exploration and Utilization.

[43] Law on the Exploration and Use of Space Resources (original French: Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace) <http://data.legilux.public.lu/file/eli-etat-leg-loi-2017-07-20-a674-jo-fr-pdf.pdf> accessed 30 September 2018.

[44] L. Barnard, UAE to Finalise Space Laws Soon, The National, March 7, 2016 <http://www.thenational.ae/business/aviation/uae-to-finalise-space-laws-soon> accessed 27 June 2017.

stakeholders-based forum, such as the forum of space agencies that adopted guidelines on the mitigation of space debris.[45]

While there are challenges to the governance of sub-issue-areas in space governance, *e.g.,* to the governance of space natural resources, military uses, space debris and space traffic control, *the overarching challenge is for the system itself*.[46] As this section demonstrates, there is a crisis in global space governance that threatens the relevance of the institutions and rules altogether. As Finnemore noted, effectiveness is "crucial to the trajectory of global governance . . . Ineffective governance and bad performance can damage the authority and, thereby, the power of governing structures"[47].

The crisis in space governance is part of the big picture of global affairs, of a system-wide phenomenon across all segments of global governance, not limited to the space realm. Indeed, "[t]raditional forms of international legalization and negotiation through universal consensus-based institutions are stagnating".[48] The deficiencies and challenges of space governance have led to this thesis in search for a better model for space governance.

[45] UN Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, Vienna 2010 < http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 11 August 2019.

[46] Rajagopalan similarly noted: "…there are several challenges facing the global governance of space, but the critical one is the lack of consensus among major spacefaring powers and the crisis in decision-making, which has paralyzed the process of developing an effective outer space regime. Though there are a few legal instruments in place, they have been proven to be increasingly ineffective" Rajeswari Pillai Rajagopalan, 'Space Governance' [2018] Oxford Research Encyclopedia of Planetary Science <http://oxfordre.com/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-107> accessed 17 February 2019.

[47] Martha Finnemore, 'Dynamics of Global Governance: Building on What We Know' International Studies Quarterly (2014) 58, 221.

[48] John Gerard Ruggie, 'Global Governance and "New Governance Theory": Lessons from Business and Human Rights' Global Governance 20 (2014), 5.

1.2.3 Crisis and Opportunity: In Search for a Better Model for Space Governance

There is a myth that in the Chinese language, the word for 'crisis' includes the meaning of 'opportunity'. While this is no more than a myth[49], the underlying notion is real –a crisis is often also an opportunity, notably for change and betterment.

The crisis in space governance has not escaped the eyes of the space community. The 2014 Manfred Lachs International Conference, organized by McGill University's Institute of Air and Space Law ("McGill IASL" or, the "Institute")held in Montréal, was devoted to this issue under the theme Global Space Governance. The conference culminated with the Montréal Declaration, which noted that "the current global space governance system that was created during the 1960s and 1970s has not been comprehensively examined since. . . [although] numerous developments have occurred . . . with serious implications". The Declaration further asserted that "the time has come to. . . propose an appropriate global space governance system"[50]. The Institute subsequently launched an international study, the outcomes of which were published[51] and also presented at various international *fora*, including UN-COPUOS and the UNGA. The study explores the existing mechanisms of global governance; regional and national perspectives; and around 20 specific issue-areas, *e.g.,* satellite telecommunications, remote sensing and Earth observation, global space security, Global Navigation Satellite Systems (GPS and others) ,among others. However, the study

[49] The widespread mistake claims that in the Chinese crisis = danger + opportunity. The Chinese word for crisis does include two characters - 危机 (pinyin: wēijī) -, the first of which means danger, but the second does not mean opportunity. 机(pinyin: jī) has several meanings, including 'incipient moment', and 'machine'. Indeed, the word 机会 (pinyin: jīhuì), which includes 机 as a component, does mean 'opportunity', but 'opportunity' is not a meaning that is included in the single character of 机. See Victor H. Mair, How a misunderstanding about Chinese characters has led many astray, Pīnyīn Info <http://www.pinyin.info/chinese/crisis.html> accessed 16 January 2017.

[50] Montréal Declaration, adopted at the 2nd Manfred Lachs International Conference on Global Space Governance, held at McGill University, in Montreal, Canada, May 31, 2014.

[51] Ram S. Jakhu and Joseph N. Pelton (eds), *Global Space Governance: An International Study* (Springer 2017). The author of this thesis took part in the study as core drafter and reviewer.

does not address a structural change in the entire system of global space governance, which is the focus of this thesis and, as this thesis argues, is where the key problem – and opportunity for change – lay.

"A crisis is a terrible thing to waste" said Nobel Laureate Paul Romer (economic sciences, 2018).[52] The crisis that space governance is experiencing led to the launch of this thesis in a search for innovative governance models.[53] This crisis is also an opportunity for change, the road for which will be discussed in the following chapters. The Montréal Declaration asserted that "the time has come to. . . propose an appropriate global space governance system" and this thesis does just that.

1.3 The Space between Global Governance and Space Governance

While space is an issue-area in global affairs, it has some distinct features. One such feature is the spirit that inspired the pioneers of the space quest, including those in leadership positions. The idea was to conduct things better in the new realm of space and especially, as stipulated as the first goal in the first UNGA resolution on space exploration: "to avoid the extension of present national rivalries into this new field"[54]. It is not a coincidence that two of the three waves of international organizations Murphy counted (and are elaborated in Chapter 2), were organizations in our subject matter- the International Telecommunication Union (ITU) and INTELSAT[55]. It is also true that the inspiration of space did not eliminate all national rivalries and other human shortcomings. The absence

[52] Jack Rosenthal, 'A Terrible Thing to Waste' *The New York Times* (31 July 2009) <https://www.nytimes.com/2009/08/02/magazine/02FOB-onlanguage-t.html> accessed 2 November 2018.

[53] See also: Eytan Tepper, 'Global Space Governance: The Crisis and the Search for Innovative Governance Models' in Elżbieta Dynia and Lidia Brodowski (eds), *Aviation and Space Law and Technology* (Rzeszów University Publishing 2017).

[54] UNGA 1348 (XIII), Question of the peaceful use of outer space, adopted 13 December 1958.

[55] <http://www.intelsat.com>.

of China from the ISS is but one example of that. Still, space governance presents improvement to global governance in other issue-areas. When the US imposed sanctions on Russia following the events in east Ukraine, the two States nevertheless continued their cooperation on the ISS, including the sending and bringing back home of US astronauts on board Russian spacecrafts.

Other features special to space include the harsh conditions of space and the high barriers to entry in terms of technology, industrial base and financing, that all mandate an increased degree of international cooperation. In addition, space is beyond national jurisdictions, and in this it resembles only the open seas and the Antarctic.

Nevertheless, when discussing space governance, one needs to remember that (i) not all that is so governed is indeed physically located in outer space[56]; and, more important, (ii) that this governance is still, and will remain so in the foreseeable future, made from earth, by national governments, international organizations and forums, and other actors on earth. For this reason, one might presume that space governance is and cannot be any different from the general global governance or other issue-areas in global affairs. While there is a lot of truth in this, the unique features of space and space activities make space governance different to a certain degree.

While we should use the knowledge accumulated about global permanence, we should have a caveat in mind to the particularities of the issue-area of outer space and the opportunities it opens.

[56] The space law treaties apply also to certain space activities performed earth, including the launch and landing of spacecrafts, which commence and end on earth or at sea and pass through the airspace.

1.4 Outline of the thesis: Towards Decentralized Regulation of Space Activities

The thesis investigates the nature and architecture of space governance and how it evolved and can and will evolve further, given the absence of a global government or supreme authority. In other words, it investigates how human space activities are steered, notably how the principles and rules applicable to these activities are established, implemented and reformed. The thesis demonstrates that after an initial period of successful development of space governance featuring institutions building and the adoption of space law treaties, from the early days in the late 1950s to the mid-1970s, space governance, as developed by those institutions, has largely been stagnated. This long stagnation is a result of the decline in the rulemaking capacity of the main institutions, comparable with the general trend in global affairs. The decline in the rulemaking capacity is partly due to lack of interest, political will or changed attitudes of States, but also due to structural problems of space governance. The consequence is that even the most important issues, *e.g.,* space debris, militarization, and utilization of space natural resources, are left insufficiently addressed. The thesis then provides the necessary historical background and the theoretical and methodological tools for the discourse on space governance and its reform. It reviews the emergence and development of global governance and the birth and evolution of the study thereof. The thesis follows with analysis of the structure of space governance and reviews theories of decentralized governance, aiming to suggest a feasible, effective and dynamic model for space governance that will enable a continuous evolution thereof. The thesis is therefore about the *architecture* of global space governance, and not about the *content of the norms*.

In a nutshell, this thesis argues that the only way to break the governance gridlock is by space governance becoming polycentric, allowing decentralized, incremental evolution of space governance. Thus, a separate forum for each sub-issue-areas (*i.e.*, specific issue-areas within the issue-area of space activities, such as militarization of space and space debris), led by stakeholders (active actors) and experts, would create rules for that issue, and possibly monitor their application. The aggregate of all forums' work would constitute feasible and efficient governance, flexible to adapt to changes. In fact, space governance is already on track to become polycentric, increasingly and inevitably, with numerous decision-making centers (governance centers) producing numerous, partially overlapping, issue-specific regimes. Still, further action is required to transform space governance to a polycentric system, which would enable the development of governance under the existing constraints that prevent it from developing otherwise. Furthermore, polycentric governance is characterized by flexibility and adaptability, which are important given the expected changes and disruptions in technologies and commercial models. While there are adverse effects for a polycentric model of governance, its advantages exceed the adverse effects, which may be further mitigated in ways the thesis discusses. This thesis takes a policy-oriented approach and establishes what may constitute a feasible and effective governance model for human space activities, considering the realities of global politics and the trends in general global governance. In terms of policy recommendations, the thesis suggests that instead of trying to fix the monocentric system we need to embrace and facilitate a decentralized, polycentric, governance system, *i.e.*, to relay to and rely on the work of separate governance centers; to divert governance-building efforts to be invested in support of the establishment and operation of these governance centers; to

acknowledge the major role of stakeholders and experts, i.e., in the linkage between activities and voice; and to mitigate the adverse effects of polycentric governance.

The theoretical framework of the thesis cuts across three disciplines. The investigation herein draws from the literature on international law and space law but also, and to a greater extent, on international relations (IR) and political economy literature that bring to the table important theories and perspectives. Significantly, the political economy literature provides empirical grounding to the theories and policy recommendations. Governance is as much a political science issue as it is of law. Moreover, the study of global governance emerged within the discipline of IR which arguably still leads the discourse on global governance. For the purposes of this investigation, I employ the IR literature on international regimes (regime theory), which later evolved to the study of global governance, and its recent conceptualization of 'regime complexes'. Political economy's institutional analysis, and in particular Elinor Ostrom's Nobel Prize winning study on the governance of common-pool resources, provides another important pillar of the investigation herein. E. Ostrom's research included a wide empirical base of lab experiments, field studies, and meta-analysis of a vast database of existing case studies from around the world [57], and in this lies the strength of her study. The empirical results support the theory of polycentric governance and its merits as developed by Vincent and Elinor Ostrom and other scholars of the Bloomington School of Political Economy.[58] The

[57] The studies were conducted by anthropologists, economic historians, engineers, historians, philosophers, and political scientists. They studied local governance of smaller to medium scale common-pool resources over long periods of time. The studies followed different types of resources located in many States, including Bolivia, Colombia, Guatemala, India, Kenya, Mexico, Nepal, Tanzania, Thailand, Uganda, Ethiopia, China, and the United States. See Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review, 1, 17.

[58] A journey that started with Vincent Ostrom, Charles M. Tiebout & Robert Warren (Vincent Ostrom,

transdisciplinary nature of this thesis' inquiry thus anchors the conclusions of the thesis in both theory and empirical findings.

To summarize the findings, I define space governance as *the steering of human space activities by guiding the behavior of the relevant actors through the cumulative effects of the repertoire of applicable norms, principles, rules, policy instruments and other applicable instruments and the work of organizations, institutions and other fora*. There are often assertions that space is the province of mankind, the common heritage of mankind and/or global commons. If these assertions or any of them were true, they would guide and provide the basis for space governance, but they are not. Space is not the "province of mankind" as many argue, and it is mystifying how widespread this mistake is. Article I of the 1967 Outer Space Treaty (OST)[59] clearly provides that "[t]he *exploration and use* of outer space. . . shall be the province of mankind" - the *activity*, not the *domain*. Space is neither the 'common heritage of mankind', as the Moon Agreement, which declared *parts* of space to be so, has not yet been ratified by a meaningful number of States, and, significantly, by none of the major spacefaring States. Moreover, to a large extent it was this very same proclamation that led many States to refrain from ratifying the Moon Agreement. Furthermore, space is not necessarily a 'global commons' and even if it is – the concept is of limited or unclear meaning and does not enhance our understanding of the nature of space

Charles M. Tiebout and Robert Warren, 'The Organization of Government in Metropolitan Areas: A Theoretical Inquiry' (1961) 55 The American Political Science Review 831) and culminated with Elinor Ostrom's Nobel lecture (Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review, 1).

[59] Charter of the United Nations and Statute of the International Court of Justice, 24 October 1945, 1 UNTS XVI.

governance beyond what is already clearly established by the OST: that space is beyond national sovereignty (OST Article II) and that there is free access to space (OST Article I).[60]

The genesis of space governance in the first two decades after the Soviet launch of the first artificial earth satellite, Sputnik1, in 1957, saw a burst of norms-creating UNGA declarations, adoption of space law treaties and institutions building: the UN Committee on the Peaceful Uses of Outer Space (UN-COPUOS), established in 1959, adopted basic principles[61] and then a constitution-like treaty, the 1967 Outer Space Treaty (OST)[62], that all gathered wide support. Specific provisions of the OST were subsequently elaborated in further treaties on the rescue of astronauts and spacecrafts,[63] liability,[64] and the registration of space objects[65]. The last treaty, on space natural resources[66] so far gained insignificant number of State ratification (18 States, none of the leading spacefaring nations[67]). Space governance was thus launched as a fairly monocentric system with a single decision-making center -UN-COPUOS - mandated with creating and expanding the *corpus juris spatialis* and introducing legally-binding and comprehensive treaties. The international system[68] is decentralized, lacking a sovereign and developing international

[60] Eytan Tepper, 'Structuring the Discourse on the Exploitation of Space Resources: Between Economic and Legal Commons' (2018) Space Policy, DOIi: https://doi.org/10.1016/j.spacepol.2018.06.004.

[61] UN General Assembly Resolution 1962 (XVIII): Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, adopted 13 December 1963.

[62] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 18 UST 2410, 610 UNTS 205, 6 ILM 386 (1967).

[63] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 19 UST 7570; 672 UNTS 119; 7 ILM 149 (1968).

[64] Convention on International Liability for Damage Caused by Space Objects, 961 UNTS 187; 24 UST 2389; 10 ILM 965 (1971).

[65] Convention on Registration of Objects Launched into Outer Space, 1023 UNTS 15; 28 UST 695; 14 ILM 43 (1975).

[66] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1363 UNTS 21; 18 ILM 1434 (1979); 18 UST 2410.

[67]UN Committee on the Peaceful Uses of Outer Space, 'Status of International Agreements Relating to Activities in Outer Space as at 1 January 2019' (2019) A/AC.105/C.2/2019/CRP.3.

[68] For the purpose of this thesis I refer to the system created by the entirety of all States and other actors

law in a horizontal, rather than vertical, manner[69]. The monocentric system of space governance is thus a part of the decentralized system of global governance, which may explain its deficiencies.

The above–mentioned forum and treaties created the nucleus of space governance – a forum and four widely-adopted treaties - that would later experience a 'big bang'. Yet, no treaty was adopted or amended since 1979, and none is expected in the foreseeable future. This can be attributed to general trends in global politics, where global governance architectures, both legal and institutional, are fragmenting[70], and space-specific circumstances, *i.e.* the decline in the rulemaking capacity of the main institutions.

The Big Bang Theory is the leading explanation of the beginning and evolution of the universe. As the theory goes, there was a tiny nucleus or singularity, containing all matter that exists today, with infinite density and intense heat, and this nucleus expanded forming the universe we live in today. Interestingly, space governance may be described in a similar manner. The main building blocks of space governance are, still today, those presented above. Yet, with the cessation of the rulemaking capability of UN-COPUOS, the 21st century sees a gradual yet steady emergence of smaller, issue-specific forums, led by experts and

in global affairs, their actions and interactions, cooperation and creation of a normative framework. This system may be strong or fragile, but it is nevertheless a system.

[69] On horizontal vs vertical international law see, for example, Richard A. Falk, 'International Jurisdiction: Horizontal and Vertical Conceptions of Legal Order' (1959) 32(3) Temple Law Quarterly 295; PE Corbett, Law and Society in the Relations of States. (Harcourt, Brace & Co 1951); Morton A. Kaplan and Nicholas B. Katzenbach, The Political Foundations of International Law (1st edition, John Wiley & Sons 1961); Richard A Falk, 'The Reality of International Law' (1962) 14 World Politics 353.

[70] Frank Biermann, Philipp Pattberg, Harro van Asselt, and Fariborz Zelli, 'The Fragmentation of Global Governance Architectures: A Framework for Analysis' (2009) 9 Global Environmental Politics 14; John Gerard Ruggie, 'Global Governance and "New Governance Theory": Lessons from Business and Human Rights' (2014) 20 Global Governance 5; International Law Commission, 'Report of the Study Group, Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law (A/CN.4/L.682)' (2006).

stakeholders, introducing various types of instruments, notably soft law instruments. A prominent example is the Inter-Agency Space Debris Coordination Committee (IADC), which introduced the Space Debris Mitigation Guidelines that were later adopted by UN-COPUOS in 2007[71], a non-legally binding soft law instrument. Various other groups, different in nature and composition, are working on the issues of military uses of space and the exploitation of space natural resources. Thus, the initial monocentric, quasi-hierarchic structure of space governance is experiencing a slow-motion big bang, by which the basic building blocks are still the early ones presented above, but subsequent expansion and evolution of space governance is decentralized. The inevitable future of space governance is by various *fora* or decision-making centers ('governance centers'), with various participants introducing various outputs in distinct sub-issue-areas. Nevertheless, UN-COPUOS is still the most important forum and the UN Office for Outer Space Affairs (UNOOSA) the most important agency. Space governance is thus becoming decentralized and eclectic, with various sub-issue-areas exhibiting varying types of governance mechanisms with varying level of elaboration, coherence and legal authority.

The thesis discusses, compares, demonstrates the convergence of, and builds on the literature of three concepts, each a version or conceptualization of decentralized governance: 'regime complexes' (IR), polycentric governance (political economy/institutional analysis) and fragmentation (international law). Fragmentation in international law is the proliferation of legal instruments and tribunals on a single issue, with partial overlap but no hierarchy. In the IR literature, a 'regime complex' describes an

[71] UN Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, Vienna 2010 < http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 11 August 2019.

array of partially overlapping and nonhierarchical regimes, often with conflicting rules, governing a particular issue-area. These two concepts describe basically the same phenomenon. Polycentric governance is a system of governance in which there are simultaneously multiple independent governance centers with at least partial overlap in jurisdictions. Think, for example, of the policing function of the government that may be exercised, simultaneously, by the federal police, state police and city police, with a certain overlap in their respective jurisdictions.[72] Regime complexes, fragmentation and polycentric governance are three versions or conceptualizations of decentralized governance, where the power or rules are not to be found in one place – a single institution or legal instrument - nor in a hierarchical set of institutions and legal instruments. The literature on regime complexes and on fragmentation demonstrates the increasing rate of decentralization in global affairs. The cumulative insights from the literatures on the above three concepts is that governance in global affairs is increasingly and inevitably decentralized, and that though it has adverse effects, its advantages arguably outweigh those adverse effects. Significantly, it enables the evolution of governance under the constraint of the absence of a global government or supreme authority – the state of anarchy in international relations. It is the only way out of the long gridlock that prevents continuous evolution of space governance.

Decentralized governance in global affairs is inherent and inevitable, due to the lack of a global sovereign. It is the result of an international system characterized by anarchy in which power is increasingly diffused; multilateral arrangements are ever more difficult to

[72] Vincent Ostrom, Charles M. Tiebout and Robert Warren, 'The Organization of Government in Metropolitan Areas: A Theoretical Inquiry' (1961) 55 The American Political Science Review 831.

establish and even maintain as States strategically refrain from binding multilateral regimes[73] and multilateralism in general is contested[74]. Leading States strategically refrain from binding multilateral regimes in order to maintain discretion, especially in view of the increase in the number of developing countries and their influence in multilateral fora. Add to that the barriers to cooperation in general - the problem of achieving and maintaining collective action is probably as old as human grouping to societies – and the result is the inevitability of decentralized global governance in general, and of decentralized space governance in particular. UN- COPUOS grew to become one of the biggest UN committees and it became harder to adopt decisions by consensus, as is the customary procedure in the committee. Comprehensive monocentric governance is no longer feasible.

Decentralized governance has numerous advantages, the first and foremost is the feasibility of achieving governance under anarchy. It enables incremental evolution of governance by the introduction of partial regimes – partial in terms of the issues they cover and the parties to the formation of the regimes. Over time and in the aggregate, they cover larger swaths of space governance and of actors. Decentralized governance is flexible and adaptable, which is especially important where rapid technological developments are concerned. Significantly, decentralized governance, and polycentric governance in particular, enable meaningful participation of stakeholders and experts in governance, which, as empirical studies have demonstrated, results in rules that better match the circumstances and conditions of what they apply to and greater adherence to those rules.

[73] Eyal Benvenisti and George W. Downs, 'The Empire's New Clothes: Political Economy and the Fragmentation of International Law' (2007) 60 Stanford Law Review 595.

[74] Julia C. Morse and Robert O Keohane, 'Contested Multilateralism' (2014) 94 International Organizations 385.

Decentralized governance has adverse effects which include redundancy and inconsistency. It raises concerns of regulatory oversight deficit and raises questions of participation, accountability and bias towards powerful States and other powerful actors. Nevertheless, the multiplicity of actors participating in decentralized governance provides balance. Furthermore, the advantages of decentralized governance can be maximized, and its adverse effects can be mitigated if governance centers meet Ostrom's 'design principles' for effective institutions[75], if institutional deference[76] is practiced and possibly if the standards of 'global administrative law' (GAL)[77] or the 'law of global governance'[78] are applied.

In practice, polycentric space governance means that instead of space governance developing top-down, by instruments introduced by UN-COPUOS, it will develop bottom-up, by numerous, issue-specific forums (*e.g.,* on militarization), led by stakeholders (the active actors /users thereof) and experts (as part of epistemic communities), that would create rules for that issue. Embracing polycentric governance, as this thesis calls for, means facilitating and encouraging the evolution of separate governance centers on each sub-issue-area: one for weaponization and militarization, one for space debris, one for utilization of space natural resources and yet another one for space traffic control. Central to polycentric governance is users' self-governance, *i.e*. that the users themselves establish, modify and possibly enforce the rules. The evidence shows that users establish rules that better suit the conditions and needs and tend to follow those rules more so than rules

[75] Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review, 1.

[76] Tyler Pratt, 'Deference and Hierarchy in International Regime Complexes' (2018) 72 International Organization 561.

[77] Benedict Kingsbury, Nico Krisch and Richard B Stewart, 'The Emergence of Global Administrative Law' (2005) 68 Law and Contemporary Problems 15; Benedict Kingsbury, 'The Concept of "Law" in Global Administrative Law' (2009) 20 European Journal of International Law 23.

[78] Eyal Benvenisti, *The Law of Global Governance* (Hague Academy of International Law 2014).

imposed from above. In the context of space governance, it means that the actors involved in a certain issue will lead in the creation of the relevant rules. Indeed, the experience with space governance shows that while the attempt to adopt a universally accepted code of conduct failed, an inter-agency forum of stakeholders adopted guidelines on space debris mitigation, which success should be monitored over time. UNOOSA should represent the global public interests and the interests of prospective and affected actors. Private actors may also take part in the governance of sub-issue-areas in which they are active. By dividing space governance to sub-issue-areas and having a forum predominately with users/ stakeholders, who have a vested interest in establishing some rules and have relevant knowledge of the issue-area, and with experts, there are greater chances to establish a governance system that is continuously evolving and meeting the changing needs.

In fact, space governance is already on track to become polycentric. The sub-issue-area of the allocation of slots in orbit around Earth and of radio frequencies is regulated by a multilateral, legally binding, comprehensive and elaborate regime, while the issue of military uses of outer space may itself be characterized by a 'regime complex'[79]. The sub-issue-areas of space debris, utilization of space natural resources and space traffic control each have a separate governance system, with separate forums, and varying types and levels of regulation.[80] UN-COPUOS has jurisdiction on all sub-issue-areas.

[79] See chapter 6 of the thesis.

[80] Eytan Tepper, 'The Final Frontier of Global Society and the Evolution of Space Governance' in Ino Rossi (ed), *New Frontiers of Globalization Research: Theories, Processes, and Perspectives from the Global North and the Global South* (Springer forthcoming).

This thesis calls for gradually transitioning to a polycentric system of space governance. Polycentric governance means incremental evolution of space governance, as the governance of each sub-issue-area evolves at a different pace according to the degree of urgency, type of challenges and agreement between the actors. It means governance that is eclectic, varying across sub-issue-areas. It means that the governance of each issue evolves by different forums with different actors, mainly those active actors in the issue, and by the introduction of various instruments, legally-binding or not, multilateral or national or industry standards and best practices. A single issue can have more than one forum, *e.g.,* one multilateral and another industry forum. All this happens and will happen in a kind of spontaneous order, as stakeholders establish forums that suggest, adopt or push for rules and standards. The aggregate of all these instruments and forums will be a more comprehensive and updated governance than a monocentric system of global governance can yield and, moreover, one that is flexible to adapt to changes and continuously evolves.

Elinor Ostrom's study provided strong empirical proof supporting polycentric governance of complex economic systems[81] and emphasized the central role of users (what I compare to stakeholders or active actors) in governance. Building on E. Ostrom's study, this thesis emphasizes the role of stakeholders in governance centers. In addition, Ostrom devised, based on the vast empirical database, design principles for robust governance systems.[82] Adjusted to the context of space governance, these principles would be met if:

(i) there is a clear definition of the sub-issue-area and its users/stakeholders;
(ii) there is a balanced proportion between the users' contribution and benefits;

[81] Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review, 1.

[82] Ibid; Michael E. Cox, Gwen Arnold and Sergio Tomás Villamayor, 'A Review of Design Principles for Community-Based Natural Resource Management' 15 Ecology and Society 38.

(iii) the users participate in the making and modifying of the rules;
(iv) the monitoring and sanctioning is carried out by the users themselves or by someone who is accountable to the users;
(v) the sanctions are graduated;
(vi) there is a dispute-resolution mechanism;
(vii) the right of users to self-organize is clearly recognized by outside authorities; and (
(viii) the issue-area-specific governance center is nested in the larger governance system of space governance.

Pratt conceptualized the practice of 'institutional deference', where international organizations (IOs) accept another IO's exercise of authority on specific issues and thereby mitigate potential conflicts and facilitate a division of labor within a regime complex.[83] If various governance centers practice institutional deference, it will further alleviate the adverse effects of decentralized governance, as it will reduce redundancy and inconsistency by reducing the scope of conflicting rules and jurisdictions. In addition, GAL and the 'law of global governance' provide modern standards for global administration that may be applied in and across the various governance centers. These standards address issues of accountability, transparency, participation, reasoned decision, and legality and may strengthen the legitimacy of the governance centers.

The second chapter of the thesis provides a historical account and analysis of the emergence and development of global governance and reviews the birth and evolution of the study of global governance up to the current and emerging trends in the study of global governance as an academic discipline. By that it provides the basis for the discourse on the much-needed reform in space governance, but also for a discourse on global governance in general and on the governance of other issue-areas in global affairs. Chapter 3 presents the

[83] Tyler Pratt, 'Deference and Hierarchy in International Regime Complexes' (2018) 72 International Organization 561.

theoretical framework of the thesis, by presenting three versions or conceptualizations of decentralized governance from three disciplines: political economy (institutional analysis), international relations (Regime Theory) and international law (fragmentation). It further demonstrates convergence of the concepts and the insights from the respective literatures and builds on the cumulative insights. As the theoretical framework implies, the thesis focuses on the architecture of space governance, and not on the content of the norms. Chapter 4 builds on the theories and empirical studies reviewed in chapter 3 to present the case for polycentric space governance and suggests embracing a polycentric model for space governance. It further suggests a key role for stakeholders and experts in space governance and portrays what polycentric space governance may look like in practice and discusses ways to maximize its benefits and mitigate its adverse effects. Moreover, the chapter presents the slow-motion 'big bang' of space governance, as it is already on track to become polycentric. Chapter 5 discusses the alleged status of space as "global commons" and suggests an approach for the governance of space natural resources. Chapter 6 discusses the governance of space warfare. It presents the regime complex of space warfare and draws a roadmap for the governance of this sub-issue-area. Chapter 7 provides the conclusions of the thesis and the research leading to it.

1.5 Originality of the Thesis and Contribution to Knowledge

The stagnation of and crisis in space governance are well known. There is a widespread acknowledgment of the need for change, but no direction on what kind of change and how to accomplish it. Discussions on global governance have focused on specific issues, but not on systemic problems. This thesis addresses the crisis in space governance from a systemic perspective of the *architecture* of space governance (as opposed to discussing the content

of the norms), a perspective not pursued before. The first contribution of this thesis is therefore to offer a new perspective for the analysis of the causes of the crisis and the possible ways to address it.

Other issue-areas in global affairs are also experiencing similar problems. Power in global politics is increasingly diffused and many States strategically refrain from binding multilateral regimes. Multilateral arrangements are ever difficult to establish and even maintain as multilateralism in general is contested. The international relations literature on these currents is therefore a necessary point of reference, and the second contribution of this thesis is to introduce this literature to the discourse on space governance, from which it was hitherto largely absent.

The oracles of the study of common-pool resources (CPRs) and international regimes, Elinor Ostrom and Keohane, respectively, suggested convergence between the literatures on local commons and on international regimes, each demonstrating the feasibility of collective action without hierarchical authority. The potential research on applying Elinor Ostrom's empirically-sustained theory to global affairs, hardly pursued, leaves, as Keohane noted, "unexploited opportunities" for investigators seeking to understand issues in global affairs.[84] The third – and perhaps most important – contribution of this thesis is to apply Ostrom's theory to governance in global affairs, and in particular to space governance. This includes notably the polycentric model of governance, the leading role of stakeholders, and the design principles for robust governance systems. This is perhaps the most important contribution as it goes far beyond the issue of space governance to global governance in

[84] Robert O. Keohane, 'Review Symposium: Beyond the Tragedy of the Commons' (2010) 8 Perspectives on Politics 577.

general, and it holds a promise for significant contribution to the international relations and international law literatures, bringing new concepts and, significantly, empirical groundings to these two mostly theoretical literatures.

The concept of fragmentation of international law is equivalent in many ways to the concept of regime complexes, introduced in the international relations literature in roughly the same time when fragmentation became a major issue of inquiry in international law – the first decade of the 21st century. The similarities between the concepts include the description of each phenomenon, the underlying causes and the results. While the connection between the two concepts has been made, the starting point of the disciplines was opposite: international law scholars are largely suspicious, if not hostile, to fragmentation, though latter research softened this initial attitude, while international relations scholars view it as a largely positive phenomenon. At the end, despite the striking similarities and the potential, there is little cross-disciplinary fertilization. The fourth contribution of this study is to demonstrate convergence of the concepts and insights, thus increasing the knowledge on each phenomenon and the possible courses of action to address it.

Moreover, the thesis compares the three versions or conceptualizations of decentralized governance - regime complexes, fragmentation and polycentric governance - and demonstrates convergence of the insights of the *three* literatures. There has been no prior suggestion of such a convergence across the three disciplines, and this is the fifth contribution of this thesis to scholarship.

This transdisciplinary thesis advances the scholarship of several disciplines. It contributes to the scholarship on global governance, international law and space law. It not only propounds new theoretical ideas but also provides policy recommendations. Perhaps the most innovative aspect of this thesis is the convergence of the literatures on, and insights from, three concepts from three disciplines, and the application of the empirically-sustained literature on CPRs to governance in global affairs. The thesis therefore innovates in the field of general global governance. The thesis also advances the knowledge on international law by drawing the knowledge on regime complexes to the discourse on fragmentation and by the thesis' newly created knowledge and insights on global governance, of which international law is a major part. The thesis contributes to the literature on space governance by introducing to the discourse the historical background, the insights from the literatures of political economy and international relations and the new knowledge created by this thesis on governance in global affairs. It further contributes to the discourse on space governance by suggesting a model for it. Moreover, the policy recommendations herein adopt an empirically grounded model of governance – polycentric governance - and this is their major strength. Given the similar problems faced by other issue-areas in global affairs, the insights of this thesis may be relevant to such issue-areas and to global affairs in general.

In addition to the theoretical core of the thesis, it sketches how polycentric space governance may look in practice and suggests that a transition to polycentric governance does not require amendment of the existing space law. The thesis goes even further and analyzes the governance of space natural resources and space warfare, suggesting how these issues should be analyzed, addressed and further promoted.

To be sure, this thesis could not encompass all sub-issue-areas of space governance, neglecting space debris and space traffic control, and could not go into the details of the governance centers of each of the sub-issue-areas and the various mechanisms for the practical implementation of the recommendations. There is room for further research on these important issues, and this thesis paves the way for further research. It lays the basis for further discussion on space governance by providing the necessary historical background and the theoretical and methodological tools for the discourse, including the cutting-edge scholarship on global governance.

Chapter 2
The Evolution of Global Governance and of the Study Thereof

This chapter serves as a historical background to the thesis by providing a historical account of the emergence and development of global governance and the study thereof. It presents the emergence and development of global governance, mainly from the 17th century to the present. It then presents the birth and evolution of the academic study of global governance from the early days and up to the current and emerging trends. It also elaborates on the concept of global governance and its various definitions over the years. By that, the chapter provides the basis for the discourse on the much-needed reform in space governance as well as for the discourse on global governance in general and on the governance of other issue-areas in global affairs.

Global governance is not only the domain of the UN, and the actors in global affairs are not only the nation States. In the absence of a central global authority, global governance, as *the steering of global affairs*, is made by all the relevant actors and is therefore decentralized. Furthermore, global governance, as the *guidance of the behavior of actors in global affairs,* is not made by hard rules imposed from above, but rather by norms and rules the actors have agreed to follow and institutions they established and/or joined. Even customary international law that applies also to States that have not agreed to its rules has emerged from the practice and *opinio juris* of a significant number of States. Indeed, international law scholars refer to international law as being horizontal, based on agreement between the main subjects thereof – States - as opposed to domestic law that is vertical, based on rules imposed from above on their subjects.[85] The various actors in global affairs – States and non-State actors – cooperate to create international law and to steer global affairs. The history of the institutionalization of international cooperation is therefore the history of global governance, and it is told in the following section.

2.1 The Quest for Global Governance

"[M]ost things exist long before they are named. So it is with global governance"[86]. Indeed, while the concept of global governance emerged only in the 1990s, actual global governance has a longer history.

[85] On horizontal vs vertical international law see, for example, Richard A. Falk, 'International Jurisdiction: Horizontal and Vertical Conceptions of Legal Order' (1959) 32(3) Temple Law Quarterly 295; PE Corbett, Law and Society in the Relations of States. (1st edition, Harcourt, Brace & Co 1951); Morton A. Kaplan and Nicholas B. Katzenbach, The Political Foundations of International Law (1st edition, John Wiley & Sons 1961); Richard A Falk, 'The Reality of International Law' (1962) 14 World Politics 353.

[86] Craig Murphy, The Emergence of Global Governance, in Thomas G. Weiss and Rorden Wilkinson, eds, *International Organization and Global Governance* (Routledge 2014), 23, 23.

Global governance, or the steering of global affairs, is mainly the result of the cumulative effects of the repertoire of applicable norms, principles and rules and the work of international organizations, institutions and other *fora*. The history of global governance is therefore the history of the rules and institutions that steers global affairs. This section provides a brief account of the milestones in the evolution of global governance and the drivers for its evolution.

2.1.1 Global Governance in Ancient Times and until the 16th Century

Traditionally, scholars of international relations viewed the Peace of Westphalia of 1648 as the starting point of international relations, representing the beginning of relations between mutually recognized sovereigns. However, if we define international relations as relations between independent political entities or societies, then it is traced back to the first time two such independent entities have encountered each other or had a continuous contact. In *International Systems in World History*[87], Buzan and Little present a wide historic view of the evolution of mankind, beginning 60,000 years ago with scattered bands of hunter-gatherers and continuing until today's international system. An international system, they argue, is relatively new, having a first appearance around 3,500 BCE with the interaction of ancient Sumerian city-states, representing the first fully-fledged international system.

Independent political entities or societies have often fought each other, but, at least occasionally, and to a growing extent through time, have also cooperated for mutual benefit

[87] Barry Buzan and Richard Little, *International Systems in World History: Remaking the Study of International Relations* (Oxford 2000). For the history of International Relations as a discipline see, for example, Michael C. Williams, *In the Beginning: The International Relations Enlightenment and the Ends of International Relations Theory*, 19(3) European Journal of International Relations (2013), 647.

or were forced to cooperate. Throughout 90% of human history, there was no global governance, or institutionalized international cooperation, at all. Humankind lived in small communities, which through time increased in size to become societies and gradually the outlook went further from the local to the regional. There were security and economic needs for expansion.[88] Norms and rules of interaction between political entities emerged between the Greek city-states[89] and between the 'warring States' in ancient China[90]. The Hebrew bible and other ancient records and inscriptions also provide evidence of the observance of certain rules between political entities, including on embassies and warfare, though these were very limited.[91] Even the idea of a global government is not new. The first recorded such call in the West was by Dante, in Monarchia (around 1310 A.D.), where he criticized the State-centric world system and called for its replacement with a universal government[92]. Although a universal government has not yet emerged, international cooperation has indeed emerged, intensified and even institutionalized.

The following review may be deemed Eurocentric. This is not to deny the occurrence elsewhere on the globe of instances of cross-border rules and cooperation, of the kind surveyed herein as milestones of global governance. However, the current world order and

[88] Murphy noted: "…the first and longest-lasting system of global governance was probably a non-system: For at least nine-tenths of human history, our ancestors lived in relatively small, mobile bands. Some bands may have fought one another over spouses and resources, and certainly, many groups traded through intermediaries over surprisingly long distances, but we have no evidence of any larger systems of power or authority beyond what may have similar rules governing trade" (Craig N. Murphy, Global Governance over the Long Haul, International Studies Quarterly (2014) 58, 216).

[89] Margaret P. Karns, Karen A. Mingst and Kendall W. Stiles, International Organizations: The Politics and Processes of Global Governance (Lynne Rienner, 3rd ed 2015), 75.

[90] Wang Tieya, International Law in China: Historical and Contemporary Perspectives, 221(2) Recueil Des Cours (Hague Academy of International Law) (1990), 195.

[91] John W. Foster, 'The Evolution of International Law' (1909) 18 Yale Law Journal 149.

[92] F.H. Hinsley, *Power and the Pursuit of Peace: Theory and Practice in the History of the Relations between States* (Cambridge 1963); Fred Parkinson, *The Philosophy of International Relations: A Study in the History of Thought* (Sage 1977), 143-54.

system of global governance emerged in Europe and later in the West more generally. Moreover, this brief account of the emergence of global governance is mostly not original research but a review of the literature and therefore this account enjoys the strengths and suffers from the weaknesses of the reviewed literature.

2.1.2 17th Century Introduction of International Law and the Westphalia Peace

International law, also known as public international law or the law of nations, is the body of norms, principles, rules and standards that apply to actors in global affairs, predominately – but certainly not exclusively – to States.

While rules that apply to the relations between independent political entities have existed in various places since ancient times, international law, as we know it today, emerged in Europe during the Renaissance and was influenced by Roman law. Issues relating to what we refer now as international law were discussed by philosophers, theologians and jurists, notably Moses Maimonides, St. Thomas Aquinas, Bartolo da Sassoferrato, Baldo degli Ubaldi, Francisco de Vitoria, and Francisco Suárez, snf Alberico Gentili. Nevertheless, it is the Dutch jurist Hugo Grotius (1583–1645) who is considered the 'father of international law'[93] and his book Mare Liberum (1609)[94], a foundational text of international law. Modern international law is thus said to have asserted itself in the 17th century, due in large part to the publication of Grotius' book and to the Congress and Treaty of Westphalia[95] of

[93] But see: Julia van Ittersum Martine, 'Hugo Grotius: The Making of a Founding Father of International Law' in Anne Orford and Florian Hoffmann (eds), *The Oxford Handbook of the Theory of International Law*, vol 1 (Oxford University Press 2016) <http://opil.ouplaw.com/view/10.1093/law/9780198701958.001.0001/law-9780198701958-chapter-5> accessed 7 August 2019.

[94] Hugo Grotius, Mare Liberum (1609).

[95] Peace Treaty between the Holy Roman Emperor and the King of France and their respective allies [signed 24 October 1648] [1648] 1 CTS 119).

1648.[96] Further milestones in the evolution of international law were mostly introduced in the aftermath of major wars involving several States, notably European powers. These include the Vienna Congress (1815), the establishment of the League of Nations system after World War I and the UN system established after World War II.[97]

The Westphalia Peace (1648) gave rise to the concept of sovereignty, however, the sovereign States needed to cooperate to avoid conflicts. Following the Industrial Revolution, cooperation was necessary for economic development and for the development of international trade. Facilitation of such transnational dealings required the development of international norms, rules and institutions. The security and economic needs led to the acceptance of sovereign States of rules for inter-State engagement that effectively limit States' newly acquired and precious sovereignty. International law provided 'rules of the game' for the sovereign nations for their cross-border engagement after the Westphalia Peace. The rules and organizations steered cross-border engagement, or global affairs, and thus emerged global governance as it is known today.

[96] John W. Foster, 'The Evolution of International Law' (1909) 18 Yale Law Journal 149.

[97] On the history of international law see: Bardo Fassbender and Anne Peters (eds), *The Oxford Handbook of the History of International Law* (Oxford University Press 2012); Ignacio De La Rasilla Del Moral, 'History of International Law, 1550–1700' <http://www.oxfordbibliographies.com/display/id/obo-9780199796953-0036> accessed 6 August 2019; Stephan Verosta, 'History of International Law, 1648 to 1815' in Rüdiger Wolfrum (ed), *Max Planck Encyclopedia of Public International Law [MPEPIL]* <https://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e707> accessed 6 August 2019. For an engaging account on the telling of the history of international law see Martti Koskenniemi, *A History of International Law Histories* (Oxford University Press 2012).

2.1.3 19th Century Introduction of the Conference System and International Organizations

In a pioneering account of the birth and early development of global governance (at the time still referred to as 'international organization'), Claude counted three major innovations of governance that emerged in the nineteenth century: (i) the Concert of Europe, (ii) public international unions (what we now call international organizations), and (iii) the Hague Conferences. [98]

The first international forums dealt with issues of peace and security, as did the Westphalia Peace (1648) and the Congress of Vienna (1815). The latter produced the most comprehensive treaty that Europe had ever seen until that time and established 'diplomacy by conference', also known as the Concert of Europe, the balance of power that would last for a century until World War I. Under the Concert system, representatives of European States convened and held negotiations by way of multilateral consultation and collective diplomacy in which major powers had special status. These conferences ended with system-wide decisions accepted by way of consensus. States agreed to behave according to specified rights and responsibilities, expecting reciprocity from the other States. Sovereign States thus worked within a framework of rules, though no formal organization was created. More than thirty such conferences were held, the last of which took place in Berlin in 1878. The modern structure of the UN has its roots in the Concert of Europe.

The establishment of international organizations, or 'public international unions' as Claude referred to them, were the second milestone of international organization (the process of

[98] Inis L. Claude, Swords Into Plowshares: The Problems and Progress of International Organization, 4th ed (Random House 1971). See also Margaret P. Karns, Karen A. Mingst and Kendall W. Stiles, International Organizations: The Politics and Processes of Global Governance (3rd ed, Lynne Rienner 2015).

organizing the trans-border relations), or global governance, in the 19th century. Though established in Europe and active initially there, the vision of these organizations was global, and they indeed later became global organizations. These organizations were established in the context of the industrial revolutions. The resulting quest for new markets and sources of materials, and the emergence of new technologies, led to establishment of organization to facilitate international communication and transportation. International standards were created and adopted in order to facilitate technological developments and innovation. The new social order brought by the industrial revolutions led to the establishment of international organizations dealing with the issues of health and the protection of workers. The first wave of international organizations saw the establishment of more than 30 international organizations between 1865 and World War I. The next section elaborates more on international organizations and global governance.

The third milestone in the evolution of global governance in the 19th century was the advent of the Hague treaties, a series of international treaties signed as a result of international conferences. These conferences were convened by Czar Nicholas II of Russia and held at The Hague in the Netherlands in 1899 and 1907 with the participation of both European and non-European States. The conferences focused on ways to prevent war and regulate behavior during wars. The novelty of the Hague conferences was that the international conferences were held to discuss *general rules*, rather than solutions to specific existing conflicts. The conferences model was later developed and evolved to become the UN General Assembly and its Committees. The peace and security aspect was further developed in the aftermath of each of the World Wars, with the establishment of the League of Nations after the first and its successor, the UN, after the second World War.

2.1.4 20th Century Introduction of the League of Nations, the UN and the Bretton Woods Systems

The aftermath of World War I saw an attempt to upgrade global governance, with the establishment of the League of Nations. The idea was initially proposed by U.S. President Woodrow Wilson as part of his Fourteen Points plan for an equitable peace in Europe. The League of Nations was founded in 1920 as a result of the Paris Peace Conference. The League of Nations was an institutionalization of the Hague conferences model and it included a permanent institution holding current 'conferences' and serving as the core of an array of many international institutions, organizations and fora, including the Permanent Court of International Justice (PCIJ), the Disarmament Commission, the International Labour Organization (ILO), the Mandates Commission, the International Commission on Intellectual Cooperation (precursor to UNESCO), the Permanent Central Opium Board, the Commission for Refugees, and the Slavery Commission. Ironically, the U.S. never joined the League as such accession was denied by the U.S. Senate. For this and other reasons, the League of Nations had but few achievements, and was practically dissolved come World War II.

The horrors and lessons of the World War II led to the strengthening of global governance. The UN and its organs, committees and affiliated organizations and institutions stand in the center of the center post-World War II global governance. They were based, but greatly improved on the model of the League of Nations. Some of these institutions and organizations such as, the International Court of Justice (ICJ), the World Health Organization (WHO), UNESCO and the International Labor Organization (ILO), inherited

previous institutions and organizations. Some of the League of Nations institutions were discontinued while other new institutions and organizations were introduced, notably the Bretton Woods System, established in 1944, at the core of which are the World Bank, the IMF, the Bank of International Settlement (BIS, known as the 'central bank of the central banks') and the GATT agreements (which later evolved to form of World Trade Organization (WTO)). The Bretton Woods System is the centerpiece in post-World War II global economic governance. Organizations and agencies focused on human rights and environmental issues were another novelty of post-war II global governance.

The post-war era was characterized by a rapid expansion of functional and specialized international legislation, organizations, tribunals and trade pacts on a global, regional and bilateral basis. There are currently more than 260 international organizations with different sizes, from three members (NAFTA/ CUSMA)[99] to more than 190 members (the Universal Postal Union (UPU)). Some are dedicated to a single task, like the ITU, while others, like the WTO, have a wider scope. Some institutions are regional, like Mercosur[100], while others are global, like the WTO.[101]

2.1.5 Global Governance around the Millennium and into the 21st Century

The dissolution of the Soviet Union, the rise of China as an economic power, and the rise of the other BRICS States transformed and is still transforming global order. The dissolution of the Soviet Union brought with it a burst of optimism famously expressed by Fukuyama's

[99] The North American Free Trade Agreement (NAFTA) of 1994 that was replaced by the Canada-United States-Mexico Agreement (CUSMA) in 2018.

[100] The South American trade bloc established by the Treaty of Asunción in 1991 <https://www.mercosur.int/en>.

[101] Union of International Associations, Yearbook of International Organizations 2018-2019 (Brill 2018). See also Margaret P. Karns, Karen A. Mingst and Kendall W. Stiles, International Organizations: The Politics and Processes of Global Governance (Lynne Rienner, 3rd ed 2015).

"end of history" – the end of the ideological evolution of humankind by a universal acceptance of Western liberal democracy as the final form of human government.[102] Others were pessimists, notably Huntington who, in response to Fukuyama, suggested that the post-Cold War world will not be so peaceful, and the US-Soviet conflict will give way to conflicts based on cultural and religious identities.[103] History of course did not end in 1992 or any time thereafter, and global politics continued to transform with the rise of the BRICS States (Brazil, Russia, India, China and South Africa). The rise of China, transformed from a poor and technologically undeveloped State to a technologically developed State and the world's second largest economy, is perhaps the most important development of global politics in the new millennium. Yet, global governance has so far not dramatically changed as a result of these developments, as international law, the UN system, and the Bretton Woods system have not yet transformed. For example, though China's stake and voting power in organizations like the IMF increased, it still does not represent its stake in the global economy. It is yet to be seen how the changing balance of power, notably the rise of China and the decline in the hegemonic power of the US[104] will affect the laws and institutions at the heart of global governance. It should be noted that claims on the decline of the US hegemony and a discussion on the potential consequences of this decline, started back in the 1970s, yet, the US is still by far the world's largest economy with unchallenged leadership in many fields, including space exploration and utilization. It just might be the

[102] Francis Fukuyama, *The End of History and the Last Man* (Maxwell Macmillan 1992).

[103] Samuel P. Huntington, *The Clash of Civilizations and the Remaking of World Order* (Simon & Schuster 1996).

[104] The leading account on this issue is Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton University Press 1984).

case that, paraphrasing American novelist Mark Twain (pen name of Samuel Clemens), the reports on the decline of US hegemony are greatly exaggerated.[105]

As the scope of global governance expands wider and deeper and even higher to the sky in outer space, so do the challenges it is facing. The world today is a multipolar world, power is diffused and rising and re-emerging powers, like Russia, China, India and other BRICS States demand that the world order, created at the time when they were weak (except for Russia), will evolve to correlate to the new multipolar world.[106] As global governance is not enshrined in a global constitution, it is flexible and ever developing. Time will tell how global governance will evolve in the 21st century.

2.1.6 International Organizations and Global Governance

Global governance is much more than international organizations. Nevertheless, since international organizations are institutions that institutionalize international cooperation, the history of international organizations is a good indication of the evolution of global governance. Murphy, a long-time investigator of the historical development of global governance, reviewed and analysed the evolution of international organizations from 1850 to the late 1980s. He noted that "[o]ne of the best ways to explore global governance. . . is to consider the history of world organizations, those intergovernmental and quasi-

[105] 'Misquotation: "Reports of My Death Have Been Greatly Exaggerated"' (Oxford Academic (Oxford University Press)) <https://oupacademic.tumblr.com/post/48310773463/misquotation-reports-of-my-death-have-been> accessed 9 August 2019; Compare: Robert Deis, 'Reports of Mark Twain's Quip about His Death Are Greatly Misquoted...' <http://www.thisdayinquotes.com/2010/06/reports-of-my-death-are-greatly.html> accessed 9 August 2019.

[106] See, for example, Olga G. Leonova. Caterogires, Models and Forecast of the Global Configuration, in Grinin, Leonid, Ilya Ilyin & Andrey Korotayev. Globalistics and Globalization Studies: Theories, Research & Teaching (Volgograd: 'Uchitel' Publishing House, 2013).

governmental global agencies that have (nominally) been open to any independent state (even though all States may not have joined)."[107]

Issues of economic and social development drove international cooperation, leading to the establishment of international organizations. The early international organizations were established by private and public bodies in order to promote industrial growth and development by way of creating larger markets and common standards. The first international organization was the International Telecommunication Union (ITU), established in 1865 under the name of International Telegraph Union. The first wave of international organizations established in the second half of the 19th century included also the Universal Postal Union (established 1874), the International Bureau of Weights and Measures (1875), the International Railway Congress Association (1885), and the United International Bureaux for the Protection of Intellectual Property (BIRPI) (1893). These were established with the goal of unifying standards and facilitating transportation and communication across national boundaries in Western Europe. They were the work of technocrats, not idealists, and were based on adaptation, not innovation[108], and this was the secret of their success and durability. These international organizations are essentially administrative agencies that introduced international bureaucracy, as a significant portion of their decisions were adopted by experts (State representatives and others), as opposed to diplomats or political level representatives (ministers, heads of State). These organizations proved to be long lasting, and their establishment led to better cross-border

[107] Craig N. Murphy, International Organization and Industrial Change: Global Governance since 1850 (Oxford University Press 1994), 1.

[108] Inis L. Claude, *Swords Into Plowshares: The Problems and Progress of International Organization* (4th ed, Random House, 1971).

infrastructure and a much larger market for the European industries, leading to the Second Industrial Revolution.

Voluntary consensus standard setting (VCSS) was another important novelty, created by scientists and engineers in the second half of the 19th century. VCSS was originally used to set industrial standards, and it recently extended for the adoption of standards for social and environmental integrity. The standards are negotiated and adopted by stakeholders, including government representatives, professionals (notably scientists and engineers), corporations, unions and NGOs. The participation and even leadership of non-governmental actors makes the VCSS a process of "private global governance".[109] Perhaps the best known VCSS is the International Organization for Standardization (ISO)[110], a non-governmental organization (NGO) established in 1947 as an international standard-setting body whose members include representatives from various national standards organizations. The ISO promotes worldwide proprietary, industrial and commercial standards. The VCSS became significant in the 1960s and 1970s[111], and since the 1980s there was a sharp increase in new standards created by ad hoc coalitions.[112] VCSS gradually became a leading form of non-governmental global governance[113] and the ISO is probably

[109] Craig. N. Murphy and JoAnne Yates, *The International Organization for Standardization (ISO): Global Governance through Voluntary Consensus* (Routledge 2009).

[110] <https://www.iso.org>.

[111] Craig N. Murphy, Global Governance over the Long Haul, International Studies Quarterly (2014) 58, 216.

[112] Kenneth W. Abbott and Duncan Snidal, 'The governance triangle: regulatory standard setting institutions and the shadow of the state', in Walter Mattli and Ngaire Woods, eds, *The Politics of Global Regulation* (Princeton University Press 2009).

[113] Craig N. Murphy, Global Governance over the Long Haul, International Studies Quarterly (2014) 58, 216.

the most influential private organization in the world, with a vast – though largely invisible - influence over most aspects of the products and services we consume every day.[114]

The evolution of global governance is interlinked with the process of globalization. Globalization is the process by which the world moves toward an integrated global society where the significance of national borders decreases.[115] It is a result of cross-border interconnections, interdependence and engagement that, in turn, increases the need for supra-national regulation, *i.e.*, global governance.[116] Indeed, many of the international organization facilitated international communication and transportation. International organizations established to facilitate international communication include the ITU which was established in 1865 to regulate the use of telegraph communication and opened the first wave of international organizations. The Radiotelegraph Union (RTU) was established in 1906 to regulate radiotelegraph communication, and the three intergovernmental organisation (IGOs), which built and operated a constellation of communications satellites: the International Telecommunications Satellite Organization (INTELSAT)[117] established in 1964, the International Maritime Satellite Organization (INMARSAT[118] established in 1979 and the European Telecommunications Satellite Organization (EUTELSAT)[119] established in 1988. International organizations established to facilitate international transportation include the International Railway Congress Association established in 1885, the

[114] Mark Mazower, *Governing the World: The Rise and Fall of an Idea 1815 to the Present* (Penguin 2012), 130.

[115] Michael Zürn, 'Globalization and Global Governance' in Walter Calsnaes, Thomas Risse and Beth A Simmons (eds), Handbook of International Relations (SAGE Publications Ltd 2013).

[116] Eytan Tepper, 'The Final Frontier of Global Society and the Evolution of Space Governance' in Ino Rossi (ed), *New Frontiers of Globalization Research: Theories, Processes, and Perspectives from the Global North and the Global South* (Springer forthcoming).

[117] <http://www.intelsat.com>.

[118] <https://www.inmarsat.com>.

[119] <https://www.eutelsat.com>.

International Union of Railways (UIC) established in 1922[120], the International Commission for Air Navigation (ICAN) first convened in 1903 and later replaced by the International Civil Aviation Organization (ICAO) established in 1944[121], the International Air Transport Association (IATA) established in 1945[122], and the International Maritime Organization (IMO) established in 1948[123]

ICAO was the first specialized agency of the UN. INTELSAT introduced a whole new kind of international organization, being a global public utility, and not a mere regulatory agency. INMARSAT and EUTELSAT were also IGOs, but all three were later privatized.[124] Thus, international organizations established to facilitate and regulate international communication and transportation also brought with them institutional innovation, from the first international organization, from the first ever international organization (ITU), through the first UN specialized agency (ICAO), to the first IGO (INTELSAT).

Space applications, especially satellite-based telecommunications and global navigation, already transformed transportation and communication, serving as powerful drivers of globalization of no less importance than trade agreements and international institutions like GATT, WTO, IMF and the World Bank.[125] Satellite based communication was the first profitable sector of space activities and transportation became another profitable space sector. It is therefore no wonder that space exploration and utilization, and particularly

[120] <https://uic.org>.
[121] <https://www.icao.int>.
[122] <https://www.iata.org>.
[123] <https://www.imo.org>.
[124] Eytan Tepper and Christopher Whitehead, 'Moon, Inc.: The New Zealand Model of Granting Legal Personality to Natural Resources Applied to Space' (2018) 6 New Space 288.
[125] Eytan Tepper, 'The Final Frontier of Global Society and the Evolution of Space Governance' in Ino Rossi (ed), *New Frontiers of Globalization Research: Theories, Processes, and Perspectives from the Global North and the Global South* (Springer forthcoming).

space based applications of communications and transportation, played – and will continue to play - an important role in the evolution of global governance.

Each industrial revolution brought with it a greater need for and benefit from international interchange and cooperation. Intergovernmental forums and organizations were established to meet and respond to the needs of their time, to enhance peace but also to facilitate economic development. International organizations facilitated industrial development in capitalist States by enabling cross-border transportation and communication, setting standards and by promoting the idea of what would later be called globalization. These organizations provide a major part of the infrastructure of current global governance.

2.1.7 Actors and Networks in Global Governance

Global governance is made by numerous actors, with various degrees of influence on the steering of global affairs. The oldest and still most influential actors are States; however, starting in the 19th century, and with an influx since the mid-20th century, non-State actors have become important players and influencers of global governance. The foremost important non-State actors are international organizations (notably the UN, WTO, IMF, World Bank, etc.). Other non-State actors include: quasi-formal intergovernmental gatherings (G7/8, the World Economic Forum, etc.); international NGOs (*e.g.,* the Red Cross) and government-organized non-governmental organizations (GONGOs) (*e.g.,* the Red Cross Society of China)[126]; and private associations (*e.g.,* the International Chamber of Commerce

[126] On GONGOs see, for example: Reza Hasmath, Timothy Hildebrandt and Jennifer YJ Hsu, 'Conceptualizing Government-Organized Non-Governmental Organizations' (2019) 15(3) Journal of Civil Society 267; Moises Naim, 'What Is a GONGO?' (*Foreign Policy*) <https://foreignpolicy.com/2009/10/13/what-is-a-gongo/> accessed 21 June 2019.

(ICC)). Other not-for-profit international entities and movements that play a part in global governance include: large-scale philanthropic foundations (*e.g.,* the Bill and Melinda Gates foundation with assets worth US$ billions and with a global view and reach of activities), transnational religious bodies (*e.g.,* the Catholic Church), transnational political movements, and less favorable actors such as transnational criminal networks and terrorist movements.[127] For-profit entities also play a role in global governance, such as multinational corporations and partnerships [128] as well as global accountancy and law firms. Furthermore, experts and epistemic networks play an important part in global governance, and they participate, often lead and sometimes initiate international cooperation, forums and institutions, as further demonstrated in the following chapters.

These global, regional, national and local actors work in partial and complex cooperation to govern - and in many cases, micro-manage - particular areas. There is a growing complexity in the scope of all actors and the way in which they interact and interrelate.[129] Indeed, global governance has grown and evolved to a myriad of sub-systems with various types of connections.[130]

The proliferation of actors-participants in global governance is not new. While some of the actors mentioned above are new or their meaningful participation in global governance is new, other non-State actors had an important part in the establishment and evolution of

[127] See Timothy Sinclair, Global Governance (Polity 2012); Frank Madsen, *Transnational Organized Crime* (Routledge 2009); and Katherine Marshall, *Global Institutions of Religion: Ancient Masters, Modern Shakers* (Routledge 2013).

[128] Margaret P. Karns, Karen A. Mingst and Kendall W. Stiles, *International Organizations: The Politics and Processes of Global Governance* (Lynne Rienner, 3rd ed 2015), 8-19.

[129] Rorden Wilkinson, Global Governance: A Preliminary Interrogation, in Rorden Wilkinson and Stephen Hughes (eds), *Global Governance: Critical Perspectives* (Routledge 2002), 2.

[130] Jan Aart Scholte, 'From Government to Governance: Transition to a New Diplomacy', in Cooper, Andrew Fenton, Brian Hocking & William Maley (eds), Global Governance and Diplomacy: Worlds Apart? (Palgrave Macmillan 2008), 39.

global governance from the beginning. Global governance did not emerge as an act of a hegemon, and it can be sustained without a hegemon. The international organizations established in the 19th century emerged without the leadership of the dominant power of the day, Great Britain, but rather by less powerful governments, professionals and well-placed citizens, and pre-existing international fora.[131] These organizations were established by and centered around professionals. in turn, these organizations themselves created networks of professionals, *i.e.* epistemic communities. To a certain extent, it is networks that are replacing the role of the hegemon in creating ever larger portions of global governance. This is not to deny the significant, sometimes crucial, influence that major powers, notably the US, has over global governance and international organizations. Yet, this influence varies across issues and organizations, and the more technical the organization (*e.g.,* ITU and ISO), the less the influence of the major powers or of political representatives and considerations in general.

The various actors in global governance cooperate to various degrees and in various ways. There are horizontal inter-governmental networks linking counterpart State officials, like INTERPOL that connects police officers from different States. There are vertical networks that connect State officials and non-State forums and organizations, like the WTO, IMF, and the World Bank, among others.[132] Non-State actors also cooperate with each other, like the IMF and World Bank and aid organizations. UN agencies cooperate with every possible actor. To a certain extent, a global bureaucracy has emerged and continues to evolve.[133]

[131] Craig N. Murphy, *International Organization and Industrial Change: Global Governance Since 1850* (Oxford University Press 1994), 9-10.

[132] Anne-Marie Slaughter, *A New World Order* (Princeton University Press 2005).

[133] On the emergence of global bureaucracy see, for example, Michael W. Bauer, Christoph Knill and Steffen Eckhard (eds), *International Bureaucracy: Challenges and Lessons for Public Administration Research*

There are many non-binding forums that facilitate the exchange of ideas, knowledge and experience and facilitate cooperation on export control, economic issues (G7, G8, G20, World Economic Forum, etc.). The outcome of these many networks is a complex meta-network which is a central part of global governance.

2.1.8 A Current Account and Trends in Global Governance

Since the end of World War II, and in an accelerated pace since the 1990s, we have witnessed a sharp increase in the scope of trans-border interactions, including trade and tourism and the less-desired cross-border effects of pollution and even international criminal and terrorism networks. The number of corporations with international activity has grown, as did the number of people with overseas activities including business, study, tourism and temporary living. International cooperation thus becomes more necessary and beneficial, and international institutions and forums promote and institutionalize international cooperation, deepening global governance. Global governance significantly evolved to meet many – though surely not all – of the modern challenges and needs, and its consequences are felt on a daily basis. As Weiss and Thakur noted:

> *There is no government for the world. yet on any given day, mail is delivered across borders; people travel from one country to another via a variety of transport modes; goods and services are freighted across land, air, sea, and cyberspace; and a whole range of other cross-border activities takes place in reasonable expectation of safety and security for the people, groups, firms, and governments involved. Disruptions and threats are rare—indeed, in many instances less frequent in the international domain than in many sovereign countries that should have effective and functioning governments.*

(Palgrave Macmillan 2017); Thomas G. Weiss, 'International Bureaucracy: The Myth and Reality of the International Civil Service' (1982) 58 International Affairs 287; James P. Muldoon, *International Organization and Bureaucracy*, vol 1 (Oxford University Press 2018).

> *That is to say, international transactions are typically characterized by order, stability, and predictability.*[134]

The full picture is of course more complicated: as we write this words, wars are waging in various parts of the world, a huge influx of refugees seek a more viable habitat and sometimes die on their way to refuge, instances of national financial crisis may turn global, as did the 2008 financial crisis, and pollution and global warming are threatening earth's environment. For each of these challenges there are mechanisms of global governance in place - norms, rules and institutions - but they are not always enough. It is important to remember two things in this context: (i) global governance is made by various actors, and the shortcomings of global governance are the shortcomings or misbehaviour of those actors or part thereof and because of insufficient cooperation between those actors; and (ii) even on a national level, where the principle of sovereignty allows national governments powers much greater than those in global governance, bad things happen, including all the above – wars, refugees, financial crisis, poverty. In fact, it is the national level that is often the source of the above phenomena. The 2008 financial crisis began in the US owing to bad economic governance in the US but spread across the globe. The same can be said of crisis regarding the environment or wars, which typically originate in a sub-global level (*e.g.,* State level or provincial level) and that global governance can only hope to mitigate the effects of such crisis.

The rise of global governance with its supra-national norms, rules and institutions, does not necessarily mean that States today are weaker. It is true that States today are in many ways not free to do all they wish to do. Nevertheless, States never were free, as their

[134] Thomas G. Weiss and Ramesh Thakur, *Global Governance and the UN* (Indiana University Press 2010).

actions were limited, *e.g.,* by economic and geopolitical conditions. On the other hand, other factors increased the power of States, from the phenomenal increase in domestic legislation and regulation to the new opportunities that global governance had opened to them, *e.g.,* in international trade and international cooperation on many issues. In many ways, States that play global governance well are far stronger than ever before. In the context of space, INTELSAT, which was a distinct global governance entity, has enabled even small States to enjoy the benefit of satellite communication services, where many of them could not have produce such services on the national level. In other words, global governance allowed States to use and supply their nationals with services, which would otherwise not be available to them. International cooperation also enables States to better handle natural disasters, *e.g.,* by sharing satellite data on such disasters through UN-SPIDER, which was established for that very purpose. Global governance therefore does not replace States but serves as another level of governance. In this sense, global governance and its relations with national legislation and government activities resembles the federal-local division of governance, but with a major difference regarding authority: whereas the federal level has an overall superiority and authority, global governance does not have the same powers. It is still to a large extent voluntary based, or to be exact, interests based.

Global governance lies and operates in the wastelands between the national and international, the local and the global, and the tension between the conflicting spheres and interests define the countours of it..[135] There are many actors with different and often conflicting interests. Not only is this diversity hard to manage, the task is even harder as

[135] John Gerard Ruggie, Forward, in Thomas G. Weiss and Ramesh Thakur, Global Governance and the UN (Indiana University Press 2010).

this diversity needs to manage itself, since in the absence of a global government and legislator, the actors of global governance themselves steer global affairs. The problems – and prospects – of global governance have been comprehensively presented by Rosenau at the very beginning of the study of global governance:

> *To anticipate the prospects for global governance in the decades ahead is to discern powerful tensions, profound contradictions, and perplexing paradoxes. It is to search for order in disorder, for coherence in contradiction, and for continuity in change. It is to confront processes that mask both growth and decay. It is to look for authorities that are obscure, boundaries that are in flux, and systems of rule that are emergent. And it is to experience hope embedded in despair. This is not to imply that the task is impossible. Quite to the contrary, one can discern patterns of governance that are likely to proliferate, others that are likely to attenuate, and still others that are likely to endure as they always have. No, the task is not so much impossible as it is a challenge to one's appreciation of nuance and one's tolerance of ambiguity.*[136]

In recent years calls to halt or even reverse the process of globalization were made from both sides of the political map. While the UK already have opted to leave the EU following such calls and a referendum, the full results of these voices across the globe are yet to be seen. The re-emergent of mercantilism and protectionism and trade wars are all elements of contra-globalization wave. All these put a strain on global governance. Nonetheless, it is important to remember that States have always acted in self-interest and that global governance emerged and evolved to a large extent in order serve the self-interests of the participating States.

[136] James N. Rosenau, 'Governance in the Twenty-first Century', (1995) 1(1) Global Governance 13.

Schwab, the founder of the World Economic Forum (colloquially known as the Davos Forum) talks about a coming fourth industrial revolution, "a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before"[137]. A new industrial revolution is expected to spur another (r)evolution in global governance.

2.2 The Study of Global Governance

The definition of global governance, as of any academic term, draws the borders of the investigation and is therefore based on and reflects the desired scope of inquiry. Indeed, Domínguez and Flores[138] explain the development of the literature on global governance using the evolution of its definitions, thematic applications, conceptual debates, and institutional developments. At the end, as Finnemore put it, "[a]nalytically, the concept of global governance is a means, not an end."[139] Therefore, and though chapter 1 already defined the term for the purposes of this thesis, this review of the study of global governance opens with the struggle to define the concept of global governance, one that this thesis also faced.

[137] Klaus Schwab, *The Fourth Industrial Revolution* (World Economic Forum 2016); Klaus Schwab, 'The Fourth Industrial Revolution: What It Means and How to Respond' Foreign Affairs, December 12, 2015, <https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution> accessed 18 January 2017.

[138] Roberto Domínguez and Rafael Velázquez Flores, 'Global Governance' (2018) Oxford Research Encyclopedia of International Studies <http://oxfordre.com/view/10.1093/acrefore/9780190846626.001.0001/acrefore-9780190846626-e-508> accessed 14 April 2019.

[139] Ibid.

2.2.1 The Concept of Global Governance

2.2.1.1 The Riddle of Global Governance

As noted in chapter 1, 'global governance' is a wide term that is open to multiple elucidations and versions and is "notoriously slippery". Moreover, there are variances in the different definitions of the term and thus in what the various authors mean when they talk of global governance. This section elaborates on the concept of global governance and its various definitions over the years. However, this is not a genealogy of the concept in the meaning and method introduced and used first by Nietzsche[140] and later by Foucault[141], with whom it is mostly associated.

The term – and now a field of study – "global governance" was introduced by Rosenau and Czempiel[142] in 1992 as something different than government. The underlying observation was that it is a myriad of actors and forms of authority, formal and informal, which steer behavior in the global arena. Questions regarding the meaning of the concept soon appeared. As early as 1995, when the concept of global governance was in its cradle, Finkelstein's article in the first issue of the journal, Global Governance, asked in its title "What Is Global Governance?"; Finkelstein's provocative answer was: " 'global governance' appears to be virtually anything" [143]. Twenty years later, Weiss and Wilkinson noted that:

> *[d]espite or perhaps because of its omnipresence, global governance remains notoriously slippery. While it has potential beyond conveying a*

[140] Friedrich Nietzsche, *On the Genealogy of Morals: A Polemic* (Original Title in German: *Zur Genealogie Der Moral: Eine Streitschrift)* (Verlag Leipzig C G Naumann 1887).

[141] Michel Foucault, *Discipline and Punish: The Birth of the Prison* (original title in French: *Surveiller et punir : Naissance de la prison*) (Gallimard 1975); Michel Foucault, *The History of Sexuality, Vol. 1: An Introduction* (original title in French: *L'Histoire de la Sexualité*) (Gallimard 1976).

[142] James N. Rosenau and Ernst Otto Czempiel, *Governance without Government: Order and Change in World Politics* (Cambridge University Press 1992).

[143] Lawrence S. Finkelstein, 'What Is Global Governance?' (1995) Global Governance 1(3) 367, 368.

> *sense of the complexity of contemporary global authority, it has become, among other things, an alternative moniker for international organizations, a descriptor for a world stage packed with ever more actors, a call to arms for a better world, an attempt to control the pernicious aspects of accelerating economic and social change, and a synonym for world government*[144].

There are several often-quoted definitions of the term, notably Rosenau's pioneering definition[145], that of the self-declared "Commission on Global Governance"[146] and of the UN Development Programme[147]. Many have struggled with the concept and inquiry of global governance[148], a term Zürn[149] described as amorphous, and Bevir[150] as ubiquitous. The next section will review the leading definitions of global governance over the years, and the following section will reiterate and expand on the definition used for this thesis.

2.2.1.2 The Leading Definitions of the Term 'Global Governance'

Rosenau, who together with Czempiel introduced 'global governance' as a concept and a field of inquiry, provided a famous – and wide - definition of the term, in the first issue of the Global Governance journal in 1995:

> *. . .global governance refers to more than the formal institutions and organizations through which the management of international affairs is or*

[144] Thomas G. Weiss and Rorden Wilkinson, 'Rethinking Global Governance? Complexity, Authority, Power, Change' (2014) 58 International Studies Quarterly 207.

[145] James N. Rosenau, 'Governance in the Twenty-first Century' (1995) 1(1) Global Governance 13.

[146] Commission on Global Governance, *Our Global Neighbourhood: The Report of the Commission on Global Governance* (Oxford University Press 1995).

[147] United Nations Development Programme (UNDP), *Human Development Report* (Oxford University Press 1999).

[148] See, for example, Finkelstein, Lawrence S., 'What Is Global Governance?' (1995) 1(3) Global Governance 367, and Thomas G. Weiss and Rorden Wilkinson, 'Rethinking Global Governance? Complexity, Authority, Power, Change' (2014) 58 International Studies Quarterly 2073).

[149] Michael Zürn, 'Global Governance as Multi-Level Governance' in David Levi-Faur (ed), *The Oxford Handbook of Governance* (Oxford University Press 2012).

[150] Mark Bevir, 'Governance as Theory, Practice, and Dilemma.' in Mark Bevir (ed), *The Sage Handbook of Governance* (Reprint ed, SageE 2013).

> *is not sustained. The United Nations system and national governments are surely central to the conduct of global governance, but they are only part of the full picture. Or at least in this analysis global governance is conceived to include systems of rule at all levels of human activity—from the family to the international organization—in which the pursuit of goals has transnational repercussions.*[151]

In the same first issue of the Global Governance journal, Finkelstein defines global governance as follows:

> *Global governance is governing, without sovereign authority, relationships that transcend national frontiers. Global governance is doing internationally what governments do at home.*[152]

Another often quoted definition is that of the Commission on Global Governance, a policy-oriented ad-hoc committee initiated by the former West German Chancellor Willy Brandt and supported by the Swedish government and the General Secretary of the UN. The committee's report provided the following definition:

> *Governance is the sum of many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and co-operative action taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interest .*[153]

In 1999 the United Nations Development Programme (UNDP) published its Human Development Report 1999, in which it described the scope of governanceas:

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[151] James N. Rosenau, 'Governance in the Twenty-first Century' (1995) 1(1) Global Governance 13.
[152] Lawrence S. Finkelstein, 'What Is Global Governance?' (1995) 1(3) Global Governance 367.
[153] Commission on Global Governance, Our Global Neighbourhood: The Report of the Commission on Global Governance (Oxford University Press 1995).

> *Governance does not mean mere government. It means the framework of rules, institutions and established practices that set limits and give incentives for the behaviour of individuals, organizations and firms.*[154]

Weiss and Thakur provide a contemporary, comprehensive but not too wide, definition as follows:

> *'global governance' is the sum of laws, norms, policies, and institutions that define, constitute, and mediate relations among citizens, society, markets, and the state in the international arena—the wielders and objects of international public power.*[155]

Najam provides the shortest definition - "the management of global processes in the absence of global government"[156].

The McGill international study on global space governance, defines global governance and global space governance as follows:

> *Global governance is a wide term that is open to multiple interpretations and meanings. For the purpose of this book, "global space governance" refers to a collection of international, regional, or national laws as well as regulatory institutions and actions/manners/processes of governing or regulating space-related affairs or activities. The concept encompasses a wide range of instruments, institutions, and mechanisms (including international and/or regional treaties, agreements, and regulations); national laws and regulations; technical standards and procedures; codes of*

[154] "Governance does not mean mere government. It means the framework of rules, institutions and established practices that set limits and give incentives for the behaviour of individuals, organizations and firms." (United Nations Development Programme (UNDP), *Human Development Report* (Oxford University Press 1999)).

[155] Thomas G. Weiss, and Ramesh Thakur, *Global Governance and the UN: An Unfinished Journey* (Indiana University Press 2010).

[156] No direct quote of Najam was available, only several other sources noting his alleged definition, without a direct quote. See, for example, Malcolm D. Childress, 'International Natural Resources Governance Initiatives' in Grenville Barnes and Brian Child (eds), *Adaptive Cross-scalar Governance of Natural Resources* (Routledge 2014) 56.

> *conduct; "rules of the road" and guidelines; and transparency and confidence-building measures, all of which are discussed, formulated, and implemented at various national, regional, and international forums. In brief, global space governance (or global governance of outer space) is the entirety of the agreements, laws, regulations and other mechanisms (mandatory and voluntary) in relation to outer space affairs or activities, and includes processes for their formulation, compliance monitoring, and/or enforcement by concerned international and/or national institutions.*[157]

The various definitions demonstrate significant variance but a common base – governance is not a matter of a single institution, instrument or action, but rather the cumulative effects of many of each, and it is about governing. These are the basic ingredients of my definition.

2.2.1.3 'Global Governance' in the Meaning Used in this Thesis

There are some background considerations leading to the definition employed in this thesis for the term 'global governance'. To begin with, 'global' is different from 'international'; 'international' is State centred, and it typifies international organizations which members are States, *e.g.,* the WTO. 'Global', on the other hand, refers to universal and worldwide coverage[158] and addresses also the interests of the international system and humankind as a whole. Further, 'governance' is not 'government'. It is neither a single body, nor a collection of distinct, clearly labelled, legally established, bodies and sets of rules. Oxford dictionary defines "governance" as "the action or manner of governing a State, organization, etc."[159] Governance refers to navigating or directing the actions of a legal entity or group of people. However, governance is not an act of a single identified body, like a government,

[157] Ram S. Jakhu and Joseph N. Pelton (eds), *Global Space Governance: An International Study* (Springer 2017).

[158] See also Thomas G. Weiss and Ramesh Thakur, *Global Governance and the UN: An Unfinished Journey* (Indiana University Press 2010).

[159] 'Governance: Definition of Governance in English by Lexico Dictionaries' (Lexico Dictionaries powered by Oxford) <https://www.lexico.com/en/definition/governance> accessed 9 August 2019.

but rather a result of the action of numerous factors, including government and NGOs, and it is a continuous process. Global governance is governance at the global level.

As noted in chapter 1, 'global governance' is defined herein as *the steering of global affairs*,[160] which is made mainly by *guiding the behavior of actors in global affairs*. What guides the behavior of actors in global affairs, and therefore steers global affairs, is mainly the cumulative effects of the repertoire of applicable norms, principles, rules, policy instruments and other applicable instruments, and the work of organizations, institutions and other fora. This definition views governance as dynamic in nature – a *process* - and not as a static picture which is the aggregate or sum of norms, rules etc. captured in a single moment in time[161]. Furthermore, this definition encompasses a wide range of instruments, institutions and mechanisms; including international and/or regional treaties, agreements, and regulations, model national laws and regulations; technical standards and procedure, codes of conduct, 'rules of the road', guidelines; and transparency and confidence building measures that are discussed, formulated and implemented at various international *fora*.

2.2.2 The Study of Global Governance

This section reviews the evolution of the study of global governance and some current trends in the new millennium. The study of the mechanisms and effects of global governance lie deep within several academic disciplines, including international law,

[160] This definition draws from a definition associated to Adil Najam, a beautifully simple definition - that global governance is "the management of global processes in the absence of global government". I did not find any direct quote of Najam, only several other sources noting his alleged definition, without a direct quote. See, for example, Malcolm D. Childress, 'International Natural Resources Governance Initiatives' in Grenville Barnes and Brian Child (eds), *Adaptive Cross-scalar Governance of Natural Resources* (Routledge 2014) 56.

[161] Weiss and Thakur define global governance as "the sum of laws, norms, policies, and institutions that define, constitute, and mediate relations among citizens, society, markets, and the state in the international arena - the wielders and objects of international public power" (Thomas G. Weiss and Ramesh Thakur, *Global Governance and the UN: An Unfinished Journey* (Indiana University Press 2010), 6).

environmental protection, international trade, development cooperation, institutional analysis, global studies, globalization, and global economy. Yet, the main discipline that studies global governance is international relations, which is the focus of this section.

2.2.2.1 The Emergence of the Study of Global Governance

As an academic discipline, international relations (IR) started in the UK after World War I. The IR literature after WWII, led by Hans Morgenthau, focused on States' action in what came to be known as the Realism school of IR, and is still one of the dominant schools of thought on IR. IR had evolved in the 1970s to study the role of non-State actors, mainly international organizations, mainly by what became known as the Liberal school of thought on IR. More IR schools of thought followed, including constructivism, Marxism, Critical Theory and Feminism. The study of international organizations developed during the 1980s to the study of international regimes that include not just organizations but also rules, norms and decision-making procedures. This study introduced Regime Theory.

The literature of Regime Theory studied the reasons and conditions that lead to the establishment and success or demise of regimes. These theories saw States as the key actors in the establishment, success and demise of regimes. Whereas the concept of international organizations and regimes originated in the liberal stream of international relations, its assumptions on States' behavior in the establishment and maintenance of regimes had realist assumptions, that is, States act vis-à-vis international regimes out of self-interest, with a view to maximize their benefits. States cooperate because it benefits them or because being left outside a regime has a cost.

With the increase of the role of non-State actors, the IR literature broke away from State-centric study of international politics. An important milestone in the development of the study of global governance was in 1992 when Rosenau and Czempiel published their edited book "Governance without Government"[162], in which they asserted that governance is not reserved for governments, but rather is the outcome of the actions of various actors. This was the genesis of the study of "global governance". The Commission on Global Governance established in 1992 and its report "Our Global Neighbourhood"[163] published in 1995 further promoted the brand and research agenda of global governance. The same year saw the first volume of the 'Global Governance' journal which declared itself as "a review of multilateralism and international organizations". The discourse on global governance thus got its own private stage, though it naturally taking place also in many other stages and journals.

Many underlying issues of global governance were studied before the concept was introduced in the 1990s, under different disciplinary titles, most notably 'world order' and 'international organization'. The study of 'world order' was characterized with a more top-down and static description of world order, not capturing the variety of actors, networks and relationships that is the reality of international politics.[164] It is important to note in this context the difference between 'international organization' to 'international organizations', the first refers to the *process* of organizing the trans-border relations, and the second to *legal entities*, organizations – previously known as 'public international unions' - like the

[162] James N. Rosenau and Ernst Otto-Czempiel (eds), *Governance without Government: Order and Change in World Politics* (Cambridge 1992).

[163] Commission on Global Governance, *Our Global Neighbourhood: The Report of the Commission on Global Governance* (Oxford University Press 1995).

[164] Thomas G. Weiss and Ramesh Thakur, *Global Governance and the UN: An Unfinished Journey* (Indiana University Press 2010).

Universal Postal Union, that take part in the process of international organization.[165] The concept of global governance came to dominate the discourse because, as compared to its predecessors, it better captures the "growing complexity in the way that the world is organized, and authority exercised"[166]. While the 'world order' paradigm was top-down and static, the global governance paradigm is that of networks, or even bottom-up, and dynamic. The concept of global governance is wider and more flexible to include various modes of order and therefore the global governance discourse is a better investigative tool for processes and problems at global level.

A distinct feature of global governance is it being a study of meta-structures, of how the operation of sub-systems shapes the meta-structure, that is, global governance.[167] Furthermore, in the sense that global governance is the study of a myriad of networks of State and non-State actors, rules, norms, expectations etc., it is the study of a complex system. To make sense of the ever more complex system of global governance, and devise feasible governance in conditions of complexity, new theories evolved, and so did this thesis.

[165] Note the difference between 'international organization' to international organizations, the first refers to the *process* of organizing the transborder relations, and the second to *organizations* , likt the ITU, that take part in this process. In the words of Claude, "International organization is a process; international organizations are representative aspects of the phase of that process which has been reached at a given time`. (Inis L. Claude, *Swords into Plowshares: The Problems and Progress of International Organization* (3rd ed Random House 1964), 4. Weiss and Wilkinson emphasized that "the "s" not only pluralizes the word but refers to specific entities and not a process of institutionalization" Thomas G. Weiss and Rorden Wilkinson, 'Introduction From International Organization to Global Governance' in Thomas G. Weiss and Rorden Wilkinson (eds), *International Organization and Global Governance* (Routledge 2014), 1.

[166] Thomas G. Weiss and Rorden Wilkinson, 'Rethinking Global Governance? Complexity, Authority, Power, Change' (2014) 58 International Studies Quarterly 207.

[167] Ibid.

2.2.2.2 Current and Emerging Trends

The ways in which global governance is made have changed, and the new literature addresses these changes with matching theories. There were days in which it was feasible to negotiate a comprehensive, universal and legally binding treaty that prescribed, in a top-down fashion, general policies, norms and rules and established international organizations with a strong mandate. Those days are over.[168] Indeed, it is widely accepted among global governance scholars that the hierarchical model of governance is outdated in terms of its ability to provide answers to current and future challenges. The already weak system of global governance is becoming even more so and global governance architectures, legal and institutional, are fragmenting. At the same time, and as the 2006 Report of the International Law Commission (ILC)[169] noted, fragmentation of international law is a widespread phenomenon. Legal fragmentation is a structural feature and there is also fragmentation of international institutions and organizations.

As the task of navigating the world without a government becomes harder and more complex, so does the study of global governance. In a 2014 account of new theories of global governance, Ruggie, referred to them as "new governance theory".[170] The concept of regime complexes, which is one of the pillars of theoretical approach of this thesis, may fall under this category.

As the new governance literature asserts, even if constituting a comprehensive and integrated global regime is no longer feasible, it is still possible to achieve a significant

[168] Robert Falkner, Hannes Stephan, and John Vogler, International Climate Policy after Copenhagen: Towards a 'Building Blocks' Approach' (2010) 3 Global Policy 252.

[169] International Law Commission, 'Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law' (A/CN.4/L.682, 13 April 2006).

[170] John Gerard Ruggie, 'Global Governance and "New Governance Theory": Lessons from Business and Human Rights'(2014) 20 Global Governance 5.

degree of convergence of norms, policies, and practices even in a highly controversial issue area. Taking into considerations the reality of the limitations of old models and the opportunities still in place for achieving governance, the new governance theory calls for a 'building blocks' approach to achieving an overall solution. Various international regimes, or 'building blocks', are closely interconnected in a regime complex. The new governance theory may also utilize a polycentric governance model, suggested by this thesis, as a means for achieving goals that could previously be achieved with the hierarchical model.[171]

Cohn and Pegram call for "a third generation of global governance scholarship"[172] and the special section they edited in a 2018 issue of the Global Policy journal, features contributions from pioneer thinkers in global governance, aimed at identifying promising lines of future inquiry and galvanize further scholarly innovation on global governance.

Slaughter[173] asserts that we already have a new world order, one not based on States or NGOs, but rather a global governance based on a complex global web of "government networks". Government officials exchange information and coordinate activity across national borders to address daily trans-border interaction as well as to tackle crime and, terrorism. There are also more institutionalized networks, from the G8 to the International Association of Insurance Supervisors. These networks are under-appreciated and, worse, underused to address the challenges facing the world today. However, and despite issues of democratic accountability, these networks are the present and future of global governance. Slaughter's view of networks-based global governance still relies on national governments

[171] Ibid.

[172] David Coen and Tom Pegram, 'Towards a Third Generation of Global Governance Scholarship' (2018) 9 Global Policy 107.

[173] Anne-Marie Slaughter, *A New World Order* (Princeton University Press 2005).

– though not on a hegemon – as she sees governments as best fit to tackle the problems of a networked world order. Viewed in this way, global governance is a meta-structure, a network-of-networks. Networks theory, and in particular social network analysis (SNA), is therefore a relevant body of knowledge. SNA studies the structure of relationships between 'social entities', which include – but are not limited to - persons, groups, organizations and nation States.[174] Networks theory and SNA can therefore be useful in analyzing the networks-based global governance we have today and will have in the foreseeable future.

The literature on networks and on the science of complexity can also increase our capacity to better understand global governance in the 21st century. Complexity theory may help us understand the complex manner in which global governance is made and exercised. A system is complex when it is composed of many parts that interconnect in intricate ways[175]. A system presents dynamic complexity when cause and effect are subtle, over time[176]. A system is complex when it is composed of a group of related units (subsystems), for which the degree and nature of the relationships is imperfectly known[177]. Global governance is undoubtedly a complex system, and the study of global governance may benefit from the literature on complexity.

The study of global governance may further benefit from an analysis thereof as complex networks, thus combining the knowledge on networks with that on complexity. Morçöl makes a compelling case for a complex governance networks conceptualization. He argues

[174] Stanley Wasserman and Katherine Faust, Social Network Analysis: Methods and Applications (Cambridge University Press 1994); Rainie Lee and Barry Wellman, *Networked: The New Social Operating System* (MIT Press 2012).

[175] Joel Moses, 'Complexity and Flexibility' (working paper).

[176] Peter M. Senge, *The Fifth Discipline: The Art & Practice of The Learning Organization* (Doubleday 2006).

[177] Joseph M. Sussman, Perspectives on Intelligent Transportation Systems (Springer 2005). See in particular chapter III.2: The New Transportation Faculty: The Evolution to Engineering Systems.

that the concepts and methods of the three fields of inquiry – governance, complexity and networks - should be synthesized for the study of complex governance networks. [178]

This thesis can be viewed as part of the new governance theory or third generation of global governance in its point of departure - the crisis in global governance - and in its assertion of the inevitable and advantageous decentralization and call for polycentric governance in global affairs.

2.3 Conclusions

Humans are social animals and through history, humans lived in societies of growing scale. Human grouping started with small groups of hunters-gatherers, a social organization that accounts for 90 percent of human history. They were largely nomadic though with increasing sedentism (living in one place for a long time).[179] Roughly 12,000 years ago, humankind transitioned to small agricultural – and therefore sedential - societies. The agricultural revolution was the result of the domestication of plants and animals, and its effects on human history were so profound that it was called the "Neolithic Revolution." The agricultural era meant reliable food supply, which enabled significant increase in global population and the emergence of cities and larger groupings.[180] Fast forward, the Peace of Westphalia Treaty of 1648 cemented the State as the largest form of human

[178] Göktu˘g Morçöl, 'Complex Governance Networks: An Assessment' (2014) Complexity, Governance & Networks 5.

[179] Richard B. Lee and Richard Daly (eds), *The Cambridge Encyclopedia of Hunters and Gatherers* (Cambridge University Press 2005).

[180] Daniel Zohary, Maria Hopf and Ehud Weiss, *Domestication of Plants in the Old World: The Origin and Spread of Domesticated Plants in Southwest Asia, Europe, and the Mediterranean Basin* (4th ed, Oxford University Press 2012); Melinda A. Zeder, 'The Domestication of Animals' (2012) 68 Journal of Anthropological Research 161; Greger Larson and Dorian Q Fuller, 'The Evolution of Animal Domestication' (2014) 45 Annual Review of Ecology, Evolution, and Systematics 115; 'The Development of Agriculture' (*National Genographic*) <https://genographic.nationalgeographic.com/development-of-agriculture/> accessed 15 July 2019; Jared M. Diamond, *Guns, Germs and Steel: A Short History of Everybody in the Last 13,000 Years* (Vintage 2005).

societies. While the State remains to date the sovereign, inter-State and cross-border relations became increasingly important, and the industrial revolutions drove the establishment of international organizations. Economic, security and social needs led to increasing cross-border engagement and to norms, rules and institutions that steer, to a certain extent, the behavior of actors in global affairs, *i.e.*, global governance. The aftermath of World War II led to a wave of international organizations and legislation and also to the academic study of global governance, though the concept of global governance emerged only in the 1990s. The world today, with increased - though also increasingly contested - globalization and an ever-wider network of global norms, rules and institutions, sees increased - and also increasingly contested - global governance. Yet, and despite many visionaries of a single global political entity or government, the State predominantly remains the final sovereign. Global governance is ever more complicated.

Global governance is the steering of global affairs and is made, absent a central global authority, by the actors and is therefore decentralized. It is made by norms and rules, which the actors in global affairs have accepted to follow and institutions they joined. While there is a remarkable degree of cross-border cooperation and coordination, allowing for the immense international supply chains, trade, tourism and social interactions and many more activities that cross national borders, global governance is facing challenges.

The study of global governance is made mainly within the discipline of international relations (including alternate descriptors, notably international studies and global affairs), but also within international law, international political economy (IPE), and other disciplines. There are various descriptors for this study, notably ‘world order’ and

'international organization', but it is the modern descriptor of global governance that captures the variety of actors, networks and relationships that is the reality of international politics and the steering of global affairs.

This thesis builds on the literature on global governance, mainly that on international regimes, but progresses beyond that to incorporate the literature on polycentric governance and suggesting the application of polycentric governance model to governance in global affairs.

Chapter 3
Methodology and Theoretical Framework

Theory is the only reasoned guide to research that is available. In the absence of theory, inquiry becomes an informed trial and errors.[181]

This chapter presents the methodology and methods employed to address the research question. It further presents the theoretical approach of the thesis. It explains the choice of the theories and concepts that serve as the pillars of the theoretical approach and provides a literature review thereof. Furthermore, it demonstrates their convergence and builds on the cumulative insights from the respective literatures.

[181] The basic assumption of the Ostrom Workshop as quoted in Filippo Sabetti and Paul Dragos Aligica, 'Introduction: The Ostroms' Research Program for the Study of Institutions and Governance: Theoretical and Epistemic Foundations' in Filippo Sabetti and Paul Dragos Aligica (eds), *Choice, Rules and Collective Action* (European Consortium for Political Research (ECPR) 2014), 1, 2.

3.1 Methodology and Methods

In order to address the research question, this thesis uses the methodology and methods and takes the theoretical approach described in this sub-section. Methodology describes the research strategy at large and methods refer to the range of techniques used to collect evidence about the social world.[182] If the methodology describes the overall strategy of the research and explains its rationale, the methods describe actions taken to execute the strategy and investigate the research question, as well as the rationale for choosing these specific actions, procedures or techniques. A thesis, and particularly one in the field of law, often involves a hybrid of methods.[183] This thesis adopts a transdisciplinary methodology, and a mainly analytical method of research with the addition of normative recommendations.

This thesis investigates space governance and analyzes it in terms of decentralized governance. The lion's share of the literature on governance at the global level, and probably the more rigorous, lies outside space law and even international law, in the discipline of international relations (IR). The literature on polycentric governance within the discipline of political economy / institutional analysis provides complementary and precious theoretical and empirical grounding, as well as insights on governance without hierarchical authority, most relevant to governance at the global level that lacks a global central authority. Fragmentation, "regime complexes" and polycentric governance are each a version or conceptualization of decentralized governance. Therefore, the methodology of this thesis is transdisciplinary, employing and integrating knowledge and methods from

[182] Matt Henn, Mark Weinstein and Nick Foard, *A Critical Introduction to Social Research* (2nd edn, Sage Publications 2009) 10.

[183] Michael Salter and Julie Mason, *Writing Law Dissertations: An Introduction and Guide to the Conduct of Legal Research* (Longman Pub Group 2007) 31.

three disciplines, that is, law (international law, space law), political economy (institutional analysis), and international relations (regime theory) in an integrated manner, without adhering to disciplinary boundaries, and synthesizing their insights.[184]

The thesis is analytical, building on prior knowledge, one of its pillars is grounded in empirical quantitative research on the management of CPRs. Elinor Ostrom's theory provides the basis for the analysis and for drawing the suggested governance model. The international relations literature is used to make the necessary leaps to the international level and to proof test the insights from applying Ostrom's theory to governance in global affairs. The literature on fragmentation is used mainly in a comparative manner, to present similar insights from the legal discipline. In addition to the theoretical, analytical nature of the thesis, it also provides normative recommendations for the desired architecture of space governance that will enable continuous evolution thereof.

In addition, this chapter provides a literature review on the concepts of fragmentation, "regime complexes"; and polycentric governance. A literature review is "the foundation and inspiration for substantial, useful research".[185] It identifies the existing knowledge on the issue in question, the methodologies and methods used in the research thereof and the terminology used in the writings on it. It further enables the researcher to critically evaluate the existing knowledge and identify existing gaps, *e.g.,* gaps in information or theory. The literature review further allows situating the research in a broader context and appropriately acknowledging the larger field of research. It thus helps to clarify the original

[184] On the meaning of transdisciplinary research and the difference between Intradisciplinary, Crossdisciplinary, Multidisciplinary, Interdisciplinary and Transdisciplinary see Marilyn Stember, 'Advancing the Social Sciences through the Interdisciplinary Enterprise' (1991) 28 The Social Science Journal 1.

[185] David N. Boote and Penny Beile, 'Scholars before Researchers: On the Centrality of the Dissertation Literature Review in Research Preparation' (2005) 34 Educational Researcher 3, 3.

contribution of the research to knowledge, as the review of the existing knowledge exposes how the current research advances the knowledge in the field.[186]

The literature review herein enables presentation of the similarities between the three literatures and prepares the ground for the convergence of the literatures and insights, as the chapter undertakes in section 3.5.

3.2 Theoretical Framework

A theoretical framework is a collection of interrelated concepts that, though it may not yet amount to a mature theory, guide the research methodology and methods. Laying the theoretical framework includes, in addition to identifying the various concepts in the collection, providing their definitions, pointing to the relevant scholarly literature and discussing them. A review of the theoretical framework should demonstrate an understanding of theories and concepts chosen and employed and how they relate to the broader areas of knowledge.[187]

This section presents the three concepts employed in this thesis and defines them, each within its respective discipline. It thus provides the basis for what can become a theory. This chapter points to the relevant literature that discusses each concept and summarizes it. The chapter contextualizes the chosen concepts within their respective literature but goes further to provide a broader contextualization of the concepts within the wider area of knowledge – on governance in global affairs. By that it enables the reader to understand

[186] On conducting a literature review and its purpose see David Thomas and Ian D. Hodges, *Designing and Managing Your Research Project: Core Skills for Social and Health Research* (Sage 2010) in chapter 7 - 'Doing A Literature Review' (p. 105).

[187] On theoretical frameworks see, for example Norman G. Lederman and Judith S Lederman, 'What Is A Theoretical Framework? A Practical Answer' (2015) 26 Journal of Science Teacher Education 593.

the concepts and theories chosen as the pillars of the theoretical framework of this thesis and their contribution to the study of the research question.

3.2.1 IR - International Regimes

International cooperation and institutions have been traditionally one of the core investigations of the IR literature. The study of *international regimes* has developed since the 1970s[188], initially as Regime Theory, has become increasingly influential and later evolved into the study of global governance that emerged in the 1990s.[189] The study of international regimes observes and seeks to explain how international cooperation emerges and is sustained in the absence of a global central political authority. International cooperation, the theory suggests, stems from the interdependence of and complex interaction between the self-interested actors in global affairs.[190] International regimes facilitate international cooperation but also themselves are made by way of international cooperation. Regime Theory is associated with neoliberal institutionalism[191], however it has a practical combination of realism and liberalism that explains 'liberal' phenomenon –

[188] See, for example, Robert O. Keohane and Joseph S. Nye, *Power and Interdependence* (Boston: Little, Brown 1977); Stephen D. Krasner, 'Structural Causes and Regime Consequences: Regimes as Intervening Variables' in Stephen D. Krasner (ed), *International Regimes* (Cornell 1983), 1; Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton 1984); Volker Rittberger and Peter Mayer (eds), *Regime Theory and International Relations* (Oxford 1993); Oran R. Young, 'Regime Dynamics: The Rise and Fall of International Regimes' (1982) 36 International Organization 277; and Robert Axelrod and Robert O. Keohane, 'Achieving Cooperation under Anarchy: Strategies and Institutions' (1985) 38(1) World Politics 226. For a recent account on the development of regime theory see Oran R. Young, 'Regime Theory Thirty Years On: Taking Stock, Moving Forward' (2012), E-International Relations <http://www.e-ir.info/2012/09/18/regime-theory-thirty-years-on-taking-stock-moving-forward> accessed 11 December 2014.

[189] See James N. Rosenau and Ernst-Otto Czempiel (eds), *Governance without Government: Order and Change in World Politics* (Cambridge University Press 1992); and The Commission on Global Governance, *Our Global Neighbourhood* (Oxford University Press 1995). Not surprisingly, some leading authors on Regime Theory became leading authors about global governance, *e.g.,* Robert O. Keohane, Oran Young and Michael Zürn. Chapter 2 of this study elaborates on the evolution of the study of global governance, and on regime theory as part of this evolution.

[190] Robert O. Keohane and Joseph S. Nye, *Power and Interdependence* (Boston: Little, Brown 1977).

[191] Anu Bradford, 'Regime Theory' in *Max Planck Encyclopedia of Public International Law* (Oxford University Press 2007).

international cooperation – with 'realist' reasoning – the self-interest of actors in global affairs.[192] International regimes are also the building blocks of global governance, as explicated herein.

The concept of and literature on international regimes are the first pillar of the theoretical approach of this thesis and its relevance is straightforward, considering the essence of regimes and global governance. Within the study of international regimes, it is the recent concept of 'regime complexes' that is used in both descriptive and prescriptive manners. It is used to describe the reality in many issue-areas in global affairs, and in particular the governance of space warfare. It is also used in chapter 4 to prescribe normative recommendations for space governance that may also suit the governance of other issue-areas in global affairs.

3.2.2 Political Economy, Institutional Analysis and Economic Governance

The second pillar of the theoretical approach of this thesis combines the theory of polycentric governance and the study of the management of CPRs. The relevance of this second pillar is less obvious and requires explication. It falls under the broad field of political economy and under the more specific fields and labels of institutional analysis, New Institutional Economics (NIE)[193] and economic governance[194].

[192] Raymond Hopkins and Benjamin Meiches suggest that "[c]ommon approaches to regime theory include realism, neoliberalism, cognitivism, and constructivism" (Raymond Hopkins and Benjamin Meiches, 'Regime Theory' in Oxford Research Encyclopedia, International Studies (Oxford University Press 2012)).

[193] See Claude Ménard and Mary M. Shirley, *Handbook of New Institutional Economics* (Springer 2005).

[194] Nobel Committee, 'Report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October 2009) <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014.

As noted above, international regimes are the product of international cooperation, from which they emerge and which they facilitate. The difficulty in achieving and sustaining international cooperation is a case of the general 'collective action problem', broadly defined. "The problem of collective action is ubiquitous: it is in many ways the central problem of social life"[195]. The problem of achieving and maintaining collective action is probably as old as human grouping to societies. The literature on collective action also has a long history, at least from Aristotle onwards.[196] This thesis focuses on a recent investigator of collective action, Elinor Ostrom. Together with Vincent Ostrom and the scholars at the Ostrom Workshop in Political Theory and Policy Analysis[197] (also known as the Bloomington school), Elinor Ostrom developed the Institutional Analysis and Development (IAD) framework, a set of concepts to be used in the analysis of collective action problems and institutions[198]. A framework is a higher level of abstraction then theory. If a theory is a system of ideas[199], a framework is, as E. Ostrom put it, the language by which a theory is thought of and presented.[200] The IAD framework was the basis to

[195] Frederick W. Mayer, *Narrative Politics: Stories and Collective Action* (Oxford University Press 2014) in Chapter 2: The Problems of Collective Action.

[196] See, for example: Mancur Olson, *The Logic of Collective Action* (Harvard University Press 1965) and see more in section 3.4.2.1 below 'The study of the management of CPRs'.

[197] <https://ostromworkshop.indiana.edu/index.html>.

[198] Larry L. Kiser and Elinor Ostrom, 'The Three Worlds of Action: A Metatheoretical Synthesis of Institutional Approaches' in Elinor Ostrom (ed), *Strategies of Political Inquiry* (Sage 1982) 179; Elinor Ostrom, 'Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework' in Paul Sabatier (ed), *Theories of the Policy Process* (2nd ed. Westview 2009) 21; Elinor Ostrom, 'Background on the Institutional Analysis and Development Framework' (2011) 39(1) Policy Studies Journal 7; Michael D. McGinnis, 'An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework for the Analysis of Institutions and Their Development' (2011) 39(1) Policy Studies Journal 169.

[199] Oxford English dictionary defines 'theory' as: "A supposition or a system of ideas intended to explain something, especially one based on general principles independent of the thing to be explained" (Oxford Living Dictionaries, English <https://en.oxforddictionaries.com/definition/theory> accessed 18 April 2018.

[200] See Elinor Ostrom, Institutional Analysis and Development: Elements of the Framework in Historical Perspective, in Encyclopedia of Life Support Systems (EOLSS) Vol. II, Historical Developments and Theoretical Approaches in Sociology. Elinor Ostrom suggests that "frameworks are the most general forms of theoretical analysis…[they] provide a metatheoretical language that can be used to compare theories" (Elinor Ostrom, Background on the Institutional Analysis and Development Framework, 39(1) Policy Studies Journal (2011),

Elinor Ostrom's theory as well as her empirical studies. Ostrom studied diverse institutional arrangements for governing CPRs and public goods. She was awarded the 2009 Nobel Prize in Economic Sciences for her contribution to the understanding of economic governance, especially that of the commons. The type of challenges that the management of common pool resources faces are not commonly associated with the challenges of global governance in general. However, as the Nobel Prize committee noted, "[Ostrom's] observations are important not only to the study of natural resource management, but also to the study of human cooperation more generally"[201]. As noted above, international cooperation is in the core of global governance, and therefore Ostrom's theory is relevant to the study of global governance.

Elinor Ostrom's work is more methodologically rigorous, theoretically and empirically, than the IR literature[202] and it provides a framework for discussion, a theory and empirical basis. The similarities between the theory on international regimes and Ostrom's theory are encouraging as the two theories reinforce each other. By understanding collective action in such a cross-disciplinary and systemic manner, one can better understand global governance which is made by the collective action of the actors in global affairs. From there on the road is clear to understanding space governance and to prescribe normative recommendations for its improvement.

7, 8).

[201] The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, 'Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (2009) <https://www.nobelprize.org/prizes/economics/2009/advanced-information/> accessed 29 September 2018.

[202] Robert O. Keohane, 'Review Symposium: Beyond the Tragedy of the Commons' (2010) 8(2) Perspectives on Politics 577.

Elinor Ostrom's study of the management of CPRs and public goods was intertwined with Vincent Ostrom's study of polycentric governance. The study of polycentric governance evolved within the political sciences in the context of the national and sub-national levels of public administration. It was launched with the study by Vincent Ostrom, Tiebout and Warren on the organization of government in metropolitan areas in the US [203] and continued along those lines, led by the Ostrom Workshop. What characterizes polycentric governance is decentralization, and at this point it correlates to global governance. Absent a central global authority, governance at the global level is made by the actors, mainly but not exclusively States, and is therefore decentralized. At the national level there is a central political authority, yet governance is sometimes decentralized, as the literature on polycentric governance demonstrates.

3.2.3 Fragmentation of International Law

The phenomenon and concept of fragmentation share key characteristics and insights with the phenomena and concepts of regime complexes and polycentric governance. Fragmentation is discussed herein as it reinforces the conclusions derived from the two main pillars of the theoretical approach of this thesis.

The next three sections (3.2 to 3.4) review the literature on international regimes, economic governance and fragmentation. The following two sections (3.5 and 3.6) demonstrate that the theories on regime complexes, polycentric governance and fragmentation are complementary and explicate how these theories converge and can,

[203] Vincent Ostrom, Charles M. Tiebout and Robert Warren, 'The Organization of Government in Metropolitan Areas: A Theoretical Inquiry' (1961) 55 The American Political Science Review 831.

together, provide a more comprehensive understanding of the nature of governance at the global level.

3.3 International Regimes

3.3.1 The Study of International Regimes

The basic premise of the study of international regimes is that power in global affairs is dispersed among numerous actors, including States, international organizations, multinational corporations and international NGOs.[204] This premise is the key link to the concept of polycentric governance. The various actors have different interests and ideologies, sometimes overlapping and at other times conflicting or competing. And yet, as a matter of fact, the various actors cooperate in various ways and degrees. This cooperation leads to, and in turn is facilitated by, international regimes. The study of international regimes inquires how international regimes emerge and are sustained, what their substantive context is, and how effective they are.

3.3.2 What are 'Regimes'?

A Regime, according to Krasner's classic definition, is "a set of implicit or explicit principles, norms, rules, and decision-making procedures around which actor expectations converge in a given area of international relations"[205]; regimes are essentially "recognized patterns of practice around which expectations converge"[206] and they embody and affect actors' expectations[207]. Essentially, regimes are "institutions that are specialized to a particular

[204] See, for example, Bertjan Verbeek, 'Regime Theory in International Relations' in Keith Dowding (ed), *Encyclopedia of Power* (Sage 2011).

[205] Stephen D. Krasner, Structural Causes and Regime Consequences: Regimes as Intervening Variables, in Stephen D. Krasner (ed), *International Regimes* (Cornell 1983), 1.

[206] Oran R Young, 'Regime Dynamics: The Rise and Fall of International Regimes' (1982) 36 International Organization 277,

[207] Robert Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton

issue (*e.g.,* the nuclear nonproliferation regime, the trade regime, the regime for stratospheric ozone) or a spatially defined area (*e.g.,* the regime for Antarctica, the regime for the North Sea)"[208]. Indeed, the terms 'international institutions' and 'regimes' were used interchangeably, and even the research field of Regime Theory was named at first 'International Institutions'[209]. Nye describes regimes as "a subset of norms, which are shared expectations about appropriate behavior. Norms can be descriptive, prescriptive or both. They can also be institutionalized (or not) to varying degrees"[210]. An example of one such regime is the Missile Technology Control Regime (MTCR)[211].

Though none of the above definitions mentions a forum, this is a feature that appears in many, but not all, regimes and it plays an important part in the regimes in which it appears. A forum may create a regime and is often established by the regime or by the same instrument that establishes the substantial rules of the regimes, in order to observe and enhance the regime. Regimes are not an ad-hoc agreements or instances of cooperation for the promotion of short-term self-interests, and they therefore require some kind of forum or administration. As Haggard and Simmons noted:

> *Most regimes, however, are likely to have at least some minimal administrative apparatus for the purpose of dispute settlement, the collection and sharing of information, or surveillance. Complex cooperative*

1984). See also Stephen D. Krasner, Structural Causes and Regime Consequences: Regimes as Intervening Variables, in Stephen D Krasner, ed, International Regimes (Cornell 1983), 1.

[208] Oran R. Young, 'Regime Theory Thirty Years On: Taking Stock, Moving Forward' (2012), E-International Relations <http://www.e-ir.info/2012/09/18/regime-theory-thirty-years-on-taking-stock-moving-forward/> accessed 11 December 2014.

[209] Early reference to definitions of regimes at times used the term 'international institutions'.

[210] Joseph S. Nye, The Regime Complex for Managing Global Cyber Activities, The Global Commission on Internet Governance Paper Series No. 1 (2014) < https://www.cigionline.org/publications/regime-complex-managing-global-cyber-activities> accessed 16 May 2016.

[211] <http://mtcr.info>.

> *tasks require more elaborate, and potentially autonomous, organizational structures.*[212]

The case of civil aviation may demonstrate this point. In 1944, the U.S. convened an international conference on civil aviation in Chicago, with representatives from 55 States. The conference resulted in the Convention on International Civil Aviation, also known as the Chicago Convention. The Chicago Convention established the International Civil Aviation Organization (ICAO), headquartered in Montréal, which observes and enhances the regime of international air transport *e.g.,* by the development of aviation standards and recommended practices.[213] Another example is that of the World Trade Organization (WTO), which represents the regime of international trade and includes a powerful dispute resolution mechanism that enforces the rules of the regime.

For the purpose of this thesis, regimes are implicit or explicit norms, rules, and decision-making procedures, descriptive or prescriptive in nature, that create, reflect and affect actors' expectations and are institutionalized to varying degrees, from a 'gentlemen's agreement through soft law to treaties. Regimes may be created, observed, enhanced and even enforced by a multilateral forum or international organization, which constitute a part of the regime.

International regimes are the building blocks of global governance. The many international regimes establish, implement and reform much of the repertoire of norms and rules that guide the behavior of actors in global affairs. These regimes include general regimes like

[212] Stephan Haggard and Beth A. Simmons, 'Theories of International Regimes' (1987) 41(3) International Organization 491.

[213] On the history of the Chicago Convention and ICAO see ICAO, The Postal History of ICAO <http://www.icao.int/secretariat/PostalHistory/1944_the_chicago_convention.htm> accessed 14 October 2016.

the UN system and specialized, issue-area specific, regimes such as the MTCR and for civil aviation. A single issue-area can have and often does have more than one regime, and the governance of a certain issue-area is therefore the aggregate result of the various relevant regimes, such as the multiple regimes on climate change[214]. The concept of regime complexes expands on this phenomenon.

3.3.3 Regime Complexes

In the absence of a world government, the subjects of the international system (primarily but not only States) participate in their own governance. This is the reality of global governance and this amount to 'governance without government'[215]. This decentralized structure projects to specific issues-areas in global affairs in which, instead of a unified coherent regime, there is a collection of regimes, which vary in scope and norms.

Using the case study of plant genetic resources (PGR), Raustiala and Victor analyzed the implications of the proliferation and rising density of international treaties and organizations and developed the concept of 'regime complexes'[216]: rather than a single, discrete regime governing a single issue-area, the relevant rules are found in several regimes - what they call *elemental regimes*. The elemental regimes are legal agreements created and maintained in distinct *fora* with the participation of different sets of actors and they overlap in scope, subject, and time. The rules in these elemental regimes functionally overlap and even often conflict, and yet there is no agreed hierarchy between them or a

[214] Robert O Keohane and David G Victor, 'The Regime Complex for Climate Change' (2011) 9 Perspectives on Politics 7.

[215] On the concept of 'governance without government' see: James N. Rosenau and Ernst-Otto Czempiel eds., Governance without Government: Order and Change in World Politics (Cambridge University Press 1992).

[216] Kal Raustiala and David Victor, 'The Regime Complex for Plant Genetic Resources' (2004) 58(2) International Organization 277.

rule or procedure for resolving conflicts between rules. The collective of these elements is a *regime complex*: an array of partially overlapping and nonhierarchical regimes, possibly interconnected and often with conflicting rules, governing a particular issue-area.

Regime complexes have become a widespread phenomenon in various issue areas in global affairs. Indeed, since its introduction in 2004, the concept has been used to analyze various issue-areas, including: trade policy,[217] international regulation of intellectual property,[218] international security including nuclear regime,[219] global refugee regime,[220] climate change,[221] the Arctic,[222] maritime piracy,[223] genetic resources,[224] managing global cyber activities[225] and more[226]. Regime complexes has a significant impact on global

[217] Christina L Davis, 'Overlapping Institutions in Trade Policy' (2009) 7 Perspectives on Politics 25; Jean Frédéric Morin, Joost Pauwelyn and James Hollway, 'The Trade Regime as a Complex Adaptive System: Exploration and Exploitation of Environmental Norms in Trade Agreements' (2017) 20 Journal of International Economic Law 365.

[218] Laurence R. Helfer, 'Regime Shifting in the International Intellectual Property System' (2009) 7(1) Perspectives on Politics 39, and Jonathan Kuyper, 'Deliberative Capacity in the Intellectual Property Rights Regime Complex' (2015) 9(3) Critical Policy Studies 317.

[219] Stephanie C. Hofmann, 'Overlapping Institutions in the Realm of International Security: The Case of NATO and ESDP' (2009) 7(1) Perspectives on Politics 45, and Grégoire Mallard, 'Crafting the Nuclear Regime Complex (1950–1975): Dynamics of Harmonization of Opaque Treaty Rules' (2014) 25(2) European Journal of International Law 445.

[220] Alexander Betts, 'Institutional Proliferation and the Global Refugee Regime' (2009) 7(1) Perspectives on Politics 53.

[221] Robert O. Keohane and David G. Victor, 'The Regime Complex for Climate Change' (2011) (9)1 Perspectives on Politics 7. See also Sebastian Oberthür and Olav Schram Stokke (eds), *Managing Institutional Complexity: Regime Interplay and Global Environmental Change* (MIT Press 2011); Kenneth W. Abbott, 'The Transnational Regime Complex for Climate Change' (2012) 30(4) Government and Policy: Environment and Planning 571; Myanna F. Dellinger, 'Narrowed Constellations in a Supranational Climate Change Regime Complex: The 'Magic Number' Is Three' (2014) 37(2) Fordham International Law Journal 373.

[222] Oran R. Young, 'Building an International Regime Complex for the Arctic: Current Status and Next Steps' (2012) 2(2) The Polar Journal 391.

[223] Michael J. Struett, Mark T. Nance, and Diane Armstrong, Navigating the Maritime Piracy Regime Complex (2013) 19(1) Global Governance 93.

[224] Jean Frédéric Morin and Amandine Orsini, 'Policy Coherency and Regime Complexes: The Case of Genetic Resources' (2014) 40 Review of International Studies 303.

[225] Joseph S. Nye, The Regime Complex for Managing Global Cyber Activities, Global Commission on Internet Governance, Paper Series: No. 1 (2014) <https://www.cigionline.org/publications/regime-complex-managing-global-cyber-activities> accessed 16 May 2016.

[226] See two volumes with a batch of contributions on regime complexes: Perspectives on Politics Vol. 7, No. 1, 2009; and 19(1) Global Governance Vol. 19, No. 1 (2013).

governance[227] and this thesis uses the concept of regime complexes to analyze the state of the governance space warfare (Chapter 6) and also to support general normative recommendations in Chapter 4.

Regime complexes are a result of the reality of international affairs. The international system is characterized by multiple actors with different and often conflicting agendas and interests. The combination of the inherent structural decentralization and interest diversity is more likely to lead, especially in complex issue-areas, to an array of narrowly focused regimes rather than to a single, comprehensive and integrated regime. Moreover, even (initially) non-complex regimes are likely to become complex. Across the various issue-areas of global governance, centralization is un-attainable, and the reality is of fragmentation and regime complexes. Ruggie similarly observed:

> *Traditional forms of international legalization and negotiation through universal consensus-based institutions are stagnating. Regime complexes that often embody divergent norms dominate previously coherent rule systems. . . . the ideal solution of comprehensive and integrated regimes . . . is increasingly unattainable*[228]

The various narrowly focused regimes in a single issue-area tend to be linked to various degrees and can be mutually reinforcing but can also, at times, be in conflict. The array is often a result of various regimes that were established in different times and there is no hierarchy between them. However, it does not necessarily entail that there is no core regime(s) or linkages between the various regimes, though that is also possible. In the

[227] Amandine Orsini, Jean-Frédéric Morin and Oran Young, 'Regime Complexes: A Buzz, a Boom, or a Boost for Global Governance?' (2013) 19 Global Governance 27.

[228] John Gerard Ruggie, 'Global Governance and "New Governance Theory": Lessons from Business and Human Rights' (2014) 20 Global Governance 5.

context of space governance, the 1967 Outer Space Treaty is a core regime as it provides the basic principles and norms of space law and it is widely accepted, having been ratified by more than 100 States, including all spacefaring nations. The middle ground between a single comprehensive regime and a fragmented stockpile of unrelated regimes is the regime complex.[229]

A multitude of regimes in a single issue-area means various normative frameworks and operative mechanisms that are partly overlapping, competing and complementing. For the set of regimes to qualify as a regime complex, the regimes should be more complementing than competing.

As Keohane and Victor noted, regime complexes are marked by connections between the elemental regimes but with the absence of an overall architecture or hierarchy.[230] Yet, core regimes and revealed patterns provide some kind of architecture and even loose hierarchy. Regime complexes are not a result of an intentional decision and design. They emerge from a gradual establishment of various narrowly focused regimes, numerous smaller steps. At a certain point some kind of pattern may be revealed, or connections made between those various regimes, though still there is no predesigned system or structure.

Is a regime complex a problem or a blessing? Keohane and Victor assert that efforts to build an effective, legitimate, and adaptable comprehensive regime on climate change are unlikely to succeed and hence regime complex is likely to persist. However, they argue that

[229] Joseph S. Nye, 'The Regime Complex for Managing Global Cyber Activities', The Global Commission on Internet Governance Paper Series No. 1 (2014) <https://www.cigionline.org/publications/regime-complex-managing-global-cyber-activities> accessed 16 May 2016.

[230] Robert O. Keohane and David G. Victor, 'The Regime Complex for Climate Change' (2011) (9)1 Perspectives on Politics 7.

a climate change regime complex, if it meets specified criteria, has advantages over any politically feasible comprehensive regime, particularly with respect to adaptability and flexibility. These characteristics are particularly important in an environment of high uncertainty. Indeed, regime complexes are not just politically more realistic; they also offer some significant advantages including flexibility in substantive content and scope.[231]

Nye similarly stresses the advantages of regime complexes, in which the loose coupling among issues permits cooperation among actors in some areas at the same time that they have disagreements in others. As he further notes:

> *What regime complexes lack in coherence, they make up in flexibility and adaptability. Particularly in a domain with extremely volatile technological change, these characteristics help both states and non-state actors to adjust to uncertainty. Moreover, they permit the formation of clubs or smaller groupings of like-minded states than can pioneer the development of norms that may be extended to larger groups at a later time.[232]*

Furthermore, the loose coupling among issues that characterizes regime complexes, permits cooperation among actors in some areas at the same time that they have disagreements in others[233], therefore allowing gradual and segmented progress. The variance in regimes will allow for local-scale experimentation that may promote the pursuit of feasible, effective and sustainable regimes. It may allow, where linkage is not made, gradual development of regimes in increments, allowing agreement on one topic while discussion still continues on another topic. Incremental regimes may allow potential

[231] Ibid.

[232] Joseph S. Nye, 'The Regime Complex for Managing Global Cyber Activities', The Global Commission on Internet Governance Paper Series No. 1 (2014) <https://www.cigionline.org/publications/regime-complex-managing-global-cyber-activities> accessed 16 May 2016.

[233] Ibid.

new members to gradually and even partially join the regime, thus lowering the bar for broadening the membership. Alternatively, where a linkage is made, it will allow bargains across topics and increase what is on stake – the sum of the linked issues. Indeed, actors often make linkage between issues, and such issue-linkage, considered by Keohane an integral part of international regimes[234], can be fruitful but might also stall the establishment of regimes.[235]

In a decentralized international system, regime complexes are both inevitable and advantageous, as they are effective in providing governance.

3.4 Economic Governance

This second pillar of the theoretical approach of the thesis combines the theory of polycentric governance, as developed in the Ostrom Workshop, and Elinor Ostrom's study of the management of CPRs, also conducted within the Workshop.

[234] Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton University Press 1984).

[235] On issue linkage see: Robert O. Keohane and Joseph S. Nye, *Power and Interdependence: World Politics in Transition* (Boston: Little, Brown 1977) and its revision by the authors a decade later: Robert O. Keohane and Joseph S. Nye, 'Power and Interdependence Revisited' (1987) 41(4) International Organization 725; Robert D. Tollison and Thomas D. Willett, 'An Economic Theory of Mutually Advantageous Issue Linkages in International Negotiations' (1979) 33(4) International Organization 425; Ernst B. Haas, 'Why Collaborate? Issue-Linkage and International Regimes' (1980) 32(3) World Politics 357; Arthur A. Stein, 'The Politics of Linkage (1980) 33(1) World Politics 62; James K. Sebenius, 'Negotiation Arithmetic: Adding and Subtracting Issues and Parties' (1983) 37(2) International Organization 281; Michael D. McGinnis, 'Issue Linkage and the Evolution of International Cooperation' (1986) 30(1) Journal of Conflict Resolution 141; Christina L. Davis, 'International Institutions and Issue Linkage: Building Support for Agricultural Trade Liberalization' (2004) 98(1) American Political Science Review 153; Paul Poast, 'Does Issue Linkage Work? Evidence from European Alliance Negotiations, 1860 to 1945' (2012) 66(2) International Organization 277; Heather E. McKibben, *State Strategies in International Bargaining: Play by the Rules or Change Them?* (Cambridge University Press 2015).

3.4.1 Polycentric Governance

Polanyi was the first to introduce the concept of polycentricism[236], a concept that subsequently spread into several disciplines[237]. Vincent Ostrom, Tiebout, and Warren first introduced the concept of 'polycentric governance'.[238] Vincent and Elinor Ostrom continued to develop the concept of polycentric governance together with other scholars at the Ostrom Workshop, some of which are referenced herein. The theory of polycentric governance is "the Bloomington school's most distinctive and innovative extension of the political economy in public choice perspective in the domain of governance studies, the concept of polycentricity".[239] Vincent Ostrom elaborated on the phenomenon of polycentric governance[240] and Elinor Ostrom provided both theoretical framework (the IAD) and empirical support to the theory.

The concepts of monocentric and polycentric are used in this thesis to mean the following: a monocentric system is a hierarchical system with a single decision-making center that

[236] Michael Polanyi, *The Logic of Liberty* (University of Chicago Press 1951).

[237] Paul D. Aligica and Vlad Tarko, 'Polycentricity: From Polanyi to Ostrom, and Beyond' (2012) 25(2) Governance 237. The concept of polycentricity was introduced to law by Lon Fuller (Lon Fuller, 'The Forms and Limits of Adjudication' (1978) 92 Harvard Law Review 353), Chayes (Abram Chayes, 'The Role of the Judge in Public Law Litigation' (1976) 89(7) Harvard Law Review 1281) and Horowitz (Donald L. Horowitz, *The Courts and Social Policy* (Brookings Institution Press 1977); to urban networks studies by Davoudi (Simin Davoudi, 'Polycentricity – Modelling or Determining Reality?' (2002) 71(4) Town and Country Planning 114) and by Hague & Kirk (Karryn Kirk and Cliff Hague, Policentricity Scoping Study (London, Office of the Deputy Prime Minister 2003). See also Vlad Tarko, Polycentric Governance: A Theoretical and Empirical Exploration, A Dissertation submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy at George Mason University, 2015 <https://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/9899/Tarko_gmu_0883E_10863%5B1%5D.pdf?sequence=1&isAllowed=y> accessed 29 Mars 2018.

[238] Vincent Ostrom, Charles M. Tiebout and Robert Warren, 'The Organization of Government in Metropolitan Areas: A Theoretical Inquiry' (1961) 55 The American Political Science Review 831.

[239] Filippo Sabetti and Paul Dragos Aligica, Introduction: The Ostroms' Research Program for the Study of Institutions and Governance: Theoretical and Epistemic Foundations, in Filippo Sabetti and Paul Dragos Aligica, eds, Choice, Rules and Collective Action (European Consortium for Political Research (ECPR) 2014), 1, 9. The "Bloomington School" is the product of the Ostrom Workshop.

[240] See, notably, Vincent Ostrom, 'polycentricity' in Michael D. McGinnis (ed), Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis (University of Michigan 1999) 52; and Vincent Ostrom, *The Meaning of American Federalism: Constituting a Self-Governing Society* (Institute for Contemporary Studies 1991), 223-44.

enjoys a monopoly on power. Polycentric governance is a case of decentralized governance in which there are multiple independent centers of collective decision-making ('governance centers'), with at least partial overlap in jurisdictions; the governance centers interact and collaborate to a certain extent or take each other into account in complex and ever-changing ways; out of these seemingly uncoordinated processes of mutual adjustment emerges the repertoire of norms and rules that guide the behavior of actors within the entire realm.[241]

The conventional wisdom was that multiplicity of political units makes governance "a pathological phenomenon" and that "too many governments [is] not enough government".[242] However, as the Bloomington School demonstrated, the merits of polycentric governance outweigh the shortcomings. The study of the problem of metropolitan government demonstrated that:

> *the existence of multiple agencies interacting and overlapping, far from being a pathological situation, 'may be in fact a natural and healthy one.' This overlapping and duplication is the result of the fact that different services require a different scale for efficient provision and that principles of*

[241] Compare the definition of Ostrom, Tiebout and Warren: "'Polycentric' connotes many centers of decision-making which are formally independent of each other. Whether they actually function independently, or instead constitute an interdependent system of relations, is an empirical question in particular cases. To the extent that they take each other into account in competitive relationships, enter into various contractual and cooperative undertakings or have recourse to central mechanisms to resolve conflicts, the various political jurisdictions in a metropolitan area may function in a coherent manner with consistent and predictable patterns of interacting behavior. To the extent that this is so, they may be said to function as a 'system' " (Vincent Ostrom, Charles M. Tiebout and Robert Warren, 'The Organization of Government in Metropolitan Areas: A Theoretical Inquiry' (1961) 55 The American Political Science Review 831); compare also: Michael D. McGinnis, 'An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework' (2011) 39(1) Policy Studies Journal 169; and Michael D. McGinnis, 'Polycentric Governance in Theory and Practice: Dimensions of Aspiration and Practical Limitations', paper presented at the Polycentricity Workshop, Ostrom Workshop, Indiana University Bloomington, 14-17 December 2015.

[242] Paul D. Aligica and Vlad Tarko, 'Polycentricity: From Polanyi to Ostrom, and Beyond' (2012) 25 Governance 237.

> *division of labor, cooperation, and exchange function in the public sector, too.*[243]

As Vincent and Elinor Ostrom noted, duplication of functions is assumed to be wasteful and inefficient, yet market economy is efficient precisely because of the existence of multiple suppliers of a single product or service *i.e.*, competition. Similar forces operate in a public economy and the duplication is efficient also in public governance.[244] Furthermore, polycentric systems have a built-in mechanism of self-correction, as they provide more opportunity for actors to intervene and correct, which contributes to the success of such systems.[245] Writing on polycentric governance in climate change E. Ostrom asserted that polycentrism is a long-term reality, but also an effective way of addressing problems that would otherwise encounter a gridlock.[246]

The above description of polycentric governance resembles that of international regimes – governance that is not based on rules imposed from above but rather on rules and mechanisms devised by the collective action of several actors or governance centers. Absent a central global authority, governance at the global level is made by the actors and is therefore also decentralized. What characterizes polycentric governance is decentralization, and at this point it correlates to international regimes and global governance. Moreover, global governance already fits the definition of a polycentric system

[243] Ibid.

[244] Vincent Ostrom and Elinor Ostrom, 'A Behavioral Approach to the Study of Intergovernmental Relations' (1965) 359 The Annals of the American Academy of Political and Social Science 137.

[245] Elinor Ostrom, 'The Comparative Study of Public Economies', Presented upon acceptance of the Frank E. Seidman Distinguished Award in Political Economy (Memphis, TN: P.K. Seidman Foundation 1998); Paul D. Aligica and Vlad Tarko, 'Polycentricity: From Polanyi to Ostrom, and Beyond' (2012) 25 Governance 237.

[246] Elinor Ostrom, 'A Polycentric Approach for Coping with Climate Change', (2009) World Bank Policy Research Working Paper No. 5095.

as there are multiple decision-making centers, notably the UN and its agencies and powerful actors like the OECD, G7 and major powers.

Polycentricity does not necessarily mean the absence of a center.[247] Andersson and E. Ostrom compared regimes with differing degrees of decentralization: highly decentralized, semi-decentralized, and highly centralized, and warned against the dangers of over-decentralization.[248]

The interaction between the governance centers – cooperation, competition and conflict – constitutes the governance of the realm. Competition does not exclude cooperation but unresolved conflicts thwart governance. Therefore, regulating the interaction between the governance centers is of critical role in the resulting governance. A polycentric system in which conflicts are resolved or contained and which is characterized by sustained cooperation is a successful governance system.

Polycentric governance is a kind of 'spontaneous order', the literature on which is mainly within the economics. In general, "spontaneous order" refers to the emergence of order as a result of the voluntary activities of individual actors with no single guiding hand. Adam Smith's concept of the "invisible hand"[249] is an example of spontaneous order. Nobel Laureate Friedrich Hayek (economic sciences, 1974) asserted that market economies are a spontaneous order that is more efficient than any central design can achieve. He therefore supported decentralization and free markets, as opposed to central planning by

[247] See Vincent Ostrom, Charles M. Tiebout and Robert Warren, 'The Organization of Government in Metropolitan Areas: A Theoretical Inquiry' (1961) 55 The American Political Science Review 831. The authors note that some activities of municipal governance require a strong central authority.

[248] Krister P. Andersson and Elinor Ostrom, 'Analyzing Decentralized Resource Regimes from a Polycentric Perspective' (2008) 41 Policy Sciences 71.

[249] Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (London, W. Strahan and T. Cadell 1776).

governments or experts. He further held that the free flow of information is essential for spontaneous order and this information is also obtained in a decentralized manner by the price mechanism.[250] Polanyi used the concept of 'spontaneous order' in the context of polycentricism, but Vincent Ostrom was reluctant to do so. Though acknowledging the merit in Hayek and Polanyi's use of the concept of spontaneity in this context, he preferred to presume that "polycentric systems of order depend upon a good deal of deliberateness in their creation, operation, and maintenance over time".[251]

A free market is not lawless. On the contrary – it needs rules in order to function properly, including to remain free from centralization, monopolies and unfair trade practices. Likewise, a polycentric system is not without rules. In both cases, the rules are predominately rules of the game, in contrast to substantive rules. Koskenniemi argues that modern international law is more procedural than substantive; that it defers substantive resolution elsewhere; and that instead of providing a list of "do's and dont's" it allocates decision making power with only a reference to 'equitable principles'. Moreover, he argues that "[t]he success of international law depends on this formality; this refusal to set down determining rules or ready-made resolutions to future conflict. Though there is a distinctly legal "process". . . there are no determining legal standards".[252] The focus of this thesis is indeed structural, as it seeks to analyze the architecture of governance and suggest structural recommendations and not substantive rules. International space law includes basic norms and rules, stipulated in the 1967 OST, which are a little more than 'equitable

[250] Friedrich A. Hayek, 'The Use of Knowledge in Society' (1945) 35 The American Economic Review 519.

[251] Vincent Ostrom, The Meaning of American Federalism: Constituting a Self-Governing Society (Institute for Contemporary Studies 1991), Ch. 9: Polycentricity: The Structural Basis of Self-Governing Systems, p. 223-44.

[252] Martti Koskenniemi, 'The Politics of International Law' (1990) 1(1) European Journal of International Law 4, 28.

principles' (but not much more) and there is a forum for discussion and decision making – UN-COPUOS. However, substantive resolution of issues is lacking, as Chapter 1 demonstrates, a problem that has launched this thesis and stands at its core.

The concept of polycentric governance has several functions. As Sabetti and Aligica note:

> *Polycentricity is a complex multifaceted concept and it is yet to be fully and systematically elaborated as an analytical instrument. It has (1) a descriptive function (it describes the complex social reality of multiple decision centers and overlapping, multi-layered jurisdictions); (2) a heuristic function (it helps identify patterns of order amidst what otherwise may look as chaotic social systems); (3) an explanatory function (it helps identify social mechanisms and causal processes in the complex concatenation of causes and effects of complex systems); and it also has (4) a normative function. In this latter respect, it introduces a rather original approach to the problem of optimal political structures, and the issue of determining what are the main features of a functional, desirable political structure.*[253]

This thesis uses the descriptive, heuristic and even explanatory functions of the concept to analyze, describe and explain the structure of space governance. It further uses its normative function as a tool of institutional design, to draw recommendations for the structural design of specific issue-areas in world politics, and in particular the structural design of space governance.

In a decentralized metropolitan or international system, polycentric governance, like regime complexes, is both inevitable and effective in providing governance.

[253] Filippo Sabetti and Paul Dragos Aligica, Introduction: The Ostroms' Research Program for the Study of Institutions and Governance: Theoretical and Epistemic Foundations, in Filippo Sabetti and Paul Dragos Aligica, eds, Choice, Rules and Collective Action (European Consortium for Political Research (ECPR) 2014), 1, 9.

3.4.2 Governance of the Commons

3.4.2.1 The Study of the Management of CPRs

The proper exploitation of common pool resources is an old issue, occupying social thinkers for at least two millennia,[254] with new findings and conclusions. Defined more broadly, it is the collective action problem also long known and discussed, including by influential social and political thinkers such as Aristotle[255], David Hume[256], Madison, Hamilton and de Tocqueville.

'Commons' are resources used by more than one actor. Examples often used in the literature are fish stocks, pastures, woods and water (for drinking or irrigation). A CPR is a resource, commons, which has two features: (i) one person's use of the resource subtracts from the potential use of other persons; and (ii) there is difficulty, physically or legally, to prevent actors from using the resource.[257] One ought to distinguish between (i) commons as a type of resource and (ii) commons as a property-rights regime. The first is a resource ***used*** by multiple actors, such as a lake used by numerous fishermen. The second refers to a resource ***owned*** together by multiple actors. A commons in the first sense is not necessarily commons in the second sense. The lake, ***used*** by multiple actors, may be ***owned*** and

[254] The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, 'Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October 2009) < http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014, 8

[255] Aristotle phrased the problem as follows: "For that which is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest; and only when he is himself concerned as an individual" (Aristotle, Politics, Book Two, Part 3, 1261b 35).

[256] David Hume, *A Treatise of Human Nature* (1740), in Book Three, Part II, Section VII - Of the origin of government.

[257] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in: B. Bouckaert and G. De Geest (eds), Encyclopedia of Law and Economics, Volume 5 (2nd ed, Edward Elgar, Cheltenham 2010) 53. Elsewhere Ostrom noted that the subtractability feature is not necessary for a resource to be a CPR and it is not present in every CPR (Charlotte Hess and Elinor Ostrom, 'Introduction: An Overview of the Knowledge Commons' in Charlotte Hess and Elinor Ostrom, *Understanding Knowledge as a Commons: From Theory to Practice* (MIT Press 2011), 3).

managed as government property, private property, a community property, or owned by no one.[258] The difference between an economic common to a legal common will be elaborated in chapter 5.

3.4.2.2 Hardin's Tragedy of the Commons

In what became the prevailing theory for years to come, Hardin claimed that CPRs that are common property will inevitably be over-used until exhaustion. The unsustainable use is a result of the free rider problem, as rational actors will maximize short-term self-benefits at the expense of long-term group interest. Hardin's assertion was consistent with the prediction of no cooperation in a prisoner's dilemma and other social dilemma games. Hardin expressed the chronicle of this fatality with dramatic words in his 1968 article *the tragedy of the commons*:

> *Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.*[259]

Hardin's article is one of the most influential and often cited articles in the social sciences. Several scholars have tried to apply Hardin's tragedy to outer space issues[260].

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[258] There are various theories on the essence of property rights. A modern leading theory is of bundles of rights rather than a single right. In the context of CPR Ostrom identified five kinds of property rights that actors using a CPR might cumulatively have" (i) access—the right to enter a specified property, 4 (ii) withdrawal—the right to harvest specific products from a resource, (iii) management—the right to transform the resource and regulate internal use patterns, (iv) exclusion—the right to decide who will have access, withdrawal, or management rights, and (v) alienation—the right to lease or sell any of the other four rights" (Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review 1; on differentiating between CPR as a resource and a commons as a property-rights regime and the kinds of property rights regime see also Daniel W. Bromley, 'Closing Comments at the Conference on Common Property Resource Management' in *Proceedings of the Conference on Common Property Resource Management* (Washington DC, National Academies Press 1986) 591.

[259] Garrett Hardin, 'The Tragedy of the Commons' (1968) 162(3859) Science 1243, 1244.

[260] See for example: Jared B. Taylor, 'Tragedy of the Space Commons: A Market Mechanism Solution to the Space Debris Problem' (2011) 50 Columbia Journal of Transnational Law 253; Scott J. Shackelford, 'The

It should be noted that when Hardin coined the phrase 'tragedy of the commons' he was actually talking about *open access* property ('a pasture open to all'), not common property.[261] Open access property is property owned by no one, also known as *res nullius*. Open access is defined by the lack of constraints on both the number of users and the amount that each user may extract,[262] hence the risk of over-harvesting and other unsustainable use (*i.e.*, the 'tragedy').

In order to avoid the tragedy of the commons, so the prevalent view held, centralized management of such resources is needed. The centralized management may take the form of privatization, or government management[263]. Most economists rejected the option of letting the users manage the resource by themselves.[264] E. Ostrom had put the prevalent view to the test by studying CPRs managed by their users.

3.4.2.3 Refuting Hardin: Ostrom's Findings and Theory

Elinor Ostrom studied diverse institutional arrangements for governing common-pool resources (CPRs) and public goods. "Ostrom has challenged the conventional wisdom that

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Tragedy of the Common Heritage of Mankind' (2008) 27 Stanford Environmental Law Journal 101; Peng Wang, Tragedy of Commons in Outer Space: The Case of Space Debris, presented at the 64th IAC, Beijing 2013 <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2260856> accessed 9 September 2014. Chaddha, on the other hand, described the problem of space debris as a 'tragedy of the commons' in the Hardinian sense and suggests, on the basis of Ostrom's study, alternative governance arrangements to successfully address the debris problem - Shane Chaddha, *An Inquiry for Alternative Governance Regimes for Outer Space* (Scholars' Press, 2014).

[261] Lee Anne Fennell, 'Ostrom's Law: Property Rights in the Commons' (2011) 5(1) International Journal of the Commons 9.

[262] Glenn G. Stevenson, *Common Property Economics: A General Theory and Land Use Applications* (Cambridge University Press 2005).

[263] This second solution is associated with Pigou - is to let the central government own the resource and levy a tax extraction. See Arthur C. Pigou, *The Economics of Welfare* (New York: Macmillan 1920). Coase rejected Pigou's suggestion, see Ronald H. Coase, 'The Problem of Social Cost' (1960) 3 Journal of Law and Economics 1.

[264] Nobel Committee, 'Report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October 2009) <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014, 9-10.

common property is poorly managed and should be completely privatized or regulated by central authorities."[265] Her research included theoretical framework, extensively using concepts from a more advanced non-cooperative game theory, especially that of another Nobel Laureate for Economic Sciences, Robert Aumann[266]. Moreover, her research included a wide empirical base of lab experiments, field studies and meta-analysis of a vast database of existing case studies from around the world [267], and in this lies the strength of her study.

Ostrom refuted Hardin's classic "tragedy of the commons" and found strong empirical proof, in lab and in the field, across States and sectors, favoring polycentric governance of complex economic systems. Ostrom found that users' management of CPRs (*i.e.*, decentralized management) is more effective and efficient in most, but not all, cases. Users achieve and sustain cooperation and envisage rules and enforcement mechanisms that result in sustainable outcomes. By contrast, governmentally imposed rules (*i.e.*, centralized management) are often counter-productive because central authorities lack knowledge about local conditions and have insufficient legitimacy. Moreover, in many cases government intervention has created more chaos than order. Ostrom's study further helps to clarify the conditions under which local governance is feasible and effective.[268]

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[265] Ibid.

[266] Ibid at 10.

[267] The studies were conducted by anthropologists, economic historians, engineers, historians, philosophers, and political scientists. They studied local governance of smaller to medium scale common-pool resources over long periods of time. The studies followed different types of resources located in many States, including Bolivia, Colombia, Guatemala, India, Kenya, Mexico, Nepal, Tanzania, Thailand, Uganda, Ethiopia, China and the United States. See Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review, 1, 17.

[268] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press 1990); Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review 1; Nobel Committee, 'Report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October

Ostrom therefore suggested that the core goal of public policy should be to facilitate the development of such decentralized local institutions, rather than a central authority imposing rules. Ostrom further identified 'design principles' that predict sustainability of governance systems and institutions.[269]

3.4.2.4 Design principles for Successful Management of CPRs

Ostrom attempted to extract from the vast database of case studies from around the world rules associated with successful systems of CPR management, but to no avail. She did, however, find regularities on a higher level of generality that predict long-term success, what she referred to as 'design principles'.[270] These principles will be of use in Chapter 4 for suggesting how to maximize the advantages of polycentric governance systems. The following is the updated version, as presented in her Nobel lecture.[271] In order to give examples for each of the design principles, the case of a fictional fishery is used: fishermen in a village on the coast of a large lake use part of the lake for fishing. There are several more villages on the coast of this large lake, somewhat distant from the village in question. The head of the village summoned a meeting of all village dwellers in order to adopt rules that would regulate the use of the lake by village dwellers for fishery, with a view to ensure sustainable use of the lake and avoid conflicts with other villages and within the village.

2009) <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014.

[269] See the three sources in the above footnote.

[270] See first two sources in the footnote preceding the above footnote.

[271] Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review 1, 13. All quotes of the design principles are from this article; while the short title of each design principle, except the eighth, is adopted from the report of the Nobel Committee (Nobel Committee, 'Report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October 2009) <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014, 11); the application part is my suggestions.

The head of the village, being familiar with Ostrom's design principles, made sure the decisions adopted meet the design principles as she (the head of the village) understands them. This is not to say that this is the only way to apply the design principles and, indeed, another village could have adopted another set of rules that also meets the design principles. The eight design principles and the rules set at the village meeting are:

(i) Rules clearly define who has what entitlement: boundaries between legitimate users and nonusers and boundaries of the CPR.

In Ostrom's words: "1A. User Boundaries: Clear and locally understood boundaries between legitimate users and nonusers are present. 1B. Resource Boundaries: Clear boundaries that separate a specific common-pool resource from a larger social-ecological system are present."

In the example: (1B) a map was drawn, clearly delimiting the fishing zone for the village fishermen. The village fishermen – and only them - can fish within this zone, but they cannot fish elsewhere in the lake; (1A) a list of village fishermen was populated and those on the list – and only them - may fish in the designated zone of the lake. Village dwellers not on the list and people from outside the village cannot fish in the designated zone.

(ii) Users' rights and responsibilities stand in reasonable proportion to their benefits and local conditions.

In Ostrom's words: "2A. Congruence with Local Conditions: Appropriation and provision rules are congruent with local social and environmental conditions. 2B.

Appropriation and Provision: Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits."

In the example: a list of fishing quota was populated. The quotas ensure sufficient subsistence for the fishermen and the village at large without depleting the fishery. Fishermen participate in the costs of maintaining the shipping dock in proportion to their quotas and use thereof.

(iii) Most of those affected by a resource regime are authorized to participate in making and modifying the rules of the regime.

In Ostrom's words: "3. Collective Choice Arrangements: Most individuals affected by a resource regime are authorized to participate in making and modifying its rules. "

In the example: all village dwellers may participate in the making and creating rule #1 (designating the village's exclusive fishing zone and populating the list of authorized fishermen). All authorized fishermen may participate in making and modifying of the other rules.

(iv) Monitoring and sanctioning are carried out either by the users themselves or by someone who is accountable to the users.

In Ostrom's words: "4A. Monitoring Users: Individuals who are accountable to or are the users, monitor the appropriation and provision levels of the users. 4B. Monitoring the Resource: Individuals who are accountable to or are the users monitor the condition of the resource."

In the example: a supervisor elected by the fishermen monitors adherence of the fishermen to the rules.

(v) Sanctions for rule violations are graduated: they start very low but become stronger if a user repeatedly violates a rule.

In Ostrom's words: "Graduated Sanctions: Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule."

In the example: the fishermen decided on a graduated list of sanctions. The sanction for exceeding the fishing quota is a fine amounting to double the excess amount of fish. The sanction for fishing beyond the designated zone, which may embroil the village in a conflict with other villages, is a week suspension of the fishing license for the first such offence, two weeks for the second such offence etc.

(vi) Rapid, low cost, local dispute resolution mechanisms are in place to resolve conflicts among users or with officials.

In Ostrom's words: "Conflict Resolution Mechanisms: Rapid, low cost, local arenas exist for resolving conflicts among users or with officials."

In the example: the head of the village serves as mediator and arbitrator in disputes between the fishermen, and she enjoys exclusive and mandatory jurisdiction on such disputes. Fishermen having a dispute and who could not agree themselves on a solution turn to the village head, who tries first to mediate and, if unsuccessful, decide the dispute.

(vii) Minimal Recognition of Rights: The rights of local users to make their own rules are recognized by the government (an outside authority).

In Ostrom's words: "Minimal Recognition of Rights: The rights of local users to make their own rules are recognized by the government."

In the example: the provincial government recognized the right of the village to the designated fishing zone, and to adopt and enforce the rules for fishing in this zone.

(viii) Nested Enterprises: When a CPR resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.

In Ostrom's words: "Nested Enterprises: When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers."

In the example: there is a lake council with representatives from each village on the coast of the lake which manages the lake as a whole, *e.g.,* in order to prevent contamination from outside sources such as factories up the river that feeds the lake.

3.4.3 Direct Applicability to Space CPRs

Some scholars and States argue that outer space, including celestial bodies, is in itself a common pool resource and 'global commons'. However, while some *parts of space* may be regarded as – and are in fact – CPRs, one should not argue that outer space, *as a whole*, is or is not a CPR. As chapter 5 elaborates, an analysis of the 'commons' feature of outer space cannot refer to space as a whole but, rather, a separate analysis must be undertaken regarding each part of space or at least categories of parts of space, *e.g.,* planets, stars,

resources (helium, platinum, water, etc.) and even artificial objects such as satellites and the International Space Station (ISS). At least with regards to those parts of space that are CPRs, Ostrom's theory is directly relevant, and designing their governance according to her design principles in mind would increase chances for long term success. Nevertheless, the more interesting and far reaching application and implications of Ostrom's theory is beyond CPRs to global governance as a whole.

3.4.3.1 From Local Commons to Global Affairs

This thesis indeed seeks to exploit the opportunities that the transdisciplinary synergy offers. Elinor Ostrom's study of the management of CPRs focused on the national and sub-national level, with many field researches done in small communities, *e.g.,* villages in various States. Therefore, in order to apply her theory and insights on the governance of CPRs to global affairs this thesis must undertake a leap from the local to the global, a transition from local commons to global affairs.

Ostrom's research is in the micro level of persons, and it can be applied to the macro level of States and firms or a mixture thereof. In fact, it might be more salient with regard to States and firms, due to the rationality factor. Decisions of States or firms are ultimately taken by (the authorized) persons and it is the decisions of persons that are captured by Ostrom's study. Ralph Waldo Emerson suggested, "[t]here is properly no history, only biography",[272] echoing his contemporary, Scottish historian Thomas Carlyle, who, popularizing the Great Man Theory of history, suggested that "[t]he history of the world is

[272] See Jon Meacham, 'Keeping the Dream Alive, Time Magazine' (21 June 2012) <http://content.time.com/time/specials/packages/printout/0,29239,2117662_2117682_2117680,00.html> accessed 15 April 2018.

but the biography of great men".[273] Moreover, Ostrom's study is expected to be more salient for States and firms because peoples' decisions tend to be more rational when they act as authorized agents making decisions for a State or a firm, than when they make decisions for themselves. These decisions involve, in both cases, decisions on collective-action problems.

Young examined the issue of scale in this precise context of convergence of the CPR and international regime literatures and found that while not all lessons are transferable, there is "considerable scope for cross-fertilization among studies of social phenomena conducted at different scales".[274] Keohane supported this conclusion[275], as did Poeteete and Ostrom[276]. Ostrom herself, together with Dietz and Stern, suggested that many of the general principles for robust governance systems for local resources "also appear to be applicable to regional and global resources, although they are less well tested at those scales."[277] This supports the application of Ostrom's theory on the governance of local commons to governance in global affairs. Moreover, the findings regarding local commons seems to apply also to global commons.[278]

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[273] See Thomas Carlyle, *The Hero as Divinity in: Heroes and Hero-Worship* (1840). But see criticism of this theory *e.g.,* by Herbert Spencer (Herbert Spencer, *The Study of Sociology, Appleton* (1896), 31) and even Lev Tolstoy (Lev Tolstoy, *War and Peace* (1869), Ch. 1).

[274] Oran R. Young, 'The Problem of Scale in Human/Environment Relationships' (1994) 6(4) Journal of Theoretical Politics 429.

[275] Keohane noted: "Ostrom's theory, as noted here, builds on a number of assumptions—in particular, lack of hierarchy—that are more applicable to world politics than to studying the modern bureaucratic state. It could "leap the gap" between local and global without the investigators worrying about whether it can "scale up" to the national level in between."(Robert O. Keohane, 'Review Symposium: Beyond the Tragedy of the Commons' (2010) 8(2) Perspectives on Politics 577).

[276] Amy R Poteete and Elinor Ostrom, 'Heterogeneity, Group Size and Collective Action: The Role of Institutions in Forest Management' (2004) 35 Development and Change 435.

[277] Thomas Dietz, Elinor Ostrom and Paul C. Stern, 'The Struggle to Govern the Commons' (2003) 302(5652) Science 1907, 1910.

[278] Elinor Ostrom and others, 'Revisiting the Commons: Local Lessons, Global Challenges' (1999) 284 Science 278.

The theory of international regimes can in itself provide a comparative reference for the applicability of the lessons from local commons. It enables examining whether those lessons reflect or are similar in knowledge on international regimes and it indeed reinforces the lessons from the CPR literature.

3.5 Fragmentation of International Law

Fragmentation of international law[279] involves both substantive and institutional fragmentation. Substantive fragmentation is the proliferation of treaties and conventions, multilateral, regional and bilateral, with partial overlap in scope and occasional conflicting but equally authoritative rules. Institutional fragmentation is the proliferation of international *fora*, courts and tribunals with partial overlap in jurisdiction.[280] Institutional fragmentation increases substantive fragmentation as even a single treaty provision might be, and sometimes is, interpreted differently by various tribunals. A related issue is the proliferation of special or self-contained regimes. A self-contained regime is a regime in a specific issue-area in global affairs (*e.g.,* human rights, trade law or space activities), with its principles, rules, *fora* and even diplomatic expertise and academic specialization.

[279] On the fragmentation of international law see, for example: James Crawford, 'Chance, Order, Change: The Course of International Law' in 365 Collected Courses of The Hague Academy of International Law (Leiden: Martinus Nijhoff Publishers, 2013) 9, 205–29; Mads Andenas, 'The Centre Reasserting Itself: From Fragmentation to Transformation of International Law' in Mattias Derlén and Johan Lindholm (eds), *Volume in Honor of Pär Hallström* (Uppsala: Iustus, 2012); Philippa Webb, *International Judicial Integration and Fragmentation* (Oxford University Press, 2013); Eyal Benvenisti and George W. Downs, 'The Empire's New Clothes: Political Economy and the Fragmentation of International Law' (2007) 60 Stanford Law Review 595; Eyal Benvenisti, The Law of Global Governance (The Hague Academy of International Law 2014); Jonathan I. Charney, 'Is International Law Threatened by Multiple International Tribunals?' (1998) 271 Recueil des cours 101; Margaret A. Young (ed.), *Regime Interaction in International Law: Facing Fragmentation* (Cambridge University Press 2012); Daniel H. Joyner, Marco Roscini (eds), Non-Proliferation Law as a Special Regime: A Contribution to Fragmentation Theory in International Law (Cambridge University Press 2012); Ole Kristian Fauchald and André Nollkaemper (eds), The Practice of International and National Courts and the (De-) Fragmentation of International Law (Hart 2012).

[280] On institutional fragmentation see, for example, Yuval Shany, *The Competing Jurisdictions of International Courts and Tribunals* (Oxford University Press 2003).

International law scholars raised concern over the phenomenon of fragmentation[281] and self-contained regimes,[282] which led the International Law Commission to establish a special Study Group, chaired by Koskenniemi, which submitted a detailed report in 2006.[283] The fragmentation of international law is due in large part to the structure of this legal system. Like global governance, the system of international law is decentralized, lacking a lawmaker and a powerful executive branch/authority. International law, as Fischer-Lescano and Teubner note, cannot be unified or hierarchized,[284] and, as Crawford puts it, "fragmentation is the product of a system of laws that, by and large, lacks a sense of vertical integration, of hierarchy".[285] Recent writings assert that there is convergence[286], but

[281] Martti Koskenniemi and Päivi Leino, 'Fragmentation of International Law? Postmodern Anxieties' (2002) 15 Leiden Journal of International Law 553.

[282] The concern is that the regime develops to such an extent that it effectively displaces general international law. See Margaret A. Young, Fragmentation – International Law – Oxford Bibliographies, <http://www.oxfordbibliographies.com/view/document/obo-9780199796953/obo-9780199796953-0113.xml#> accessed 27 September 2018; James Crawford, 'Chance, Order, Change: The Course of International Law' in 365 Collected Courses of The Hague Academy of International Law (Leiden: Martinus Nijhoff Publishers, 2013) 212; Bruno Simma, 'Self-contained Regimes' (1985) 16 Netherlands Yearbook of International Law 111 ; Bruno Simma and Dirk Pulkowski, 'Of Planets and the universe : Self-Contained Regimes in International Law' (2006) European Journal of International Law 17(3) 483; Bruno Simma and Dirk Pulkowski, 'Leges Speciales and Self-Contained Regimes' in James Crawford, Alain Pellet, and Simon Olleson (eds), *The Law of International Responsibility* (Oxford University Press 2010) 139; Martti Koskenniemi, 'The Politics of International Law – 20 Years Later' (2009) 20(1) European Journal of International Law 7; Margaret Young, Regime Interaction in International Law: Facing Fragmentation (Cambridge University Press 2012). Tomer Broude and Yuval Shany (eds), *Multi-Sourced Equivalent Norms in International Law* (Hart 2011).

[283] Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law, Report of the Study Group of the International Law Commission finalized by Martti Koskenniemi (A/CN.4/L.682, 13 April 2006). For other detailed accounts on fragmentation see Gerhard's piece that led to the establishment of the Study Group: Gerhard Hafner, 'Risks Ensuing from Fragmentation of International Law' (2000) Official Records of the General Assembly, Fifty-fifth Session, Supplement No. 10, UN Doc. A/55/10 (2000), at 321–339, and also Martti Koskenniemi, 'The Fate of Public International Law: Between Technique and Politics' (2007) 70 Modern Law Review 1.

[284] Andreas Fischer-Lescano and Gunther Teubner, 'Regime-Collisions: The Vain Search for Legal Unity in the Fragmentation of Global Law' (2004) 25 Michigan Journal of International Law 999. See also Tomer Broude and Yuval Shany (eds), *The Shifting Allocation of Authority in International Law* (Hart 2008).

[285] Whewell Crawford, *Chance, Order, Change: The Course of International Law: General Course on Public International Law* (Martinus Nijhoff 2014).

[286] Mads Tønnesson Andenæs and Eirik Bjørge (eds), *A Farewell to Fragmentation: Reassertion and Convergence in International Law* (Cambridge University Press 2015). Andenas and Bjorge and the other contributors to the volume they edited argue that international law now sees more convergence and unity than fragmentation, inter alia as the result of the work of the International Court of Justice (ICJ) and most

fragmentation, just like decentralization, is a permanent structural feature of international law and will remain as long as the international system is characterized by the lack of a supreme authority, and possibly even beyond.

Benvenisti and Downs[287] assert that fragmentation is a serious problem as it operates to sabotage the evolution of a more democratic and egalitarian international regulatory system and to undermine the reputation of international law for integrity. Fragmentation, they assert, is used by powerful States to preserve their dominance and to opportunistically break the rules without seriously jeopardizing the system they have created.

Nevertheless, for the most part the initial concerns from fragmentation subsided. Crawford asserts that still "the center holds" and that the system of international law retains the tools necessary to maintain its own coherence.[288] Indeed, as Broude notes, fragmentation "is no longer considered to constitute an existential threat to international law as a system. Fragmentation, to a great extent, has been normalized, or accepted, as both politically inevitable and legally manageable".[289]

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other international tribunals and UN institutions, such as the International Law Commission (ILC) and special procedures of various. Nevertheless, Andenas and Bjorge admit that "[f]ragmentation of international law has not, however, come to a complete end; the end of all fragmentation is not a realistic prospect... fragmentation [is] a part of a dynamic legal system…[c]onvergence can be regarded as just as much a part of any legal system, together with fragmentation (Mads Tønnesson Andenæs and Eirik Bjørge, 'Introduction: From Fragmentation to Convergence in International Law' in Mads Tønnesson Andenas and Eirik Bjorge (eds), *A Farewell to Fragmentation: Reassertion and Convergence in International Law* (Cambridge University Press 2015) 1.

[287] Eyal Benvenisti and George W. Downs, 'The Empire's New Clothes: Political Economy and the Fragmentation of International Law' (2007) 60 Stanford Law Review 595.

[288] James Crawford, 'Chance, Order, Change: The Course of International Law' in 365 *Collected Courses of The Hague Academy of International Law* (Leiden: Martinus Nijhoff Publishers, 2013) 9.

[289] Tomer Broude, 'Keep Calm and Carry On: Martti Koskenniemi and the Fragmentation of International Law' (2013) 27 Temple International and Comparative Law Journal 279. However, as Broude also notes, Koskenniemi cautions that fragmentation promotes anti-formalist managerialism in international affairs, which he (Koskenniemi)

Moreover, fragmentation may be perceived as a positive, constructive phenomenon. Koskenniemi and Leino[290] pointed to the proliferation of international tribunals and substantive fragmentation of international law and asserted that fragmentation is an institutional expression of political pluralism internationally, that it does not warrant excessive worries and that it may even bring positive outcomes. Charney[291], in discussing the proliferation of international tribunals, asserts that notwithstanding differences, the tribunals operate within the same fundamentals and that alternative tribunals complement the work of the ICJ and strengthen, not weaken, the system of international law. Furthermore, adoption of different approaches on a single issue by various tribunals, he argues, may be positively viewed as 'experimentation' that may lead to the discovery of the best approach or rules for that issue. Fragmentation, Charney asserts, is not a problem but a blessing.[292]

In discussing fragmentation, it is crucial to take into account the background, which is the constraints of the system of international law. When taking that into consideration, fragmentation emerges as more of a solution than a problem. Indeed, as Koskenniemi and Leino noted:

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views negatively.

[290] Martti Koskenniemi and Päivi Leino, 'Fragmentation of International Law? Postmodern Anxieties' (2002) 15 Leiden Journal of International Law 553.

[291] Jonathan I. Charney, 'Is International Law Threatened by Multiple International Tribunals?' (1998) 271 Recueil des cours 101.

[292] Jonathan I. Charney, 'Is International Law Threatened by Multiple International Tribunals?' (1998) 271 Recueil des cours 101; see also Jonathan I. Charney, 'The Impact on the International Legal System of the Growth of International Courts and Tribunals' (1999) 31 International Law and Politics, 697. On the pros and cons of fragmentation see also Gerhard Hafner, 'Risks Ensuing from Fragmentation of International Law' (2000), Official Records of the General Assembly, Fifty-fifth session, Supplement No. 10 (A/55/10), Annex, 326–54; Gerhard Hafner, 'Pros and Cons Ensuing from Fragmentation of International Law' (2004) 25(4) Michigan Journal of International Law 849. On fragmentation in international trade see: John H. Jackson, 'Fragmentation or a Unification among International Institutions: The World Trade Organization' (1999) 31 International Law and Politics 823.

> *To read the debate about fragmentation as if it had to do only with coherence in the abstract is to be mistaken about what is actually at stake. Special regimes and new organs are parts of an attempt to advance beyond the political present that in one way or another has been revealed unsatisfactory.*[293]

Fragmentation, one may conclude, is inevitable, given the constraints of world politics. It allows the development and application of international law, where it would have been impossible or too difficult to do so otherwise. In a decentralized international system, a fragmented decentralized legal system is both inevitable and effective in providing international regulation. Like regime complexes and polycentric governance, fragmentation, is both inevitable and advantageous in a decentralized international system.

3.6 Convergence and Synthesis

The choice of the pillars of the theoretical approach of this thesis is grounded in the similarities between the underlying causes and the characteristics of regime complexes, fragmentation and many cases of polycentric governance. Moreover, the thesis demonstrates – and builds on - convergence of these three theories of decentralized governance and, significantly, their insights and conclusions.

International regimes are established in a system, the international system, where power is dispersed among various actors. These actors cooperate to establish and maintain rules and manage global affairs in a decentralized manner. A regime complex means that a single issue-area has multiple and partly overlapping legal instruments and *fora*. Polycentric governance is a case of decentralized governance in which there are multiple independent

[293] Martti Koskenniemi and Päivi Leino, 'Fragmentation of International Law? Postmodern Anxieties' (2002) 15 Leiden Journal of International Law 553.

centers of collective decision-making, with at least partial overlap in jurisdictions, which cooperate to establish and maintain rules to manage common affairs. Fragmentation in international law is the proliferation of rules, international institutions and international tribunals.

Regime complexes and fragmentation both describe phenomena at the international level and emanate from a decentralized international system. The concept of polycentric governance was studied mainly in the national level and emanates from the sub-national decentralization in metropolitan areas and also from the realities and needs of the management of CPRs. Though polycentric governance was studied mainly in the national level, it can and should be applied to global affairs. Ostrom herself, together with Dietz and Stern, suggested that many of the general principles for robust governance systems for local resources "also appear to be applicable to regional and global resources, although they are less well tested at those scales".[294] Keohane and Elinor Ostrom considered convergence between the literatures on local commons and that on international regimes[295], each demonstrating the feasibility of collective action without hierarchical authority. Moreover, they also noted that "many of the 'design principles' underlying successful self-organized solutions to CPR problems appear relevant to the design of institutions to resolve problems of international cooperation as well as those at a strictly local level".[296] Moreover, Elinor Ostrom's work is methodologically, theoretically and

[294] Thomas Dietz, Elinor Ostrom and Paul C. Stern, 'The Struggle to Govern the Commons' (2003) 302(5652) Science 1907.

[295] Robert O. Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (Sage 1995). See also Robert O. Keohane, 'Review Symposium: Beyond the Tragedy of the Commons' (2010) 8(2) Perspectives on Politics 577.

[296] Robert O. Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (Sage 1995).

empirically more rigorous, than the IR literature.[297] Therefore, applying Elinor Ostrom's theory to global affairs may provide a more rigorous body of knowledge.

The literature on international regimes as well as Ostrom's study of the management of CPRs have both been set to study the emergence of cooperation from the interaction of multiple self-interested actors in the absence of a central political authority. In global affairs and in CPRs of the kind E. Ostrom studied, governments do not supply sufficient governance. As E. Ostrom noted "national governments are too small to govern the global commons and too big to handle smaller-scale problems."[298] Neither States nor the users of CPRs studied by E. Ostrom have an authoritative hierarchy to create and enforce rules governing their relations with one another.

Some international relations scholars suggested that the anarchy characterizing global affairs politics would render sustained attempts at international cooperation infeasible.[299] Other scholars rejected this suggestion and pointed to the plethora of international regimes that do not establish hierarchical mechanisms but nevertheless facilitate and promote international cooperation.[300] Similarly, Ostrom refuted Hardin's assertion that these situations would result in the tragedy of the commons and demonstrated that collective action in the management of CPRs is feasible, occurs across sectors and cultures and is

[297] Robert O. Keohane, 'Review Symposium: Beyond the Tragedy of the Commons' (2010) 8 Perspectives on Politics 577.

[298] Elinor Ostrom, 'A Behavioural Approach to the Rational Choice Theory of Collective Actio' (1998) 92(1) The American political science review 1, 17.

[299] Kenneth N. Waltz, *Man, the State and War* (Columbia University Press 1959), Kenneth N. Waltz, *Theory of International Politics* (Addison-Wesley 1979).

[300] Robert Axelrod, *The Evolution of Cooperation* (Basic Books 1984); Robert O. Keohane, *After hegemony: Cooperation and Discord in the World Political Economy* (Princeton University Press 1984); Kenneth A. Oye (ed), *Cooperation Under Anarchy* (Princeton 1986); Duncan Snidal, 'The Limits of Hegemonic Stability Theory' (1985) 39(4) International Organization 579; Oran R. Young, *International Cooperation: Building Regimes for Natural Resources and the Environment* (Cornell University Press 1989).

effective. Indeed, in the case of global affairs as in the case of local CPRs, governance is made by the collective action of the actors.

The literatures on international regimes and on CPRs both emphasize the importance of institutional development and the role institutions play in facilitating cooperation. However, Ostrom's study was more methodologically rigorous, as noted above. While the use of international relations provides the context and a check on the validity of my conclusions, the knowledge from the study of common pool resources provides extensive empirical evidence as well as design principles for successful institutions, both are missing from international relations literature and provide significant contribution to the discussion and knowledge on global governance.

The cumulative insights from the literature on fragmentation, regime complexes and polycentric governance are that decentralization is inevitable and a phenomenon that is here to stay. This is not surprising, considering the decentralized structure of the international system. The cumulative insights also portray the advantages of decentralized governance and, just as important, how the adverse effects of decentralization can be mitigated.

Decentralized governance has numerous advantages and the first and foremost is the feasibility of achieving governance in the absence of a global supreme authority. It enables the development of governance by incremental evolution, formation of clubs or smaller groupings of like-minded actors that can pioneer the development of norms that may be extended to larger groups at a later time, cooperation among actors in some areas even if they have disagreements in others, and experimentation in different approaches.

Decentralized governance is flexible and adaptable, which is especially important where rapid technological developments are concerned, and it enables meaningful participation of users and experts in governance. At the end of the day, decentralized global governance is an institutional expression of political pluralism internationally.

The advantages of polycentric governance can be maximized, and the adverse effects be mitigated, in ways presented in chapter 4.

3.7 The Road Less Travelled[301]: Prior Interdisciplinary Attempts

Most previous attempts to apply Elinor Ostrom's theory to space activities[302] were merely initial and general thoughts or comments. Chaddha presented a comprehensive suggestion but with a focus on a specific issue – space debris. In contrast, this thesis goes beyond the management of this or other CPR.[303] It takes Ostrom's theory from the management of CPRs to pure governance, not just of CPRs. This thesis innovates by applying the concept of regime complexes to outer space regimes, by demonstration and building on the convergence of the concepts and literatures on regime complexes, polycentrism and fragmentation, and by applying this new knowledge to space governance, as elaborated in section 1.5 above.

[301] Compare: Robert Frost, The Road Not Taken (a poem, 1916).

[302] Joan Johnson-Freese and Brian Weeden, 'Application of Ostrom's Principles for Sustainable Governance of Common-Pool Resources to Near-Earth Orbit' (2012) 3(1) Global Policy 72; Tiffany Chow and Brian Weeden, 'An Introduction to Ostrom's Eight Principles for Sustainable Governance of Common-Pool Resources' (2012) <http://swfound.org/media/61531/isusymposium2012paper_tchowbweeden.pdf> accessed 20 July 2016; and Henry Hertzfeld, Brian Weeden and Christopher Johnson, 'How Simple Terms Mislead Us: The Pitfalls of Thinking About Outer Space as Commons' (conference paper AC-15 - E7.5.2 x 29369) presented at the 66th IAC / 58th IISL Colloquium, held in Jerusalem in September 2015.

[303] Shane Chaddha, *An Inquiry for Alternative Governance Regimes for Outer Space* (Scholars' Press 2014).

Vincent Ostrom asserted that "it is *necessary* to explore the application of polycentricity to the realm of international affairs as well" (emphasis added).[304] Keohane and Ostrom envisioned convergence between the literatures on CPR and on international regimes and called for more work in this direction. In a volume they edited[305], that included contributions contemplating the feasibility of convergence between the two bodies of knowledge, they noted:

> *Thus, a remarkable convergence seems evident between two independent streams of literature… At both local and global levels, researchers have found that when individuals or organizations (such as states) can make credible commitments, they are frequently able to devise new constraints (institutions, or sets of rules) that change the basic structure of incentives that they face…Not surprisingly, many of the 'design principles' underlying successful self-organized solutions to CPR problems appear relevant to the design of institutions to resolve problems of international cooperation as well as those at a strictly local level.*[306]

Alas, this path was not thoroughly taken, and the disciplinary walls remained. As late as 2010, in a symposium themed "Beyond the Tragedy of the Commons", shortly after Elinor Ostrom was awarded the Nobel Prize (Economic Sciences, 2009) for her work on CPRs, Keohane reiterated that there is *striking* analytic resemblance between the study of local and global commons, that Ostrom's work has been more systematic than most of the parallel work in international relations and that it carries significant potential contribution to the study of global affairs. Regretting that Ostrom's theory and methods were not

[304] Vincent Ostrom, The Meaning of American Federalism: Constituting a Self-Governing Society (Institute for Contemporary Studies 1991), Ch. 9: Polycentricity: The Structural Basis of Self-Governing Systems, p. 223-44, 224.

[305] Robert O. Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (Sage 1995).

[306] Ibid.

applied to global affairs, he further asserted that there are "unexploited opportunities" for investigators who seek to understand issues in global affairs.[307]

3.8 Conclusions

Global governance is studied mainly within the discipline of international relations, and therefore this body of knowledge was the first to draw from. Within this literature, the recently introduced concept of regime complexes is of particular relevance to the problem that this thesis studies, to its analysis, and to the provision of policy recommendations to address it. International law, that also addresses issues of global governance, and is the discipline to which space law belongs, is another default body of knowledge which is to be tapped, and the literature of fragmentation of particular relevance to the issue and similarity to the concept of regime complexes. The literature on polycentric governance, which belongs to political science and economy, is not an obvious choice. However, as this chapter demonstrated, this body of literature not only provides important insights on governance, but is also relevant to global affairs.

As demonstrated above, fragmentation, regime complexes and polycentric governance are each a version or conceptualization of decentralized governance and each proves to have merits that outweigh the shortcomings. These three concepts are mostly studied separately

[307] Robert O. Keohane, 'Review Symposium: Beyond the Tragedy of the Commons' (2010) 8(2) Perspectives on Politics 577. See also other contributions in this volume from the same symposium. See in particular the contribution of Axelrod in which he raises a caveat: "Ostrom herself is well aware of the problems of doing interdisciplinary research. As she once put it, 'the disciplinary huts of many modern universities do not really enable one to have effective intellectual exchange across disciplines' (as quoted in Zagorski 2006)" (Robert Axelrod, 'Review Symposium: Beyond the Tragedy of the Commons' (20120 8(2) Perspectives on Politics 580).

in three different disciplines,[308] but *there is convergence between the underlying causes, characteristics and, significantly, insights, of the three theories of decentralized governance*.

These three theories provide us with key insights on the reality of global politics and how governance can be introduced under the constraints of an anarchic international system. As elaborated above, global governance is decentralized, and it is inevitable that issue-areas within global affairs will experience decentralization, even if they had an initial monocentric structure. Fragmentation and regime complexes, while they may seem alarming, allow provision of governance where it would not otherwise be possible, and they are thus positive phenomena. Polycentric governance, while it may also seem alarming, is actually an efficient model of governance, as proven in theory and, significantly, with a vast empirical study, across States and sectors. The combined insights lead to the conclusions that the governance of issue-areas in global affairs may inevitably become decentralized and even polycentric, and that this may be advantageous.

The next chapter builds on cumulative conclusions of this chapter to argue the case for polycentric space governance and possibly for polycentric governance of other issue-areas in global affairs.

[308] But see Margaret Young (ed), *Regime Interaction in International Law: Facing Fragmentation* (Cambridge University Press 2012) for a discussion combining international law and international relations. This collection of papers discusses "regimes", including fragmentation of international law and conflicting regimes, and how regimes interact in a situation of ongoing diversity; see also Robert O. Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence : Heterogeneity and Cooperation in Two Domains* (Sage 1995). In this volume, edited by Keohane and Ostrom, an oracle of Regime Theory and an oracle of institutional analysis and CPR literature, the authors have joined to discuss similar problems: at the international level, there is no hierarchy and authority enforcing cooperation, in the smaller CPRs, there is no hierarchy of government officials creating rules or enforcing agreements; also Nye, in writing on the regime complex in the context of cyber activities, discusses 'commons' and club goods, concepts at the basis of the study of CPRs, and refers to the work of Ostrom on CPRs.

Chapter 4
The Case for Polycentric Space Governance

This chapter builds on the historical background presented in chapter 2 and the theories discussed in chapter 3 to suggest a structural way to address the governance deficit reviewed in chapter 1. This chapter advocates for polycentric governance of space activities, issues and areas, including habitats.

4.1 A Structural Problem

The crisis in global governance is, in part, structural, and therefore addressing it requires addressing the structure or architecture of space governance. Space governance was launched as a largely monocentric system, with UN-COPUOS mandated with building the *corpus juris spatialis*. However, UN-COPUOS' treaty-making phase essentially ceased in the mid-1970s and, under its current settings, it largely lacks the capability to steer space activities. Furthermore, calls for an international space agency[309] have not been answered and likewise "the inclusion of an independent, international organization tasked with regulation of resources as described in the Moon Treaty and UNCLOS was a major obstacle to ratification for many parties"[310] . The international system has no central government and global governance in general is therefore - *necessarily* – decentralized. As a result, it is not sustainable to maintain a monocentric system of governance (space governance) within a decentralized system of governance (general global governance).

The reasons for the decentralization of global affairs are here to stay, and therefore so is decentralization - in global affairs, in general, and in space governance, in particular. To name just a few such reasons: the lack of a global government and global legislature that can attempt to provide a unified, coherent set of laws, tribunals or regimes, not to mention enforcing them; the process of specification that leads to the creation of self-contained regimes; the pluralistic nature of the international system, with multiple actors with

[309] See, for example: Narayanan Komerath, James Nally and Elizabeth Zilin Tang, 'Policy Model for Space Economy Infrastructure' (2007) 61 Acta Astronautica 1066; Lewis Pinault, 'Towards a World Space Agency' in Charles S Cockell (ed), *Human Governance Beyond Earth: Implications for Freedom* (Springer 2015); Bruce Cordell, 'Interspace - Design for an International Space Agency' (1992) 8 Space Policy 287; Kenneth S. Pedersen, 'Is It Time to Create a World Space Agency?' (1993) 9 Space Policy 89.

[310] Pascale Ehrenfreund, Margaret Race and David Labdon, 'Responsible Space Exploration and Use: Balancing Stakeholder Interests' (2013) 1 New Space 60, 70.

different and often competing interests; the rigidness of existing regimes, that often cannot adapt to the changes in the global politics and, as a result, only creating a new regime can provide a new balance, adapted to the new reality; the different levels of the international arena – global, regional and national, where regional regimes compete with and complement each other and with global regimes. It is therefore unlikely to achieve centralized, monocentric governance of global affairs. Decentralization is the inevitable future of global governance, as well as space governance, and only a fundamental change in global politics could change this course of events. The findings presented in chapter 3, on the merits of decentralized governance, are therefore good news.

4.2 Embracing Polycentricism

Since centralized governance is not feasible, and considering the proven merits of polycentric governance, as well as of regime complexes and fragmentation, this thesis proposes embracing polycentric governance as a model for space governance, and possibly for the governance of other issue-areas in global affairs or even to global affairs in general. Embracing polycentric space governance by encouraging and facilitating the establishment of diverse polycentric institutions may not merely be the only feasible model for space governance, but also more efficient than other discussed alternatives, which are not even feasible.

Where the unknown outweighs what is known, where we expect new and major discoveries, achievements and challenges, adopting a flexible regime is preferred. Much is unknown about future space exploration and utilization and the technologies and policies are still in the making. It is therefore difficult and counterproductive to establish rigid

institutions and regimes, except the basic norms, principles and rules which are already in place. The technological, economical, legal and sociological developments and even revolutions necessitate a flexible governance regime that would be able to entertain adjustments to suit governance to the needs. A rigid regime will delay development. The suggested polycentric governance regime provides the required flexibility that allows adaptation and self-correction, and are therefore capable of accommodating changes.

As section 4.7 below demonstrates, space governance is already on track to become polycentric, as stakeholders and experts establish forums that suggest, adopt or push for rules and standards. Thus, polycentric governance emerges organically from the reality in global affairs. Yet, polycentric governance is not just inevitable but also, perhaps counter-intuitively, efficient, as demonstrated, theoretically and empirically. The efficiency of polycentric governance systems in providing governance without government is one of the main reasons to opt for such systems. After all, effectiveness is, as Finnemore noted, "crucial to the trajectory of global governance… [i]neffective governance and bad performance can damage the authority and, thereby, the power of governing structures"[311]. Adapting to the reality of international politic in the 21st century, space governance should become polycentric.

Polycentric space governance suggests governance not by a strong, central, global institution, committee or even merely a forum, nor by rules imposed from the top , but rather by facilitating and encouraging stakeholders-led governance of separate sub-issue-areas, by forming separate, issue-area-specific governance centers, which would together

[311] Martha Finnemore, 'Dynamics of Global Governance: Building on What We Know' (2014) 58 International Studies Quarterly 221.

encompass the vast majority of the entire issue-area of space activities, and which may be interconnected by a joint coordinating forum. This polycentric model would create the basis for larger scale cooperation and governance at a global level. A set of semi-independent governance centers, loosely interconnected, is feasible and even more efficient than centralized governance or a single comprehensive institution or forum.

The suggested polycentric governance model is consistent with the current space law, and can accommodate current international organizations, at the higher levels, as central coordinating forums that would promote the interaction between the various governance centers and direct the system as a whole.

4.3 Contemplating a Universal Application of Polycentric Governance

The option for a universal application of polycentric governance is beyond the scope of this thesis, but it is nevertheless briefly touched herein, in order to demonstrate that it was seriously considered. Vincent Ostrom, building on Madison, noted:

> *If the conditions applicable to polycentric orders can be generalized to apply to all patterns of order in a society, we might then meet the conditions specified by Madison in essay 51 of The Federalist where he suggests that 'this policy by supplying by opposite and rival interests, the defects of better motive, might be traced through the whole system of human affairs, private as well as public' (Hamilton, Jay, Madison 1788: 337, my emphasis). If the whole system of human affairs is capable of being organized on principles of polycentricity rather than monocentricity, we could have human societies that no longer depend upon a unity of power to achieve coherence. Such an idea is of radical proportions; but this is what Madison is saying in what I would regard as the single most important assertion about the organizing principle of American federalism to be found in The Federalist. This assertion, then, is fully consistent with de Tocqueville's that American*

> *democracy is a self-governing society: 'there society governs itself for itself' (de Tocqueville [1835] 1945, 1:57).*[312]

This is, admittedly, a brazen suggestion. There is precedent for polycentric governance at the supranational level, though not on a global scale. The Holy Roman Empire was an amorphous central European political entity, encompassing numerous peoples in a decentralized system lacking even a permanent capital. It was, as Wilson suggested, a case of polycentric governance.[313] The Spring and Autumn period in the history of China (8th – 5th century BCE) may be considered to have seen polycentric governance, though not as an equilibrium but rather as a phase between central rule and internal wars. During the Spring and Autumn period, the Zhou ruler gradually lost power in favor of local military leaders. Loyalty to the Zhou ruler became weak, symbolic or even revoked, depending on local conditions. Yet, many local leaders kept formal and some degree of practical allegiance to the Zhou ruler for various reasons. Power became decentralized, but no new equilibrium emerged. Eventually, powerful States fought the Zhou ruler and each other in what is known as the Warring States period (5th-3th century BCE). However, the Spring and Autumn period also saw a remarkable cultural thrive, with many of China's leading scholars and schools of thought emerging in this period that shaped Chinese civilization. It was the time of Confucius, Lao Zi, and Sun Tzu. It saw the thriving of the 'Hundred Schools of Thought' of Chinese philosophy. Both Chinese philosophical traditions / religions emerged in this period: Confucianism and Daoism (Taoism) (the third popular religion in China, Buddhism, originated in India). Two other important philosophical traditions also

[312] Vincent Ostrom, *The Meaning of American Federalism: Constituting a Self-Governing Society* (Institute for Contemporary Studies 1991), Ch. 9: Polycentricity: The Structural Basis of Self-Governing Systems, p. 223-44, 223.

[313] Peter H. Wilson, *The Holy Roman Empire: A Thousand Years of Europe's History* (Penguin UK 2017).

emerged in this period: Legalism and Mohism.[314] What succeeded the Holy Roman Empire were nation States, including Germany, Austria, Switzerland and Italy. In contrast, what succeeded the warring States in China was a return to a single Chinese empire. A polycentric system is therefore not necessarily eternal – it can collapse and bang to pieces or unite to a monocentric system.

4.4 The Key Role of Stakeholders and Experts in Space Governance

Institutional design includes constitutional-level rules specifying the participants, how authority is distributed and how rules are made[315], what Hart would call 'secondary rules'[316]. Central to polycentric governance is users' self-organization or self-governance, *i.e.*, that users organize themselves to address shared problems and interests.[317] In self-governance, the users of the CPR (*e.g.,* fishermen fishing from the same lake, farmers using the same water basin) themselves establish, modify and possibly enforce the rules regulating the use and protection of a common resource.[318] As Elinor Ostrom noted, "[c]rafting development-enhancing institutions is an ongoing process that must directly

[314] On the Spring and Autumn period in the history of China see: Cho-yun Hsu, 'The Spring and Autumn Period' in Michael Loewe and Edward L. Shaughnessy (eds), *The Cambridge history of ancient China: from the Origins of Civilization to 221 BC* (Cambridge University Press 1990) 545; John King Fairbank and Merle Goldman, *China: A New History* (2nd ed, Harvard University Press 2006).

[315] Vincent Ostrom, 'A Forgotten Tradition: The Constitutional Level of Analysis' in Michael D. McGinnis (ed), *Polycentric Governance and Development: Readings from the Workshop in Political Theory and Policy Analysis* (University of Michigan Press 1999); Larry L. Kiser and Elinor Ostrom, 'The Three Worlds of Action: A Metatheoretical Synthesis of Institutional Approaches' in Michael D. McGinnis (ed), *Polycentric Games and Institutions: Readings from the Workshop in Political Theory and Policy Analysis* (University of Michigan Press 2000).

[316] HLA Hart, *The Concept of Law* (Oxford University Press 1961).

[317] Bryan Bruns, 'Putting Polycentric Governance into Practice' in Andreas Thiel, William A. Blomquist and Dustin E. Garrick (eds), *Governing Complexity: Analyzing and Applying Polycentricity* (Cambridge University Press 2019); Marcel J. Dorsch and Christian Flachsland, 'A Polycentric Approach to Global Climate Governance' (2017) 17 Global Environmental Politics 45.

[318] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press 1990).

involve the users. Instead of designing a single blueprint for all places and circumstances, officials need to enhance the capability of social actors to design their own institutions". [319]

Elinor Ostrom demonstrated that self-governance brings sustainable results. Empirical studies on governance of CPRs made in various States regarding various types of CPRs demonstrated that resource users were successful in organizing themselves and managing CPRs, often better than governments.[320] The evidence demonstrated that users establish rules that better suit the conditions and needs and tend to follow those rules more than they follow rules imposed from the top. They have both the intimate knowledge of local conditions and the interest and incentive to devise and follow adequate rules. Users also devise a variety of formal and informal mechanisms and ways of monitoring and sanctioning, especially when they have economic rights, *e.g.,* when they are given harvesting rights. Users' monitoring and sanctioning proved to be better than such imposed from the top. The leading role of users is crucial in the successful governance of CPRs. Indeed, "a common factor in ensuring successful governance of CPRs is the active participation of resource users in the management of the flow of benefits from the resources."[321]

[319] Paul Dragos Aligica, 'Rethinking Institutional Analysis: Interviews with Vincent and Elinor Ostrom' <https://www.mercatus.org/publication/rethinking-institutional-analysis-interviews-vincent-and-elinor-ostrom> accessed 10 May 2019.

[320] Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review, 1.

[321] Roy Gardner, Andrew Herr, Elinor Ostrom, and James A. Walker 'The Power and Limitations of Proportional Cutbacks in Common-Pool Resources' (2000) 62(2) Journal of Development Economics 515, 515. See also Jeremy S. Brooks, Margaret A. Franzen, Christopher M. Holmes, Mark N. Grote, and Monique Borgerhoff Mulder, 'Testing Hypotheses for the Success of Different Conservation Strategies' (2006) 20(5) Conservation Biology 1528.

Self-governance can emerge in cases of little to no government involvement, but can also be facilitated or even encouraged by the government.[322] Users organize themselves by convening forums, gathering and sharing knowledge and establishing self-governing mechanisms, *e.g.,* organizations and institutions.[323]

The viability of self- governance is one of the most important lessons from Ostrom to space governance. The world is presided over by many governments (not, significantly, *a* government). There is no single sovereign or a strong global authority, and the same goes for outer space activities. Stakeholders-based governance is not just advantageous, it is also inevitable.

In the context of space governance, self-organization or self-governance means that stakeholders will lead to the creation, and possibly also monitoring and enforcement, of the relevant rules. Stakeholders are those actors who are directly involved in a certain sub-issue-area and therefore have stakes in its successful governance. It is the equivalent of 'users' in the CPR literature.

These stakeholders may include most of the States or a handful of them and may also include non-State actors. On the one extreme, virtually all States are using radio frequencies and are therefore stakeholders, and on the other extreme, with regard to weaponization, the actual or potential producers of space weapons include no more than

[322] In Japan the state used laws in order to encourage the development of self-governance in the early 1900s (Ashutosh Sarker, Toru Ikeda, Takaki Abe, and Ken Inoue, 'Design Principles for Managing Coastal Fisheries Commons in Present-Day Japan' (2015) 117 Ecological Economics 32).

[323] Bryan Bruns, 'Putting Polycentric Governance into Practice' in Andreas Thiel, William A Blomquist and Dustin E. Garrick (eds), *Governing Complexity: Analyzing and Applying Polycentricity* (Cambridge University Press 2019).

three to five actors: the US, Russia, China, India and the EU. In the mining of space natural resources, private companies play a leading role and are therefore also stakeholders.

Thus, the 'users'/'stakeholders' of the weaponization issue may be those who develop or have the capacity to develop space weapons; the 'users'/'stakeholders' of the debris issue are all those who create debris; and the 'users'/'stakeholders' of the Moon are all those who, at the relevant time, have presence on or are in close vicinity of the Moon. Many States have satellites in orbit (indigenous or procured), and all those States should participate in the regime allocating slots.

Polycentric governance therefore means that stakeholders have a central role in the governance of the sub-issue-area in which they are directly involved. The stakeholders have an incentive to play a significant role in the governance of the sub-issue-area in which they act, and they have knowledge that can contribute to the governance of that issue-area. In the ITU regime, for example, stakeholders, including private companies and other telecommunication operators, actively participate in ITU conferences and standard setting meetings. In this sense, the addition of actors who are non- stakeholders might stall, or even prevent, the evolution of a governance system We can further envision that commercial entities active in space and even persons who populate space habitats participate in making the rules directly applicable to them, if they are independent actors and not emissaries, although they might have diminished rights and duties compared to the States. Yet, this does not mean there are no other participants in the said governance. The governance of each sub-issue-area should also take into account the concerns and the interests of future users and global public policy in general, and these may be represented

by UNOOSA and NGOs like the Secure World Foundation. When, further down the road, space habitats will be established, the people who will populate these habitats should have an important role in the governance of these habitats. While the ISS is governed in a semi-military hierarchy, a space habitat should adopt a more democratic system, with significant voice for the inhabitants.

Designing governance mechanisms that would facilitate development of space technologies, activities and commerce must directly involve the stakeholders. With the caveat of representation of future stakeholders and other indirectly affected actors as well as global public policy, stakeholders should have a key role in the governance of the sub-issue-areas in which they are active. Furthermore, motions for distribution of space benefits do not prevent application of users' management since management and ownership are not necessarily congruent and, as the next section suggests, the issue of distribution is a matter for UN-COPUOS, and not for the issue-area-specific governance centers.

The Antarctic Treaty System is an example of users'/stakeholders' self-regulation. The Antarctic Treaty, which is *not* a UN treaty, and its nearly 200 supplementing instruments form together the Antarctic Treaty System (ATS). ATS provides a flexible, incremental system that can be amended and supplemented without the need to amend the treaty itself. However, the most notable feature is that all of these amendments and additions are made by those nations States that are active in Antarctica, *and only by them*. "Countries that do not operate in Antarctica are justifiably excluded from altering the treaties that govern the

region."[324] The ATS has proven to be a stable, effective, comprehensive and adaptable system.

There may be various types of users/ stakeholders. In the case studies analyzed by Ostrom there was typically one kind of users, and consumers were not considered as users. The fishermen in a lake were users, not those who buy fish. In the context of space activities there may be several kinds of users. Users of a spaceport, space station or a Moon base include the actors establishing and operating those installations and the users of those installations, such as those who launch, dock or land there (those are also consumers, but distinguished from end-consumers, such as smartphone holders using a GPS, which would still not regarded as users). All actual users would take part in the management, as described in the above principles, but perhaps with varying responsibilities and competences. The composition of the forum and the rule-making mechanism should allow for efficient governance.

Experts should also have a key role in space governance, as they bring the shared values and accumulated policy-oriented knowledge of epistemic communities. An epistemic community, as conceptualized by Haas, is "a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy relevant knowledge within that domain or issue-area"[325]. It is a network of individual

[324] Pascale Ehrenfreund, Margaret Race and David Labdon, 'Responsible Space Exploration and Use: Balancing Stakeholder Interests' (2013) 1 New Space 60, 63. On the ATS and its implications see also Oran R. Young, 'Governing International Spaces: Antarctica and Beyond' in Paul Arthur Berkman, Michael A. Lang, David W. H. Walton, and Oran R. Young (eds), *Science Diplomacy: Antarctica, Science and the Governance of International Spaces* (Smithsonian 2011), 287.

[325] Peter M. Haas, 'Introduction: Epistemic Communities and International Policy Coordination' (1992) 46 International Organization 1. See also Mai'a K. Davis Cross, 'Rethinking Epistemic Communities Twenty Years Later' (2013) 39 Review of International Studies 137; and Peter Haas, 'Epistemic Communities' [2008] The Oxford Handbook of International Environmental Law. For a genealogy of the concept of epistemic

professionals or experts who come from various sectors (government, industry, academe) and States and they communicate and exchange knowledge and ideas, *e.g.,* through conferences. Academic disciplines and professional societies are also epistemic communities. They point out problems and offer solutions, aimed at other members of the epistemic community and also policymakers. The expert often share some basic norms, values, or believes. There are also other conceptualizations for the networks of individuals with influence on national and global policy, notably policy networks and policy communities[326], (transnational) advocacy networks[327], and transnational or global policy networks[328]. Epistemic communities are particularly important and influential in issue-areas characterized by novelty and technical complexity[329], hence their importance for the space sector.

Epistemic communities create and disseminate knowledge and ideas and facilitate the agreement on the basics of the discourse, policy and action, *e.g.,* basic concepts, norms, values, and methodologies. Epistemic communities are not themselves part of a national government, intergovernmental organization, but they influence global policy in their issue-area. By the knowledge and expertise they bring, they have an important role in the

communities see: Andrea Bianchi, 'Epistemic Communities' in Jean d'Aspremont and Sahib Singh (eds), *Concepts for International Law: Contributions to Disciplinary Thought* (Edward Elgar 2019).

[326] Mark Thatcher, 'The Development of Policy Network Analyses: From Modest Origins to Overarching Frameworks' (1998) 10 Journal of Theoretical Politics 389; William D. Coleman, 'Policy Networks' in James D. Wright (ed), *International Encyclopedia of the Social & Behavioral Sciences* (2nd ed, Elsevier 2015); Michael M. Atkinson and William D. Coleman, 'Policy Networks, Policy Communities and the Problems of Governance' (1992) 5 Governance 154.

[327] Margaret E. Keck and Kathryn Sikkink, *Activists Beyond Borders: Advocacy Networks in International Politics* (Cornell University Press 1998).

[328] Diane Stone, 'Global Public Policy, Transnational Policy Communities and Their Networks' (2008) 36 Policy Studies Journal 19.

[329] Peter M. Haas, 'Introduction: Epistemic Communities and International Policy Coordination' (1992) 46 International Organization 1; Claire A. Dunlop, 'The Irony of Epistemic Learning: Epistemic Communities, Policy Learning and the Case of Europe's Hormones Saga' (2017) 36 Policy and Society 215.

construction and operation of governance centers and of polycentric governance in general.[330] As chapter 2 demonstrated, experts and epistemic communities drove the first wave of international organizations by establishing experts-led international organizations such as the ITU. With the caveat of representation and of addressing the concerns of future stakeholders and other indirectly affected actors, stakeholders and experts should have a leading role in space governance.

4.5 Polycentric Space Governance in Practice

The governance of space activities has a solid base, with several widely accepted space law treaties and dedicated UN organs, and this should and will remain the basis of space governance. However, in order to evolve and meet the changing needs, space governance must become polycentric. This means, in a nutshell, that a separate issue-area-specific forum for each sub-issue-area (*e.g.,* militarization), led by the active actors thereof, would create rules for that sub-issue-area and possibly monitor their application. Space governance would thus be the aggregate of all forums' work.

Chapter 3 defined polycentric governance as a case of decentralized governance in which there are multiple independent centers of decision-making ('governance centers'), with at least partial overlap in jurisdictions; the governance centers interact and collaborate to a certain extent or take each other into account in complex and ever-changing ways; out of these seemingly uncoordinated processes of mutual adjustment, emerges the repertoire of norms and rules that guide the behavior of actors within the entire realm.

[330] See also Bryan Bruns, 'Putting Polycentric Governance into Practice' in Andreas Thiel, William A Blomquist and Dustin E Garrick (eds), *Governing Complexity: Analyzing and Applying Polycentricity* (Cambridge University Press 2019).

Polycentric space governance in practice thus means that there will be a separate governance center for each sub-issue-area: one for weaponization and militarization, one for space debris, one for utilization of space natural resources and yet another one for space traffic control. Each governance center would have a forum led, and possibly even established, by the relevant stakeholders and experts, with UNOOSA representing the global public interests, and the interests of all non-participating actors. UNOOSA may thus represent and deliver the concerns of those who are not active in the issue-area, but are largely affected or are prospective actors. UN-COPUOS would be the supervising multilateral coordination forum. Global administrative law or the law of global governance may provide further assurances regarding participation and accountability, as noted in the following section. Private actors would also take part in the governance of issue-areas in which they are active. A single issue can have more than one forum, *e.g.,* one multilateral and another industry forum.

Under the suggested model, the issue-area of weaponization of space would have its own regime or governance center, separate and different from the one on the allocation of slots in the geostationary orbit and radio frequencies. Virtually all States are using radio frequencies and most States either have satellites in orbit, indigenous or procured, or procure satellite bandwidth. Therefore, all those States should – and do - participate in the governance center allocating radio frequencies and slots in the geostationary orbit. In contrast, when it comes to weaponization, the actual or potential users include, as noted above no more than three to five actors. These three to five users should establish and enforce the rules on the weaponization of space, and the addition of actors who are non-users might stall – or even prevent - the achievement of such a regime. The interest of the

future stakeholders, potential victims, other affected actors and global public policy, in general, can and should be represented by UNOOSA, which would be coordinated with the UN's First Committee (Disarmament and International Security) and the Conference on Disarmament (CD), and UNIDIR and UNODA. Only a handful of States and private corporations are active in the sub-issue-area of mining space natural resources. These users should lead the adoption of industry standards and common practices. It stands to reason that industry representatives would also have a seat at the decision-making table. The issue of the distribution of the benefits from space natural resources is relevant to all States/humankind and thus should be discussed in UN-COPUOS. In the context of space traffic control, those operating spacecrafts should set the standards and mechanisms to prevent collisions.

Polycentric space governance means *separate* and *different* governance centers for each sub-issue-area. They are separate because there is one, or more, governance center for each sub-issue-area. They are different due to the variance in the number and identity of stakeholders and experts. They would introduce various instruments, legally-binding or not, multilateral or national or industry standards and best practices. Despite the governance centers being issue-area specific and thus separate, partial overlap and conflicts may exist, as they do in regime complexes and wherever there is fragmentation and as acknowledged in the literature on polycentric governance.

The 'big picture' of space governance will ultimately be the sum of the governance centers of each sub-issue-area and the rules they establish. By dividing space governance to sub-

issue-areas and having a forum predominately with users/stakeholders, which have an interest in establishing some rules and knowledge on the nature of the needed rules.

A polycentric governance system should preferably have basic principles and coordinating institutions. The 1967 Outer Space Treaty can and should be the basis for all separate governance centers. The steering of their respective sub-issue-area should be in conformity with the OST. UNOOSA, in addition to its role as representing global public interest and the interests of non-participating actors, can provide crucial support and coordination between the various governance centers. Of particular importance is the facilitation of communication and interaction between the various governance centers – with other governance centers and with the main institutions (notably UN-COPUOS). This interaction would determine to a large extent the nature of the entire system of space governance. In a polycentric system, as in all complex system, "[t]he interactions matter more than the nature of the units".[331]

UN-COPUOS, which is already "arguably. . . at a crossroad, looking for its *raison d'etre* in the new Millennium"[332], would need to adopt its functions, *e.g.,* by serving as a forum for multilateral discussions on broad systemic principles that apply across the governance centers and those questions that affect non-users. For example, whereas only few actors will execute space mining, all States, and humankind in general, have legitimate interest in the issue of property rights to space natural resources, and the possible distribution of the benefits therefrom. The interest stems from space being considered by many as 'global

[331] Nassim Nicholas Taleb, 'Complex Systems' (*Nassim Taleb*) <https://nassimtaleb.org/tag/complex-systems/> accessed 8 July 2019.

[332] Tare Brisibe, 'Parliamentary Diplomacy in the United Nations and Progressive Development of Space Law' (2016) 18 European Journal of Law Reform 6.

commons' and its riches to belong to all humankind, and there is a demand for distribution of the benefits from mining space natural resources.[333] In addition, it is suggested that the outcome of the work of the various governance centers would be presented to the full forum of UN-COPUOS. Lyall and Larsen foresaw such a change in the role of UN-COPUOS and noted that "as space law matures and as what is required tends more and more to be private and domestic law solutions for particular problems, it may be that COPUOS will take a back seat, and substantial developments will be found elsewhere"[334]. The roles, procedure, and goals of UN-COPUOS, of course, deserve a separate through discussion.

In short, for space governance to become polycentric, the policy should be to (i) facilitate and encourage the progressive development of (ii) partly overlapping, issue-area-specific governance centers; (iii) established and managed by stakeholders and experts in each sub-issue-area; (iv) introducing various kinds of instruments; and (iv) interconnected and observed by a multilateral coordinating forum exhibiting wide representation of future stakeholders, other indirectly affected actors and global public policy.

The above description of polycentric space governance in practice is one possible way in which the polycentric structure can appear, but not the only way. "There is no one strategy and no one way for building systems of polycentric ordering. We cannot expect such systems either to be constructed or to work in only one way. They have too much

[333] As demonstrated elsewhere, the discourse on this issue is clouded by misconceptions and confusion between legal and economic notions: Eytan Tepper, 'Structuring the Discourse on the Exploitation of Space Resources: Between Economic and Legal Commons' (2018) Space Policy DOI: https://doi.org/10.1016/j.spacepol.2018.06.004.

[334] Francis Lyall and Paul B Larsen, *Space Law, A Treatise* (Ashgate 2009) 22.

spontaneity and creativity to confirm to a single mold."[335] A polycentric structure of space governance may eventually take another form, but with similar basic features.

As the next section demonstrates, space governance is, in fact, already on track to become polycentric.

4.6 Polycentric Space Governance and Space Law

There is no fundamental need to adjust space law in order for polycentric space governance to emerge, as nothing in the current space law prevents the establishment and work of the separate governance centers. There is no urgent need to introduce new treaties or amend existing ones as the suggestions herein include policy goals and design principles, not hard-law rules, and they can – and should – be applied in conformity with the OST. The OST does not provide for a central authority or organization that manages outer space and therefore stakeholders-led governance and a polycentric structure would not violate the treaty but would rather be in line with it. In addition, the rules that would be set by the various governance centers would still all have to be in accordance with the legal norms set out in the OST and elsewhere. The OST remains the normative framework for the space quest.

Moreover, not only does space law allows for polycentric or decentralized space governance, but space law itself can evolve in a decentralized manner. Instruments introduced by issue-area-specific governance centers may later become widely accepted and even legally binding. Even a whole body of law can evolve in a decentralized manner, as Law Merchant (*lex mercatoria*) has shown. In medieval Europe, merchants across

[335] Vincent Ostrom, *The Meaning of American Federalism: Constituting a Self-Governing Society* (Institute for Contemporary Studies 1991) in chapter 9: Polycentricity: The Structural Basis of Self-Governing Systems.

Europe, from different places, cultures and speaking different languages developed customary rules of international trade as a private international legal system. It was an informal body of law with, at least initially, private adjudication and enforcement.[336] This body of law developed key institutions for trade, including negotiable credit instruments, such as promissory notes and bills of exchange, critical to modern trade. Law Merchant well served the needs of trade because it was made by those who best know the needs. This process may be reiterated in the context of commercial space activities.

4.7 The Big Bang of Space Governance

4.7.1 The Big Bang Theory

The Big Bang Theory is the leading explanation of the beginning and evolution of the universe and is a combination of astronomical observations and mathematical models. The theory is the product of the work of numerous scientists, notably Vesto Slipher, Alexander Friedmann, Albert Einstein, Edwin Hubble, Georges Lemaître and George Gamow, Stephen Hawking and Alan Guth. As the theory goes, our universe expanded from a small nucleus or initial singularity, containing all matter, with infinite density and intense heat. Suddenly, around 14 billion years ago, the 'big bang' occurred and this singularity began expanding, and it is expanding ever since, and in an accelerating pace, forming the universe we live in today. From the first moment, the universe contained a vast array of fundamental particles comprising all that currently exists, mixed with light and energy. The tiny particles grouped together, forming atoms that grouped together to form stars and galaxies. Over the course of the evolution of the universe, galaxies group together and crash and stars are being born

[336] Bruce L. Benson, 'The Spontaneous Evolution of Commercial Law' (1989) 55 Southern Economic Journal; Leon E. Trakman, *The Law Merchant: The Evolution of Commercial Law* (FB Rothman 1983).

and die, creating asteroids, comets, planets, and black holes.[337] The Big Bang theory accounts for the expansion of the Universe as an eternal inflation. Stephen Hawking's final theory of the big bang, as published in a paper co-authored with Thomas Hertog and submitted for publication shortly prior to his death, deviates from the eternal inflation convention. Based on 'string theory', Hawking and Hertog predicted that the universe is globally finite and reasonably smooth, significantly simpler than portrayed by the widely accepted theories.[338]

Interestingly, space governance can be described in a similar way to the essence of the big bang theory. The basic particles of space governance, as introduced at the genesis of space exploration, are the nucleus from which space governance has expanded and is still expanding. Unlike the physics big bang, not all the current particles of space governance were contained in this nucleus, and whereas the time-span of the big bang was a fraction of a second, the one of space governance is measured in decades. Nevertheless, space governance is experiencing a big bang, as this section suggests.

4.7.2 The Big Bang of Space Governance

Centralization is an efficient way to establish a new regime. However, a centralized and coherent governance system is often fragile as centralization has its costs and deficiencies which accumulate through time, including rigidness, insufficient adaptation to the interests of various actors and changing realities and free riders. The costs and deficiencies drive even initially centralized and coherent governance systems towards decentralization. The

[337] On the big bang theory see, for example, the popular science book of Nobel Laureate Steven Weinberg (1979, Physics): Steven Weinberg, *The First Three Minutes: A Modern View of The Origin of The Universe* (Updated edition, Basic Books 1993).

[338] Stephen W. Hawking and Thomas Hertog, 'A Smooth Exit from Eternal Inflation?' (2018) Journal of High Energy Physics 2018: 147. https://doi.org/10.1007/JHEP04(2018)147.

evolution of space governance demonstrates this evolutionary pattern. It started as a fairly monocentric system with the establishment of UN-COPUOS and through it introducing comprehensive and universally accepted set of legally binding treaties. However, after the first stage faded in the mid-1970s, the pendulum started to swing towards a more decentralized, and even polycentric, governance structure. This means more forums and instruments, mostly issue-specific, of various types and with various participation, coherence, comprehensiveness, acceptance and legal force. This means that each sub-issue-area may have a difference governance system – with a distinct forum or forums, instruments and level of coherence and implementation. The governance of four sub-issue-areas of space governance demonstrate the overall decentralization, and divergence of the governance systems.

The first is the allocation of slots in orbit around Earth and of radio frequencies. Radio frequencies are used for various purposes on Earth as well as to communicate with and command satellites. This is an issue of critical importance, as the lack of a comprehensive, detailed system that is followed by all actors will lead to disruptions in communication and placement of satellites. Perhaps this is the reason why this issue has the best governance system of all space issues, with a powerful intergovernmental institution, the International Telecommunication Union (ITU) and a multilateral, legally binding, comprehensive and elaborate treaty system, at the top of which is the Constitution and Convention of the ITU[339]. Practically all States are members of the ITU and parties to the treaty systems and follow the rules it provides. Industry representatives also participate in various ITU meetings and

[339] Constitution and Convention of the International Telecommunication Union 1992 (1825, 1826 UNTS).

decision-making processes. It is, indeed, the best regulated issue-area in space activities and an excellent example of a well-functioning issue-area-specific governance center.

In contrast, the case of space natural resources demonstrates weak regulation and forums. The extraction and exploitation of space natural resources, *e.g.,* by mining near Earth asteroids for titanium or the Moon for water and helium 3, has little multilateral regulation. The OST is vague about such operations, no rule was subsequently agreed upon, and even the right to mine is contested.[340] OST Article I provides that "[o]uter space, including the moon and other celestial bodies, shall be free for exploration and use…", and therefore arguably allows mining as "use" of celestial bodies. However, the (intentionally) vague wording left room for debate which started almost immediately after the adoption of the OST. After 30 years of debates, the UNGA adopted a declaration in 1996 [341] that seemingly elaborated on the OST provisions but did not decide or end the debate.[342] The less regulation, the more legal literature there is on the subject.[343] The Leiden Institute of Air and Space Law is leading an independent research group, with membership spanning academe, government and the industry, that is working on voluntary 'building blocks' for

[340] Ram S. Jakhu, Joseph N. Pelton and Yaw Otu Mankata Nyampong, *Space Mining and Its Regulation* (Springer 2017); Ricky Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space* (Springer 2012); Philip De Man, *Exclusive Use in an Inclusive Environment: The Meaning of the Non-Appropriation Principle for Space Resource Exploitation* (Springer 2016).

[341] UN General Assembly Resolution 51/122: 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, adopted 13 December 1996 (A/RES/51/122).

[342] On the 1996 Declaration and the debate leading to it see: Elena Carpanelli and Brendan Cohen, 'A Legal Assessment of the 1996 Declaration on Space Benefits on the Occasion of Its Fifteenth Anniversary' (2012) 38 Journal of Space Law 1.

[343] See, for example: Ram Jakhu, Joseph Pelton and Yaw Otu Mankata Nyampong, *Space Mining and Its Regulation* (Springer 2017); Ricky Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space* (Springer 2012); Philip De Man, *Exclusive Use in an Inclusive Environment: The Meaning of the Non-Appropriation Principle for Space Resource Exploitation* (Springer 2016), Eytan Tepper, 'Structuring the Discourse on the Exploitation of Space Resources: Between Economic and Legal Commons' (2018) Space Policy DOI: https://doi.org/10.1016/j.spacepol.2018.06.004.

the governance of space natural resources[344]. While the multilateral framework for the governance of space natural resources is weak or hardly existent, national action and legislation is taking an important place. The US, Luxembourg and the UAE have launched space mining projects. In 2015 the US adopted a law recognizing the right of US citizens (and companies) to mine space natural resources and their right over the space natural resources they extract.[345] Luxembourg has subsequently introduced a national law that follows the U.S. model[346], and the UAE intends to do the same[347]. It is likely that other States who will venture to mine space natural resources will adopt this model that provides incentives and rewards for those who mine the resources but does not include the distribution of those benefits with States who do not pursue mining. If indeed more States would follow this model, it may lead to the consolidation of a norm. The sub-issue-area of space natural resources is a governance center in evolution. An epistemic community is emerging, as professionals who create and accumulate knowledge on the issue in various disciplines, *e.g.,* engineering, economic, legal, policy. A forum was established, and additional forums may evolve, *e.g.,* a forum for industry standards, hopefully. With time and in the aggregate, the governance of space natural resources will evolve to become more comprehensive and updated.

[344] The Hague International Space Resources Governance Working Group, 'Draft Building Blocks for the Development of an International Framework on Space Resource Activities' <https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/draft-building-blocks.pdf> accessed 22 April 2019.

[345] U.S. Commercial Space Launch Competitiveness Act 2015 (129 STAT. 704).

[346] Law on the Exploration and Use of Space Resources 2017 (Official Gazette of the Grand Duchy of Luxembourg 674).

[347] Jinyuan Su, 'Legality of Unilateral Exploitation of Space Resources under International Law' (2017) 66 International and Comparative Law Quarterly 991.

Between both the above ends of governance centers – a highly developed one and an emerging one – there are other sub-issue-areas which arguably have their own semi-developed governance center. The issue of military uses of outer space has multiple, partial and scattered regulation and *fora*, what may be characterized as a regime complex[348], as elaborated in chapter 6 herein. Most of the rules and fora are not even space-specific. Article III of the OST applied international law to the activities of States in outer space and by that applied public international law's 'laws of war' to human activities in space. The 1963 Partial Test Ban Treaty (PTBT) provides for a ban on nuclear weapons tests in outer space, and the 1977 Environmental Modification Convention (ENMOD)[349] prohibits the hostile use of environmental modification techniques having widespread, long-lasting, or severe effects on the environment, specifically applying to the environment of outer space. In terms of *fora*, the UN's First Committee and Security Council, the CD, UNIDIR and UNIDA all have mandates on this issue. Space specific provisions are included in the OST, e.g., Article IV of which prohibits the placement of weapons of mass destruction in orbit around Earth and the establishment of military bases on celestial bodies. Yet, "[t]he principles of space law and current proposals to address the challenges of space security do not currently provide an effective normative framework to address the initiation and possible conduct of hostilities"[350]. There is an ongoing international project to identify all the rules

[348] See below chapter 6 of the thesis.

[349] Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, concluded May 18, 1977, 31 UST 333, 1108 UNTS 152.

[350] Ram S. Jakhu and Joseph N. Pelton (eds), *Global Space Governance: An International Study* (Springer 2017) 298.

of international law applicable to military uses of outer space and organize them in a single manual (MILAMOS)[351] and an epistemic community is already vibrant.

The issue of space debris is arguably already an established governance center. The Inter-Agency Space Debris Coordination Committee established in 1993 introduced non-legally binding 'guidelines' introduced - the Space Debris Mitigation Guidelines[352] - that were adopted by UN-COPUOS in 2007. Here the forum has no universal participation and instead it is led by the major users or stakeholders. However, as noted before, the quantity of space debris has sky-rocketed after the adoption of the guidelines[353], thus questioning the effectiveness of this governance center to date.

Finally, there is the issue of space traffic control, *i.e.*, preventing collisions between space crafts and between a spacecraft and space debris. It is an issue of growing importance[354] and an emerging – if not an established – governance center. The need for space traffic control was demonstrated by the 2009 collision between a commercial US satellite and a Russian deactivated satellite[355] and the 2013 collision of Ecuador's first satellite with space debris[356]. There are discussions on whether the International Civil Aviation Organization

[351] 'Manual on International Law Applicable to Military Uses of Outer Space' (*Manual on International Law Applicable to Military Uses of Outer Space*) <https://www.mcgill.ca/milamos/> accessed 19 February 2019. It will not introduce new rules but rather identify existing rules in various treaties and other legal instruments. See also the Woomera Manual on the International Law of Military Space Operations <https://law.adelaide.edu.au/woomera> accessed 15 May 2019.

[352] UN Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, Vienna 2010 < http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 11 August 2019.

[353] European Space Agency, 'About Space Debris' (21 February 2018) <http://www.esa.int/Our_Activities/Operations/Space_Debris/About_space_debris> accessed 19 February 2019.

[354] Stuart Eves, *Space Traffic Control* (American Institute of Aeronautics and Astronautics 2017).

[355] Brian Weeden, '2009 Iridium-Cosmos Collision Fact Sheet' (2010) <https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf> accessed 18 February 2019.

[356] Ronnie Nader and Thomas S. Kelso, 'The Pegasus Incident: The Loss of the First Ecuadorian Satellite

(ICAO) should have mandate on the issue, and the ICAO has already started working towards such direction[357]. However, it is the US that leads the efforts of avoiding collision with space debris. The US manages a space situational awareness (SSA) system that tracks all objects larger than a softball and alerts all actors in space for possible collisions. The issue of space traffic control demonstrates that a single user can dominate a governance center, or part thereof. In this case, the US dominance stems from the fact that it is the sole provider of SSA information. The US is gathering and disseminating the information and therefore determines the standards for SSA. The European Space Agency (ESA) is working on its own SSA system, and when it become functional, that might require change in the governance of the issue. In June 2018 the US President signed Space Policy Directive-3 adopting a National Space Traffic Management Policy ("National STM Policy," 2018) that will determine the character of space traffic control at least as much, if not more, than any multilateral forum and instrument.

As demonstrated above, while some sub-issue-areas have multilateral arrangements, universal or stakeholders-led, others are regulated in part by national action and legislation. Some issue-areas exhibit a well-developed and effective governance and others emerging governance centers with various degrees of development and effectiveness. This course of action allows a break from the long gridlock and update the governance of each sub-issue-area, and thus of space governance in general, and in the long run it would keep space governance updated and flexible to adapt to the many changes we expect to see further. The governance of each sub-issue-area would evolve at a different pace according

and Its Recovery', Proceedings of the 65th International Astronautical Congress 2014 (Toronto, Canada, 29 September - 3 October 2014 (Curran 2014).

[357] 'ICAO Space Programme' <https://www.icao.int/airnavigation/AeroSPACE-Transport/Pages/default.aspx> accessed 18 February 2019.

to the degree of urgency, type of challenges and agreement between the actors. The governance of each issue would evolve by different forums with different actors, introducing – and possibly monitoring the application of - various instruments.

The main building blocks of space governance are, still today, UN-COPUOS and the four space treaties presented above. Yet, space governance is no longer developed by a single forum – UN-COPUOS - introducing comprehensive, multilateral and legally binding treaties. With the cessation of the rulemaking capability of UN-COPUOS, the 21st century sees a gradual yet steady emergence of smaller, issue-area-specific forums, often led by experts and stakeholders, introducing various types of instruments – 'guidelines', 'building blocks', 'manual', etc. As partial and scattered as they are, they update and spread the coverage of space governance, and with more efforts directed to developing governance in this way, instead of via UN-COPUOS, we can expect greater success at filling the gaps. Thus, the initial monocentric, hierarchic structure of space governance is experiencing a slow-motion big bang, by which the basic building blocks are still the early ones introduced at the very beginning, but subsequent expansion and evolution of space governance is decentralized throughthe work of various governance centers, with various participants introducing various outputs in distinct sub-issue-areas. Considering the inevitable decentralization, we can expect the continuation – and possible acceleration – of the emergence of issue-specific governance centers and new regimes. Nevertheless, UN-COPUOS is still the most important forum, and the UNOOSA the most important agency. UNOOSA already works and assists all actors in space governance and therefore serves in practice as coordinator, bringing the accumulated knowledge and practices to each new actor. Space governance is thus becoming decentralized and eclectic, with various sub-issue-areas exhibiting varying types

of governance mechanisms with varying level of elaboration, coherence and legal authority. This bottom-up evolution of a polycentric governance system is a kind of 'spontaneous order', the emergence of order as a result of the voluntary activities of individual actors with no single guiding hand.[358]

4.7.3 Analytical Significance and Policy Recommendations

If space governance is already on track to become polycentric, then what is the need for this thesis? The answer is in terms of both analytical significance and policy recommendations.

Analytical significance: the analytical significance of this thesis lies in the need to recognize and understand current processes. The thesis innovates, *inter alia*, by analyzing space governance as a system in transition from a monocentric system to a polycentric one, and by applying the political economy and CPR literatures to space governance. By that, this thesis provides the analytical tools for understanding and constructing, to the extent planning is feasible, space governance and the governance of sub-issue-areas in space activities.

Moreover, polycentric systems are complex systems and 'complexity studies' demonstrate the importance – and even necessity - of analyzing complex systems as such. A 'complex system' is a system with a large number of different elements capable of interacting with each other and with their environment, yet characterized by non-linearity in the relations

[358] Friedrich A. Hayek, 'The Use of Knowledge in Society' (1945) 35 The American Economic Review 519; Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (London, W. Strahan and T. Cadell 1776).

among the elements.[359] Typically, complex systems are composed of self-organizing elements. They cannot be controlled or directed centrally, and their problems cannot be solved centrally.[360] As Taleb noted, "[t]he main idea behind complex systems is that the ensemble behaves in ways not predicted by the components. The interactions matter more than the nature of the units. Studying individual ants will *never* . . .give us an idea on how the ant colony operates"[361]. Therefore, only thinking and analyzing a complex system as such, enables proper understanding of the whole as well as its parts. Similarly, only thinking of space governance as a system in transition to a complex system of polycentric governance would enable proper understanding of space governance, in general, and the governance of each sub-issue-area, in particular.

Policy recommendations: despite space governance already being on track to become polycentric, action is needed in order to further this course and the success of the various governance centers. "Polycentric orders are open systems that manifest enough spontaneity to be self-organizing and self-government. But the maintenance of such orders depends upon a sufficient level of intelligent deliberation to correct errors and reform themselves."[362] Deliberate action is therefore also needed to correct errors or fill-in the gaps, just as a free economy needs the occasional government intervention, *e.g.,* in cases of market failure.

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[359] On complexity theory see L.A.N Amaral and J.M. Ottino, 'Complex Networks: Augmenting the Framework for the Study of Complex Systems' (2004) 38 The European Physical Journal B 147; on complexity theory and its use for the study of governance see Göktu˘ g Morçöl, 'Complex Governance Networks: An Assessment' (2014) 1 Complexity, Governance & Networks 5.

[360] Göktu˘g Morçöl, 'Complex Governance Networks: An Assessment of the Advances and Prospects' (2014) Complexity, Governance & Networks 5.

[361] Nassim Nicholas Taleb, 'Complex Systems' (*Nassim Taleb*) <https://nassimtaleb.org/tag/complex-systems/> accessed 8 July 2019.

[362] Vincent Ostrom, *The Meaning of American Federalism: Constituting a Self-Governing Society* (Institute for Contemporary Studies 1991) in chapter 9: Polycentricity: The Structural Basis of Self-Governing Systems, p. 223-44.

Furthermore, in order to facilitate and expand polycentric space governance, this thesis calls for embracing the polycentric model, diverting governance-building efforts to governance centers and to assist and recognize the work of these centers. UNOOSA may be expanded to be able to provide support for the various governance centers, and participate in their work.

This thesis could neither encompass all specific issues, nor the various mechanisms for the practical implementation of the recommendations. Further research is needed on these important issues, and the analysis of the system and components of space governance, one in transition to polycentric governance, and provides the foundations for such further research. The thesis further discusses the ramifications and advantages of polycentric governance and the ways to maximize the advantages and mitigate the adverse effects (presented in section 4.8 below). By this the thesis provides further direction and caveat for further research.

Moreover, this thesis calls to consider the establishment of a forum of industry stakeholders and experts to create and adopt standards for space activities. These standards may include technical standards in the tradition of the VCSS, notably ISO, and could include social-sciences type standards (*e.g.,* behavioral or legal standards). If the ITU, ICAO, and INTELSAT led institutional innovation in global governance, a new forum or organization along the above lines may provide yet another round of institutional innovation in global governance. It could be established and led by industry stakeholders and experts from around the globe, supported financially by NGOs and research grants, and

with limited governmental interference. It could thus focus on standardization of space activities to facilitate technological and commercial innovation, and expansion.

4.7.4 The Particles of Space Governance

The building blocks of space governance, *i.e.*, the main factors that guide the behavior of actors in the realm of space, may be divided to rules and fora, broadly defined to include norms and principles (as types of rules) and institutions (as a type of forum). The major building blocks of space governance are the four widely accepted space law treaties[363], UN-COPUOS including its sub-committees and working groups and UNOOSA. The next two paragraphs provide a more elaborate - though not necessarily exhaustive – taxonomy of the building blocks of global space governance.

In terms of rules, broadly defined, there are various instruments with varying degrees of legal authority, including legally binding treaties and soft law instruments. These are: the five major UNGA declarations,[364] the rules set in the five space law treaties (with a caveat that the Moon Agreement does not present widely accepted norms); other relevant treaties

[363] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 18 UST 2410, 610 UNTS 205, 6 ILM 386 (1967); Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 19 UST 7570; 672 UNTS 119; 7 ILM 149 (1968); Convention on International Liability for Damage Caused by Space Objects, 961 UNTS 187; 24 UST 2389; 10 ILM 965 (1971); and Convention on Registration of Objects Launched into Outer Space, 1023 UNTS 15; 28 UST 695; 14 ILM 43 (1975).

[364] UN General Assembly Resolution 1962 (XVIII): Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, adopted 13 December 1963; UN General Assembly Resolution 37/92: Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting, adopted 10 December 1982 (A/RES/37/92); UN General Assembly Resolution 41/65: Principles Relating to Remote Sensing of the Earth from Outer Space, adopted 3 December 1986 (A/RES/41/65); UN General Assembly Resolution 47/68: Principles Relevant to the Use of Nuclear Power Sources in Outer Space, adopted 14 December 1992 (A/RES/47/68); UN General Assembly Resolution 51/122: 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 adopted 13 December 1996 (A/RES/51/122). A list of declarations and their full version is available online at <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html> accessed 16 January 2017.

and conventions[365], the 2007 Space Debris Mitigation Guidelines[366] and, to a lesser extent, the many UNGA resolutions on space.

In terms of *fora*, broadly defined, there are numerous institutions, NGOs, research institutes and other *fora* which deal exclusively or otherwise with space issues, and which affect the behavior of actors in space activities, and thus take part in steering space activities. These include: multilateral and regional forums - COPUOS, UNOOSA, UN-SPIDER[367], UNRCSSTE[368], GEO[369], IDAC[370], ICG[371] and APSCO[372]; NGOs such as the Secure World Foundation[373]; the institutes of (air and) space law in several universities across the world (Cologne, McGill, Leiden, Beijing Institute of Technology, Harbin Institute of Technology), the European Space Policy Institute (ESPI)[374], and the European Centre for Space Law (ECSL)[375]. The space community in general, and the space policy and law community in particular, is an epistemic community – "a network of professionals with recognized expertise and

[365] Notably the 1963 Nuclear Test Ban Treaty (Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and under Water, 480 UNTS 43, 14 UST 1313, 2 ILM 889 (1963)) and UNIDROIT's 2006 Cape Town Convention (The Cape Town Convention on International Interests in Mobile Equipment, 2307 U.N.T.S. 285; UN Doc. No. A/AC.105/C.2/2002/CRP.3 (2001)) together with the 2012 Space Assets Protocol (Protocol to the Convention on International Interests in Mobile Equipment on Matters specific to Space Assets, 2307 U.N.T.S. 285 (2012)).

[366] UN Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, Vienna 2010 < http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 11 August 2019.. On the space-related soft law instruments see: UN Office for Outer Space Affairs, Compendium on Mechanisms Adopted in Relation to Non-Legally Binding United Nations Instruments on Outer Space <http://www.unoosa.org/oosa/en/ourwork/spacelaw/nlbcompendium.html> accessed 12 August 2019.

[367] The United Nations Platform for Space-based Information for Disaster Management and Emergency Response <http://www.un-spider.org>.

[368] Regional Centers for Space Science and Technology Education (UNRCSSTE), established under a UN initiative. See UN General Assembly Resolution 45/72: International co-operation in the peaceful uses of outer space, adopted 11 December 1990 (A/RES/45/72).

[369] The intergovernmental Group on Earth Observations <https://www.earthobservations.org>.

[370] The Inter-Agency Space Debris Coordination Committee <http://www.iadc-online.org>.

[371] The International Committee on Global Navigation Satellite Systems <http://www.unoosa.org/oosa/SAP/gnss/icg.html>.

[372] The Asia-Pacific Space Cooperation Organization <http://www.apsco.int>.

[373] <https://swfound.org>.

[374] >http://www.espi.or.at>.

[375] >http://www.esa.int/About_Us/ECSL_European_Centre_for_Space_Law>.

authoritative claims to policy-relevant knowledge in a particular issue area"[376] which, like many epistemic communities, is international in its membership.[377] There are also the various working groups established by UN-COPUOS, the Hague working group on space natural resources, the group that drafted the international study on global space governance[378], the group working on the MILAMOS and other working groups may also exist or will be established. There are also numerous NGOs that create and disseminate knowledge and suggest rules or standards, *e.g.,* the Secure World Foundation (SWF) and the International Association for the Advancement of Space Safety (IAASS). Not all of these forums are decision-making centers, but they each influence space governance to a certain extent.[379]

There are governance centers that are not focused on space issues but nevertheless discuss and have impact on space issues, *e.g.,* the International Atomic Energy Agency which, together with UN-COUOS Scientific and Technical Subcommittee, introduced in 2009 the "Safety Framework for Nuclear Power Source Applications in Outer Space"[380].

There are therefore many space related *fora*, some of which may be referred to as governance centers. While UN-COPUOS is the most important forum, there is no hierarchy

[376] Anne L. Clunan, 'Epistemic Community' (*Encyclopedia Britannica*) <https://www.britannica.com/topic/epistemic-community> accessed 22 April 2019.

[377] John Gerard Ruggie, 'International Responses to Technology' (1975) 29 International Organization 569. On epistemic communities see, for example, Peter M. Haas, 'Introduction: Epistemic Communities and International Policy Coordination' (1992) 46 International Organization 1; and Mai'a K. Davis Cross, 'Rethinking Epistemic Communities Twenty Years Later' (2013) 39 Review of International Studies 137.

[378] Ram S. Jakhu and Joseph N. Pelton (eds), *Global Space Governance: An International Study* (Springer 2017).

[379] For further review of the actors in space governance see Jakhu and Pelton (ibid) in particular in chapters 2 and at the tables at the end of other chapters, listing relevant actors.

[380] UN Committee on the Peaceful Uses of Outer Space, Scientific and Technical Subcommittee, and the International Atomic Energy Agency, *Safety Framework for Nuclear Power Source Applications in Outer Space* (2009) <https://fas.org/nuke/space/iaea-space.pdf> accessed 12 August 2019.

between the various governance centers. Nevertheless, they are not at par with each other. The various governance centers are neither of equal legal status nor of equal power or influence. They diverge from formal institutions to voluntary groupings and epistemic communities and they diverge in the degree of their influence on actors' behavior. In other words, instead of hierarchy there is heterarchy, where no one governance center dominates the rest, and authority is distributed, bringing about a flexible network of interdependent and interacting governance centers.[381] Space governance, as presented herein, is dispersed to numerous, independent or semi-independent governance centers operating in heterarchy.

4.8 Maximizing the Advantages and Mitigating the Adverse Effects of Polycentric Governance

Polycentric governance has advantages as well as adverse effects and some polycentric systems perform better than the others. Therefore, a mere call for a polycentric model is not enough, and this section offers some ways to maximize the advantages and mitigate the adverse effects of polycentric governance, though this is by no means an exhaustive list of either. Ostrom's design principles may help maximize the advantages of polycentric governance, whereas 'institutional deference' and 'global administrative law' can mitigate its adverse effects.

4.8.1 Ostrom's Design Principles for Robust Governance Systems

Regime theorists offer some criteria for assessing whether decentralized regime complexes are actually superior to integrated institutions[382] but it is Elinor Ostrom that provides more

[381] For a definition of 'heterarchy' see: Satoshi Miura, 'Heterarchy' (*Encyclopedia Britannica*) <https://www.britannica.com/topic/heterarchy> accessed 22 April 2019.

[382] Robert O. Keohane and David G. Victor, 'The Regime Complex for Climate Change' (2011) 9

concrete design principles, which correlate with successful governance systems and can therefore predict to a certain extent the success of a governance model.[383] Analyzing the vast database of case studies from around the world, Ostrom found regularities that correlate to and predict long-term success of a governance system, what she refers to as 'design principles'. "The design principles appear to synthesize core factors that affect the probability of long-term survival of an institution developed by the users of a resource".[384] While some of the design principles are well known, others are new and even surprising and "[e]ven though these design principles do not provide an easy solution to the often complex policy problems involved, in cases where they are all heeded, [as Ostrom noted,] 'collective action and monitoring problems tend to be solved in a reinforcing manner'."[385] While they are based on local commons, they seem to apply to global commons[386] and to human cooperation more generally[387]. Chapter 3 presented the eight design principles, and this section reiterates them with the addition of how they may be applied to space governance or to space governance centers:[388]

Perspectives on Politics 7.

[383] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press 1990); and Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review 1.

[384] Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review 1, 13.

[385] Nobel Committee, 'Report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October 2009) <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014.

[386] Thomas Dietz, Elinor Ostrom and Paul C. Stern, 'The Struggle to Govern the Commons' (2003) 302(5652) Science 1907; Robert O. Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (Sage Publications 1995).

[387] Nobel Committee, 'Report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance' (12 October 2009) <http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html> accessed 15 January 2014.

[388] The design principles are taken from Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 American Economic Review 1.

(i) User Boundaries and Resource Boundaries: Rules clearly define who has what entitlement: boundaries between legitimate users and nonusers and boundaries of the CPR.

Possible application to space governance: there should be a clear definition or delineation of the sub-issue-areas and of each user's entitlements. Separate sub-issue-areas should be recognized, notably the geostationary orbit, the moon, mars, asteroids, the ISS, military uses of space, utilization of space natural resources, space traffic control and space debris. All States may explore and use outer space and can be active in each sub-issue-area, and so do non-State actors (individuals, firms etc.), subject to applicable national regulation. The users/ stakeholders of each sub-issue-area should be clearly identified, and the nature and scope of their activities should be clear.

(ii) Users' rights and responsibilities stand in reasonable proportion to their benefits and local conditions, *i.e.*, "[a]ppropriation and provision rules are congruent with local social and environmental conditions. . . and [a]ppropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits."[389]

Possible application to space governance: responsibilities of users will be proportional to their use and benefit, and it will come to effect also in the governance centers. Rules on the appropriation and provision of space natural

[389] Ibid.

resources should be congruent with local conditions and ensure sustainable use. There will be linkage between benefits and bearing of costs.

(iii) Most of those affected by a resource regime are authorized to participate in making and modifying the rules of the regime.

Possible application to space governance: Most/all of the actual users/stakeholders in each sub-issue-area (geostationary orbit, moon etc.) will participate in the rulemaking, *i.e,*. in the governance center. A forum of the users/stakeholders will be the managing forum. Each sub-issue-area will have its own users and hence its own users'/ stakeholders' forum.

It is important to note that the users/stakeholders'-led governance is for rules of operation, not distribution. The users/stakeholders will manage as they are those who have the knowledge and need to make the rules. The distribution issue is separate, and discourse on it will involve all those with a claim, that is, all States.

(iv) Monitoring and sanctioning are carried out either by the users themselves or by someone who is accountable to the users.

Possible application to space governance: monitoring and sanctioning would be carried out within the governance center and/or by the users/stakeholders of a sub-issue-area. In any case, non-users, have no control or way to supervise. For example, those who engage in military uses of space will monitor the compliance of others to the rules on military uses of space.

(v) Sanctions for rule violations are graduated: they start very low but become stronger if a user repeatedly violates a rule.

Possible application to space governance: Users/ stakeholders will be advised to adopt a graduated sanctions regime.

(vi) Rapid, low cost, local dispute resolution mechanisms are in place to resolve conflicts among users or with officials.

Possible application to space governance: Users/ stakeholders will be advised to establish a conflict resolution mechanism that will have the above characteristics.

(vii) Minimal Recognition of Rights: The rights of local users to make their own rules are recognized by the government (an outside authority).

Possible application to space governance: the right of users to self-organize is clearly recognized by outside authorities (in this case there are no outside authorities, due to the anarchy in international relations, but a recognition by UN-COPUOS would be productive). A wide recognition of the right of users / stakeholders of the various sub-issue-areas to self-organize and manage the sub-issue-areas.

(viii) Nested Enterprises: When a CPR resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.

Possible application to space governance: the governance center is nested within the larger governance system (in this case, space governance and its main institution, UN-COPUOS). Space governance will be organized in multiple nested

layers. The basic layer is the various governance centers of the various sub-issue-areas. The various governance centers may constitute an interdependent system of relations, a web or even have a central coordinating body. Such a body may include all interested States and other potential users. UN-COPUOS can serve as the coordinating body. The polycentric system, therefore, includes two levels: the level of the issue-area-specific governance centers, led by the users/ stakeholders; and the higher-level, that of a web of governance centers and/or the coordinating forum.

Thus, the suggested polycentric governance system can accommodate current international organizations as important nested layers in the overall governance system.

The coordinating forum can promote the interaction between the various governance centers, and direct the system as a whole, while the various governance centers remain independent, notwithstanding their obligation to comply with the OST.

The last two design principles constitute the polycentric governance system and are together the most important lessons from Ostrom's study to space governance: Users/ stakeholders-led governance system with multiple nested layers.

Elinor Ostrom's 'design principles' for robust governance systems should be taken into consideration in the development or expansion of space governance. Naturally, these principles need to be adjusted to the context (and the above is only a general and initial suggestion of application and adjustment) and perhaps not all can be fully applied, but each governance center should strive to meet them to the degree possible and considering

specific conditions of the issue and governance center, and so do the other layers of the polycentric governance system.

4.8.2 Institutional Deference

Partial overlap is integral to polycentric governance, as it is to regime complexes and fragmentation. International *fora* and organizations partially overlap in their jurisdiction. This is particularly the case where there are several *fora* on a single issue-area. Overlap can exist between the respective jurisdictions of multilateral and regional forums, of intergovernmental forums with industry forums and so forth. In addition, the various instruments introduced by various governance centers may partially overlap and occasionally conflict. While this may be a price worth paying, as suggested above, in view of the benefits of decentralized governance, the potential conflict between overlapping *fora* and instruments can be mitigated.

Pratt conceptualized the practice of 'institutional deference', where one international organization accepts another international organization's exercise of authority on specific issues and by that mitigate rule conflict and facilitate a division of labor within a regime complex.[390] This is a form of inter-institutional coordination that can be practiced also in the case of space governance, and UNOOSA, that already promotes inter-institutional cooperation, can facilitate also this type of coordination.

Analyzing an original data set of over 2,000 policy documents of international organizations, Pratt found evidence that institutional deference is "a strategic act that is shaped both by efficiency concerns and power politics" and that it is associated with

[390] Tyler Pratt, 'Deference and Hierarchy in International Regime Complexes' (2018) 72 International Organization 561.

division of labor, as "[international organizations] that defer to each other are more likely to focus their rule-making efforts on separate sub-issues"[391]. Pratt also demonstrated that deference is used to efficiently pool resources among disparate organizations.

There are several practices that can be regarded as institutional deference. An institution or other forum may adopt a set of rules established by a different institution as is, or it may alter its own conduct and operations so to confirm to such a set of rules.

Deference is a tool to manage jurisdictional overlap and inconsistencies in international rules. If various governance centers practice institutional deference, it will further alleviate the adverse effects of decentralized governance, as it will reduce redundancy and inconsistency by reducing the scope of conflicting rules and jurisdictions. Furthermore, by its association with division of labor, institutional deference supports polycentric governance, as the point of the governance centers is to focus their rulemaking and possibly monitoring efforts on separate sub-issue-areas. Intergovernmental organizations can adopt industry standards and multilateral forums such as UN-COPUOS can adopt a set of rules introduced by another forum, as it did in the case of the Space Debris Mitigation Guidelines[392].

4.8.3 Standards for Decentralized Governance

Polycentric governance provides a feasible way to develop space governance and can prove to be efficient, as it is built in large part on the key role of stakeholders. At the same time, it

[391] Ibid.

[392] UN Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, Vienna 2010 < http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 11 August 2019.

raises concerns of democratic deficit[393] and regulatory oversight deficit[394]. Specifically, it raises questions of participation, accountability and there are concerns over imbalance of power between the various actors – States and non-States alike, and preservation of the dominance of powerful States.

The work of Kingsbury, Stewart, Krisch and others on 'global administrative law' (GAL)[395] and Benvenisti's work on the 'law of global governance'[396] provide modern standards for global administration that may be applied in and across the various governance centers and thus mitigate the above concerns. GAL provides accountability of global administrative bodies and ensures they meet "adequate standards of transparency, participation, reasoned decision, and legality".[397] Benvenisti uses a different terminology, but in his discussion on the law of global governance he reaches similar conclusions: he suggests that global governance bodies should be subjected to procedural and substantive legal constraints, similar to those imposed by domestic administrative laws. Benvenisti further suggests that there is an emerging web of such global norms, and that they promote the legitimacy of the global bodies.

While polycentric governance may evolve spontaneously – as it arguably already evolving in the case of space governance - GAL and/or the law of global governance may provide the

[393] Eyal Benvenisti and George W. Downs, 'The Empire's New Clothes: Political Economy and the Fragmentation of International Law' (2007) 60 Stanford Law Review 595.

[394] Eyal Benvenisti and George W. Downs, 'National Courts and Transnational Private Regulation' in Fabrizio Cafaggi (ed), *Enforcement of Transnational Regulation: Ensuring Compliance in a Global World* (Edward Elgar 2014).

[395] Benedict Kingsbury, Nico Krisch and Richard B. Stewart, 'The Emergence of Global Administrative Law' (2005) 68 Law and Contemporary Problems 15; Benedict Kingsbury, 'The Concept of "Law" in Global Administrative Law' (2009) 20 European Journal of International Law 23.

[396] Eyal Benvenisti, *The Law of Global Governance* (Hague Academy of International Law 2014).

[397] Benedict Kingsbury, Nico Krisch and Richard B Stewart, 'The Emergence of Global Administrative Law' (2005) 68 Law and Contemporary Problems 15, 17.

tools to ensure space governance meets adequate standards, inter alia in terms of participation and accountability. This, however, requires further and separate study as this thesis does not examine the potential to apply GAL and/or the law of global governance to polycentric governance in general and to space governance in particular and the expected results from such an application.

4.9 New Space driving governance reform

As reviewed above, new technologies that were catalyzers for advancement in global governance, are space-related technologies – radio and satellite communication. Both ITU and INTELSAT were revolutionary organizations, ITU being the first public international union and INTELSAT being the first 'internationalized' public service corporation, exhibiting close ties between business and government. Civil aviation also introduced new types of organizations to global governance, with International Air Transport Association (IATA), established in 1919 as an association of airlines and ICAO, established in 1944, as the first international organization of the postwar UN system. We are in the midst of the age of New Space, which presents a revolution in terms of actors – where the commercial sector is gradually taking the lead – and in new technologies being developed (*e.g.,* reusable launch vehicles, sub-orbital flights and technologies for mining space natural resources). An industrial revolution in the space industry is likely to have ramifications far beyond the sector. As reviewed above, there was a direct link between the industrial revolutions to the evolution and subsequent milestones in global governance. It therefore stands to reason that another industrial revolution will be directly linked to a(n) (r)evolution of global governance – an evolution in global governance will be needed to facilitate such an

industrial revolution, and the revolution will bring about further changes to global governance.

4.10 Conclusions

In the second era of space quest, the era of New Space, and on the verge of expanding human boundaries by commercial spaceflights and extra-terrestrial habitats, adequate governance should be in place to facilitate technological and commercial development and the flow of economic and social benefits thereof for humankind. In a decentralized international system, a simple model will not do. Old problems and new challenges can and should be met by solutions based on the theoretical and empirical work done in the last four decades in the fields of Institutional Analysis, Regime Theory and Global Governance, and more recent synthesis of them. Like previous industrial revolutions, New Space may spur reforms or evolution in global governance.

It is not sustainable to maintain a monocentric system of (space) governance within the decentralized system of (global) governance. Space governance is on track to become polycentric, and we should embrace and facilitate this transition. This chapter suggests that a polycentric system of governance that will produce better results and enable continuous evolution of space governance so it would meet the ever-changing challenges and opportunities of space exploration and exploitation. A set of independent governance centers, loosely interconnected, is feasible and even more efficient than centralized governance or a single comprehensive regime. There are also ways to maximize the advantages of polycentric governance and to mitigate its adverse effects.

Polycentric space governance means, in practice, that each sub-issue-area, *e.g.,* space natural resources, militarization, space traffic control, will have a separate issue-area-specific forum(s) (governance center or even centers), led by stakeholders and experts with the active participation of UNOOSA. Each governance center will introduce and modify rules and possibly monitor their application. These governance centers will be led by stakeholders and experts that are best suited, in terms of knowledge and incentives, to introduce governance mechanisms, with participation and assistance of UNOOSA. The basis of space governance – the space law treaties and UN organs - will remain, and the governance centers will be an additional layer that promotes space governance. This is expected to result in a break from the gridlock and the introduction of rules that are better suited to the circumstances and more likely to be followed, than rules imposed from the top. Space governance will be the sum of the diverse governance centers and interactions in and between them and with the UN organs. In fact, space governance is already on track to become polycentric, as stakeholders and experts establish forums that suggest, adopt or push for rules and standards, but further action and (re)cognition is needed. In terms of policy recommendations, it means embracing polycentric governance, facilitating the introduction of governance centers and acknowledging their importance and their output. It further means diverting more governance-building efforts in this direction, while mitigating its adverse effects.

Polycentric governance will allow decentralized, incremental evolution of space governance. The governance of each sub-issue-area will evolve at a different pace according to the degree of urgency, type of challenges and agreement between the actors. It will allow the establishment of partial regimes, where an attempt for a comprehensive

regime fails; and it will permit cooperation among actors in some areas at the same time that they have disagreements in others. The governance of each sub-issue-area will evolve by different forums with different participants, and by the introduction of various instruments, legally-binding or not, multilateral or national, or industry standards and best practices. The aggregate of all these instruments and forums will be a more comprehensive, flexible, and updated governance than a monocentric system of global governance could yield. These characteristics are particularly important in issue-areas with high uncertainty or fast or frequent changes emanating from technological development and changes in global geopolitics, and space activities are such an issue-area. The merits of polycentric governance are not limited to space activities and the conclusions herein may suit other issue-areas in global affairs and global affairs in general.

Chapter 5
The Governance of the Space Commons

This chapter discusses the legal and governance aspects of the new “gold rush” - the race to mine the vast richness of space. The chapter critically analyzes the renewed debate on space being ‘global commons’, held in the context of the utilization of space natural resources, and suggests that the debate is flawed by misunderstanding and use of the concepts of commons and global commons. The chapter provides a critical analysis of the ‘commons’ feature of outer space and space natural resources, based on economic analysis and legal theory. The chapter notably differentiates between (i) commons as an economic term; and (ii) commons as a legal regime. The chapter further demonstrates that the concept of 'global commons' is of limited or unclear meaning, and it does not imply the property rights regimes in the domains and resources it presumably describes, including outer space. Finally, it discusses the architecture and place of the governance of space natural resources within a polycentric system of space governance.

* This chapter is based on an article the author published in Space Policy journal[398] with the permission of the Thesis Advisory Committee.

[398] Eytan Tepper, ‘Structuring the Discourse on the Exploitation of Space Resources: Between Economic and Legal Commons’ (2018) Space Policy (DOI: https://doi.org/10.1016/j.spacepol.2018.06.004).

5.1 The New "Gold Rush"

We are witnessing the beginning of a new "gold rush", this time for the riches of space - to extract and exploit space natural resources – minerals, metals (*e.g.,* platinum), helium 3 and water. The potential gains are huge. Goldman Sachs presented to its clients a detailed review which asserts that space mining could be more realistic than perceived. The review asserts that the costs have significantly decreased, bringing them nearly in line with costs of mining on earth and just a third of the funds invested in Uber, well within the reach of the Venture Capital funds. The review further asserts that the potential profit from space mining is immense as just one asteroid might contain US$ 50 billion worth of platinum.[399] To be sure, there are significant technical challenges that are still being figured out, but the knowledge is accumulating. Several companies have already engaged in R&D[400] on the topic; it is discussed in many conferences, and in 2018, the Colorado school of mines launched a new program dedicated to the mining of space natural resources[401]. Several projects for mining space natural resources were launched in the past decade by the private sector, with or without the support of a State. Planetary Resources and Deep Space Industries, both American companies focused on mining space natural resources, where pioneers in both conducting R&D on the space mining and raising awareness for the possibility and prospects of space mining. However, as it often happens when new technologies are involved, both companies encountered financial difficulties, the first was acquired by ConsenSys and the second was acquired by Bradford Space. Moon Express has

[399] Jim Edwards, 'Goldman Sachs: Space-Mining for Platinum Is More Realistic than Perceived' *Business Insider* (6 April 2017) <https://www.businessinsider.com/goldman-sachs-space-mining-asteroid-platinum-2017-4> accessed 20 April 2017.

[400] Notably Planetary Resources and Deep Space Industries.

[401] 'Space Resources Program - Colorado School of Mines' <https://space.mines.edu/> accessed 7 July 2019.

also declared intentions to pursue space mining .[402] In Japan, JAXA, Japan's space agency, signed a memorandum of understanding with a private company, Tokyo-based iSpace Inc., to establish infrastructure for the mining, transportation, and use of resources on the moon.[403] Luxembourg has also joined the race, aiming no less than to lead Europe in the space-mining sector. Already home to one of the world's largest operators of communication satellites SES S.A. (Société Européenne des Satellites), Luxembourg has set aside €200 million for space mining operations[404] and partnered with Deep Space Industries and Planetary Resources[405]. The UAE declared intention to pursue space mining[406] and China has also joined the race[407].

There are significant technological challenges ahead, and at this stage it is by no means commercially viable, but the huge potential ensures that the efforts to mine space natural

[402] Lori Ioannou, 'Billionaire Closer to Mining the Moon for Trillions of Dollars in Riches; (*CNBC*, 31 January 2017) <www.cnbc.com/2017/01/31/billionaire-closer-to-mining-moon-for-trillions-of-dollars-in-riches.html> accessed 20 April 2017.

[403] Eleanor Warnock, 'Japan Joins Race for Space Resources' (*Wall Street Journal*, 16 December 2016) <www.wsj.com/articles/japan-joins-race-for-space-resources-1481874269> accessed 20 April 2017.

[404] Robert-Jan Bartunek, 'Luxembourg sets aside 200 million euros to fund space mining ventures' (*Reuters*, 3 June 2016) <www.reuters.com/article/us-luxembourg-space-mining-idUSKCN0YP22H> accessed 17 March 2017.

[405] 'Prospector-X: An International Mission to Test Technologies for Asteroid Mining' (Deep Space Industries) <https://deepspaceindustries.com/prospector-x-an-international-mission-to-test-technologies-for-asteroid-mining/> accessed 17 March 2017; 'Planetary Resources and The Government of Luxembourg Partner to Advance the Space Resource Industry' (Planetary Resources, 13 June 2016) <www.planetaryresources.com/2016/06/planetary-resources-and-the-government-of-luxembourg-partner-to-advance-the-space-resource-industry/> accessed 17 March 2017.

[406] Mohamed Al Ahbabi, 'The UAE Space Program, presentation at the Second ICAO/UNOOSA Symposium, Montreal, March 15–17, 2016' <www.icao.int/Meetings/SPACE2016/Presentations/1e%20-%20M.%20AlAhbabi%20-%20Welcome%20Remarks%20-%20UAE%20Space%20Agency.pdf> accessed 17 March 2017. Lucy Barnard, 'UAE to Finalise Space Laws Soon' (*The National* 7 March 2016) <www.thenational.ae/business/aviation/uae-to-finalise-space-laws-soon> accessed 27 June 2017.

[407] Namrata Goswami, 'China's Get-Rich Space Program' (*The Diplomat*, 29 February 2019) <https://thediplomat.com/2019/02/chinas-get-rich-space-program/> accessed 7 July 2019; 'China's Nuclear Spaceships Will "Mine Asteroids, Fly Tourists" by 2040' (*South China Morning Post*, 17 November 2017) <https://www.scmp.com/news/china/policies-politics/article/2120425/chinas-nuclear-spaceships-will-be-mining-asteroids> accessed 7 July 2019.

resources will continue. The US won the race to the moon; who will win the race for space mining? Who will be the first to tap into the vast riches of space?

The new gold rush for the exploitation of space natural resources has relaunched the debate on the legal basis for such exploitation, notably with regards to issues of property rights and how to distribute the benefits from space which is widely - but not necessarily duly - considered as global commons. This chapter aims to restructure the discourse on the governance of space natural resources by analyzing the basic concepts and how they may be applied.

5.2 The (Re)Emergence of a Discourse

A critical discussion is (re)emerging in space policy, economics and law: on the classification, use and possible ownership of space natural resources, and the governance of these activities in terms of rules and institutions. A related, if not integrated, discourse is on the distribution of the benefits from space in general, and from space natural resources in particular.

The issue is not new. The 1979 Moon Agreement specifically addressed space natural resources and provided a framework for the regulation of the issue. The Moon Agreement entered into force, but only 18 States ratified it, and none of the leading spacefaring nations. There is, however, a recent renewed interest in the agreement. Germany declared intention to ratify it, and that until such ratification it will work in conformity to its provisions. Russian diplomats have also noted intention to ratify the agreement. Such important ratification may bring to life an agreement widely considered a failed treaty. In addition, at the 2019 session of COPUOS' Legal Subcommittee, Belgium and Greece submitted a

proposal for the establishment of a working group for the development of an international regime for the utilization and exploitation of space resources.[408] The proposal was supported, inter alia, by Brazil and China, two major states, and if this initiative proves successful, it may be a step in fulfillment of Article 11(5) of the Moon Agreement which provides that "States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible."

Introducing an international regime as the Moon Agreement suggests would be highly difficult, and even the Moon Agreement itself still faces limited recognition. Perhaps the major obstacle to achieving such recognition is Article 11(1) of the Agreement which provides that celestial bodies within the solar system[409] and their natural resources are the common heritage of mankind. This declaration has caused controversy and led many States to refrain from ratifying it.[410] Indeed, "…the inclusion of an independent, international organization tasked with regulation of resources as described in the Moon Treaty and UNCLOS was a major obstacle to ratification for many parties."[411] While Germany, Russia and even China, all leading spacefaring nations, may eventually chose to support the Moon Agreement, it is unlikely that the US, the leading spacefaring nation and the leading potential miner of space natural resources, will ratify it.

[408] UN General Assembly, Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-eight session, Vienna, 1-12 April 2019 (A/AC.105/C.2/L.311).

[409] Article 1(1) applies all provisions relating to the Moon also to other celestial bodies in the solar system.

[410] BM Hoffstadt, 'Moving the Heavens: Lunar Mining and the "Common Heritage of Mankind" in the Moon Treaty' (1994) 42 UCLA Law Review 575.

[411] Pascale Ehrenfreund, Margaret Race and David Labdon, 'Responsible Space Exploration and Use: Balancing Stakeholder Interests' (2013) 1 New Space 60, 70.

The general issue of the distribution of the benefits from the exploration and use of space has been debated for years.[412] The 1967 Outer Space Treaty provides that "[t]he exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out *for the benefit and in the interests of all countries*, irrespective of their degree of economic or scientific development, and shall be the province of all mankind". After many years of debate, mainly along the North-South lines and also along the West-East lines, the 1996 Declaration on International Cooperation[413], referred to by some as the "Space Benefits Declaration", elaborated on the issue though left wide vague margins.[414]

Meanwhile, the technological and commercial environment advanced, and the extraction of space natural resources is expected in the foreseeable future. Nevertheless, there is no agreed normative framework in the international level to regulate the exploitation of space natural resources. Instead, some States have turned to national legislation. In November 2015, the United States adopted the Commercial Space Launch Competitiveness Act[415], Chapter 513 of which - Space Resource Commercial Exploration and Utilization - recognizes the right of US citizens to all asteroid resources they obtain, a contested move which some claim to be contrary to the OST. The stated goal of the Act is to "facilitate a progrowth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions,

[412] Elena Carpanelli and Brendan Cohen, 'A Legal Assessment of the 1996 Declaration on Space Benefits on the Occasion of Its Fifteenth Anniversary' (2012) 38 Journal of Space Law 1.

[413] UN General Assembly Resolution 51/122: 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, adopted 13 December 1996 (A/RES/51/122).

[414] Carpanelli and Cohen (n 411).

[415] H.R.2262 U.S. Commercial Space Launch Competitiveness Act of November 25, 2015. Public Law No: 114-90, the bill and official texts available online <https://www.congress.gov/bill/114th-congress/house-bill/2262> accessed 31 July 2016.

and for other purposes".[416] Planetary Resources declared this legislation "the single greatest recognition of property rights in history" and envisaged that "this [new US] legislation establishes the same supportive framework that created the great economies of history, and will encourage the sustained development of space".[417]

Luxembourg followed the US example and in 2017 adopted a law regulating the extraction of space natural resources which recognizes that space natural resources are capable of being appropriated by private companies.[418] The United Arab Emirates (UAE) is preparing national space legislation that will regulate also space mining it hopes to pursue.[419]

The various projects for space mining and the legislation being adopted in key States clearly signals that "money time" has come: the governance of space natural resources is being shaped now, with or without consensus among States. It is therefore important to study, at this point in time, the proper governance - norms, rules, and institutions - of space natural resources. Yet, the discourse is unstructured, and there is confusion regarding the most basic notions.

[416] Ibid.

[417] 'President Obama Signs Bill Recognizing Asteroid Resource Property Rights into Law' (*Planetary Resources*, 25 November 2015) <https://www.planetaryresources.com/2015/11/president-obama-signs-bill-recognizing-asteroid-resource-property-rights-into-law/> accessed 17 March 2017.

[418] Law on the Exploration and Use of Space Resources; 'Luxembourg Is the First European Nation to Offer a Legal Framework for Space Resources Utilization' (13 July 2017) <http://spaceresources.public.lu/en/actualites/2017/Luxembourg-is-the-first-European-nation-to-offer-a-legal-framework-for-space-resources-utilization.html> accessed 17 July 2017.

[419] Lucy Barnard, 'UAE to Finalise Space Laws Soon' *The National* (7 March 2016) <https://www.thenational.ae/business/uae-to-finalise-space-laws-soon-1.219966> accessed 27 June 2017.

5.3 The Fallacies in the Discourse on the Governance of Space Natural Resources

The growing interest in space mining has indeed led to an increase in scholarship on the issue[420] and to the establishment of the Hague International Space Resources Governance Working Group, led by Leiden University's Institute of Air and Space Law.[421] It seems that the prevailing view is that space is commons, although the nature of this "commons" feature is not clear and surely not agreed upon even by those supporting it. Others argue that outer space is not commons.[422] Significantly, the United States, probably the most important actor in the mining of space natural resources, seems to hold the position that space is not commons.[423] Claims that space is or is not commons are followed by assertions and conclusions derived from these claims. A claim that space is commons is likely to be followed by a conclusion restricting its use, a restriction that derogates from the freedom of exploration and use of outer space stipulated in Article I of the OST. Article I provides that outer space "shall be free for exploration and use by all States", and it is therefore important to ensure that this freedom is not restricted based on misunderstanding or

[420] Ricky Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space* (Springer 2012); Ram Jakhu, Joseph Pelton and Yaw Otu Mankata Nyampong, *Space Mining and Its Regulation* (Springer 2017); Philip De Man, *Exclusive Use in an Inclusive Environment: The Meaning of the Non-Appropriation Principle for Space Resource Exploitation* (Springer 2016); Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime* (Martinus Nijhoff Publishers 2009); Stephan Hobe and Philip De Man, 'National Appropriation of Outer Space and State Jurisdiction to Regulate the Exploitation, Exploration and Utilization of Space Resources' (2017) 66 Zeitschrift fur Luft- und Weltraumrecht - German Journal of Air and Space Law 460; Jinyuan Su, 'Legality of Unilateral Exploitation of Space Resources under International Law' (2017) 66 International and Comparative Law Quarterly 991; Annette Froehlich (ed), *Space Resource Utilization: A View from an Emerging Space Faring Nation* (Springer 2018).

[421] 'The Hague International Space Resources Governance Working Group' (*Leiden University, Institute of Air and Space Law*) <https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-for-air-space-law/the-hague-space-resources-governance-working-group>.

[422] At the 58th IISL Colloquium on the Law of Outer Space in 2015, Hertzfeld, Weeden and Johnson presented a paper claiming space is not commons. The presentation spurred fierce comments from all leading space law scholars present, demonstrating the importance of the issue and that this position is probably in minority (Henry R. Hertzfeld, Brian Weeden and Christopher D. Johnson, 'How Simple Terms Mislead Us: The Pitfalls of Thinking About Outer Space as a Commons (Conference Paper AC-15 - E7.5.2 x 29369)' (2015)).

[423] Scott Pace, Executive Secretary, National Space Council, Lunch Keynote: Space Development, Law, and Values' IISL Galloway Space Law Symposium Cosmos Club, Washington, D.C., December 13, 2017.

misuse of the concept of "commons".

Despite the centrality of the concept of "commons" to the discourse on space natural resources, its meaning seems to evade many authors, who alternate between the economic and legal meaning and even combine features from both into a mélange of elements. In addition, it is not common practice to differentiate between the various parts of space and between resource systems and resource units, distinctions that may be unfamiliar to many legal scholars. Economists, for their part, often perceive property rights, another notion important for the discourse of space natural resources, in inconsistent ways that also deviate from its legal meaning. The lack of conceptual clarity and consistency cripples the discourse as there is no common base for the discussion. Instead, there is at least occasional erroneous or inconsistent use of the terms and features, which casts a shadow on the conclusions of such a discourse and thwarts cross-disciplinary discussion. The conceptual errors pave their way to policy of the highest level. For example, in the 2017 Conference on Disarmament, during a discussion on the agenda item of Prevention of an Arms Race in Outer Space, the EU made an official statement which included the following basic assumption: "The EU recognises the outer space as a *global common good*, to be used for the benefit of humankind" (emphasis mine)[424]. One can hope that after reading this chapter, such a mismatch of statements will no longer be made – and more important, will not form the basis for analysis or policy.

[424] 'Conference on Disarmament - Working Group on the "Way Ahead" - EU Statement on the Prevention of an Arms Race in Outer Space - European External Action Service' (*Europa - EU*, 16 June 2017) <https://eeas.europa.eu/headquarters/headquarters-homepage/28329/conference-disarmament-working-group-way-ahead-eu-statement-prevention-arms-race-outer-space_en> accessed 9 July 2019.

Confusion and failure to distinguish between the economic and legal meanings of "commons" and between resource systems and resource units was prevalent also in the general debate on private versus common property. Elinor Ostrom, who was awarded the Nobel Prize (economic sciences, 2009) for her research on the management of the commons, and Hess, whose research focus was on commons, noted that these confusions cloud the debate about the relative merits of private and common property and "reduce clarity in assigning meaning to terms and retard theoretical and empirical progress…".[425]

This chapter suggests a structure for the important discourse on the governance of space natural resources by: (i) distinguishing between the legal and the economic concepts of commons; (ii) differentiating between various parts of space (*e.g.,* planets, void space, earth orbits, man-made spacecrafts); and (iii) differentiating between resource systems and resource units. The chapter further provides the foundations for the discourse by (i) presenting the concept of 'economic commons' and 'legal commons' and clarifying the meaning of property rights; (ii) by pointing the limited contribution of the concept of "global commons" to the discourse; and by (iii) connecting the economic and the legal. On the basis of this common language it will be possible to conduct a fruitful discourse on, and provide a critical analysis, inter alia, of the *lex lata* and *lex ferenda* regarding space natural resources and their utilization. In addition, this chapter briefly examines whether some parts of space are economic and/or legal commons. The chapter finally connects the economic and legal perspectives and sketches how space natural resources may be governed, within a polycentric system of space governance suggested in chapter 4.

[425] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010).

5.4 Structuring the Discourse on the "Commons" Feature of Space

This section explains the dividing lines between the economic and legal concepts of "commons", between the different parts of space that may or may not be economic and/or legal commons, and between resource systems and resource units.

5.4.1 Differentiating an Economic Feature from a Legal Regime

The first step in delving into the meaning of the concept of "commons" is to distinguish between (i) commons as an economic feature and (ii) commons as a legal regime, i.e. between commons as a resource (an object or a "thing") and commons as a property rights regime (and therefore an abstract, separate and different from the "thing" upon which they are projected). The first refers to a type of resource, one which is used by multiple users, such as a lake that is used by numerous fishermen. The second refers to a property rights regime, that is, the ownership over the resource, and denotes that the property rights are jointly held by more than one actor. A mistake, often made, is to alternate between "commons" in the economic and the legal sense.

It is crucial to differentiate between resources and the legal regime that governs them.[426] It is likewise important to stress and reiterate that *there is no automatic association between commons as an economic feature and commons as a legal regime*.[427] An "economic commons" may have different property rights regimes, not just "legal commons". The lake - an economic commons - may be State property, where the government grants fishing licenses, or privatized, where a single owner sells fishing licenses/quotas, and can also be

[426] Lee Fennell, 'Ostrom's Law: Property Rights in the Commons' (2011) 5 International Journal of the Commons 9; Daniel W. Bromley, 'Closing Comments, in: National Research Council (U.S.) Panel on Common Property Resource Management', *Proceedings of the Conference on Common Property Resource Management* (National Academies Press 1986).

[427] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010).

community property ("legal commons") or owned by no one. Therefore, it is one thing to suggest that space is commons in the economic sense and another thing altogether to suggest that space is commons in the legal sense, and one does not even imply the other. Being goods or a resource of a certain kind does not necessitate a single specific property rights regime.[428]

It should be noted, however, that there is a connection between the type of resource in the economic meaning and the efficient governance thereof, governance that may be established or described in terms of a legal regime of property, as will be discussed in Section 5.8 below.

The next step is to put forward a full definition of economic commons and legal commons and examine if space, or any parts thereof, are economic or legal commons, bearing in mind that a positive answer to one does not necessarily entail a positive answer to the other and vice versa. Section 5.5 below defines economic commons and examines whether space or parts thereof are economic commons, whereas Section 5.7 defines legal commons and examines whether space or parts thereof are legal commons.

5.4.2 Differentiating between the Various Parts of Space

The second step in analyzing the "commons" feature of outer space is to separate the discussion and conduct an independent examination of each part of space to conclude if it is "commons" and according to this derive its proper governance. By "parts of space" I mean areas, resources, and objects, natural or artificial, *e.g.,* planets, asteroids, void space, earth orbits, and even man-made spacecrafts. It would be a conceptual mistake and a

[428] Ostrom and Hess (2010) ibid.

sweeping generalization to ask whether *Earth* is commons (economic or legal) as there is a difference between the open seas, private land, State-owned land, airspace, etc. It is likewise a sweeping generalization and, in the economic sense, utterly meaningless to ask whether *outer space*, an infinitely larger domain, is commons; to put planets, stars, void space, and orbits in one basket and ask if the content of the basket is commons. Each has its economic characteristics and is susceptible of being regulated by a different legal regime. Moreover, space today includes a large and increasing amount of artificial objects, *e.g.,* satellites, probes, the International Space Station (ISS), and even space debris, which are already treated differently, not as "commons" but as under the jurisdiction of the State of registry. To be sure, outer space is commonly referred to as 'global commons', but as section 5.6.2 below demonstrates, domains traditionally considered to be 'global commons' already have different property rights regimes as to specific benefits therefrom: the United Nations Convention on the Law of the Sea (UNCLOS) provides a different regime to fishery and the deep seabed, and the regulations of the International Telecommunication Union (ITU) provide a regime regarding the geostationary orbit that is not applicable to the rest of space. Moreover, while OST Article I and II do not differentiate between outer space and celestial bodies, Article IV paragraph 2 does provide rules (on military uses) that apply only to celestial bodies, not to other parts of space, *e.g.,* void space.

The question whether space is commons must therefore be replaced with more specific questions that distinguish between the various parts of space. One may ask whether the moon is commons or even whether planets in general are commons, but one should not ask whether "space" is commons. Examination whether a part of space is commons may be conducted regarding a single part of space, *e.g.,* about the geostationary orbit or about

categories of parts of space, *e.g.,* about earth orbits (which include the geostationary orbit, low earth orbit, and high earth orbits) and resources (*e.g.,* helium, platinum, water). However, even the use of categories needs special care as there may be variations in a single category. For example, the geostationary orbit is highly congested, but other orbits are not, which means that the various earth orbits feature subtractability and others not, with effects on their classification, as we shall see in section 5.6 below. One should not ask whether celestial bodies are 'commons' as these include asteroids, moons, planets, and the stars, with relevant differences between each of them that might alter the answer.

It is beyond the scope of this thesis to study whether each of the many single parts of space is an economic or legal commons, nor even each category of parts of space. Instead, Sections 5.5 and 5.7 below examine select categories of parts of space to find if they are economic or legal commons in order to demonstrate the process of analysis this chapter advocates for.

5.4.3 Differentiating Resource Systems from Resource Units

Another important distinction is between resource systems and the flow of resource units from the resource system.[429] The resource system can be a lake, and the flow would then be the fish in the lake. There can be more than one type of benefits from one resource system. The lake has fish but also water for drinking, irrigation and navigation. There can be different - and in a way "competing" - resource units, such as trees that bear fruits which can be picked, but alternatively, the trees can be chopped for use of the timber. The

[429] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010); Lee Fennell, 'Ostrom's Law: Property Rights in the Commons' (2011) 5 International Journal of the Commons 9; William Blomquist and Elinor Ostrom, 'Institutional Capacity and the Resolution of a Commons Dilemma' (1985) 5 Review of Policy Research 383.

governance of resources needs to address the use of both the resource system and resource units. Rules must be in place to determine and perhaps limit the access to the system. Other rules must be in place to determine and perhaps limit the right to harvest the resource units to ensure sustainable use of the resource system and its flow of benefits.[430]

The aforementioned distinction is important because *the resource system and resource units do not necessarily have the same governing regime*.[431] *The contrary is more likely*: Given the distinction and difference between the resource system and resource units and between the resource units themselves, there are likely to be several different governing regimes. One parcel of rights may be allocated with regard to the resource system and another - and probably different - parcels of rights may be allocated with regard to each resource unit. Furthermore, the different parcels of rights are likely to be granted to different actors. Continuing with the example of the lake, one set of rights may be allocated to the public which includes recreational access to the lake; another set of rights may be allocated to fishermen which includes fishing rights; and another set of rights may be allocated to nearby villages which includes rights to extract water for irrigation; yet another set of rights may be allocated to nearby towns, or the entire province, to extract water for drinking. Each set of rights will have distinct - and different - grantees, rights, and limitations.

5.5 Parts of Space as Economic "Commons"

Economics as a discipline focuses on resources and their use. The classic dichotomy of Private Goods v. Public Goods, made by Nobel Laureate Samuelson (Economic Sciences,

[430] Ostrom and Hess (2010) ibid.
[431] Ibid.

1970), fits the classic institutional dichotomist view that markets are optimal for handling private goods but for the public goods we need a central government. Elinor Ostrom added two types of goods: common-pool resources (CPRs) and Toll Goods. This section defines economic "commons", presents the four types of goods/resources (private goods, public goods, CPRs, and toll goods), and then determines whether parts of space - planets, minerals waiting to be harvested, void space, and orbits - are economic commons or another type of a resource.

5.5.1 "Commons" and "Common-Pool Resources" Defined

The two terms "commons" and "common-pool resources" share the word "common" but have different definitions.

"Commons" are resources used by more than one actor. Examples often used in the literature are fish stocks, pastures, woods, and water (for drinking or irrigation). As Hess and Ostrom noted "Commons is a general term that refers to a resource shared by a group of people. In a commons, the resource can be small and serve a tiny group (the family refrigerator), it can be community level (sidewalks, playgrounds, libraries, and so on), or it can extend to international and global levels (deep seas, the atmosphere, the Internet, and scientific knowledge). The commons can be well bounded (a community park or library); transboundary (the Danube River, migrating wildlife, the Internet); or without clear boundaries (knowledge, the ozone layer)".[432]

[432] Charlotte Hess and Elinor Ostrom, 'Introduction: An Overview of the Knowledge Commons' in Charlotte Hess and Elinor Ostrom (eds), *Understanding Knowledge as a Commons: From Theory to Practice* (MIT Press 2011).

A CPR is one of four types of goods/resources. It is a resource which has two features: (i) one person's use of the resource subtracts from the potential use of other persons and (ii) there is difficulty, physically or legally, to prevent actors from using the resource.[433]

A resource or goods have various features, and two of them are relevant to their classification: (i) subtractability of use and (ii) the possibility of excluding potential beneficiaries. The first asks whether the use of the resource by one person subtracts from the use thereof by another person. In other words, will such use by one actor diminish or even nullify the potential benefit of future users? A chocolate bar is characterized by a high degree of subtractability: If one person eats the chocolate bar, others can no longer eat it. For this reason, the feature of subtractability is known in economics also as 'rivalry' as there is rivalry between the various potential beneficiaries from the bar. Land, whether used for agriculture or housing, is another example of high subtractability or rivalry. In contrast, when one person enjoys the peace and security as well as street lighting that the State provides, it does not subtract or diminish from the peace and security and street lighting that others can enjoy. These goods are characterized by low subtractability or non-rivalry.

The second feature, excludability, asks whether it is significantly difficult, physically or legally, or very costly, to exclude a potential beneficiary. It is relatively easy to exclude unauthorized persons from eating a chocolate bar or using a certain house. However, it is harder to prevent unauthorized entry to a vast forest and it is very difficult to prevent a

[433] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010); Charlotte Hess, 'Research on the Commons, Common-Pool Resources, and Common Property - Definitions' (*Indiana University - Digital Library of The Commons*, 2006) <http://dlc.dlib.indiana.edu/dlc/contentguidelines> accessed 31 July 2016.

certain person from enjoying the peace and security and street lighting provided by the State. It is likewise legally difficult to prevent an actor from using the open seas.

These two features of subtractability and excludability provide the four categories of resources or goods, as presented in Table 1 below:

Table 1: Types of goods/resources

		Subtractability of Use	
		High	**Low**
Difficulty of excluding potential beneficiaries	**High**	Common-pool resources: groundwater basins, lakes, irrigation systems, fisheries, forests, etc.	Public goods: peace and security of a community, national defense, knowledge, fire protection, weather forecasts, etc.
	Low	Private goods: food, clothing, automobiles, etc.	Toll goods: theaters, private clubs, daycare centers

[source: Elinor Ostrom[434]]

A chocolate bar and an apartment are private goods as there is rivalry in their consumption and it is easy to exclude potential beneficiaries from using them. A theater is a toll good - it is easy to exclude potential beneficiaries from entering it, but there is little rivalry: one person watching the play does not prevent others from watching the same play and having the same benefit, although there is capacity limit according to the available number of seats in the theater. A large groundwater basin is a CPR as one person's use of the water diminishes the potential benefit of other users, yet it is difficult, physically or legally, from excluding potential beneficiaries. Streetlights are a public good- one person's use does not

[434] Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 The American Economic Review 641.

diminish the potential benefit to others and it is difficult to prevent potential beneficiaries from using it.

Of interest to us are the CPRs as this chapter focuses on the "commons" feature of outer space and its resources. Nevertheless, we should bear in mind that classification of real-world cases to CPRs or public goods is not trivial. Both CPRs and public goods share the feature of non-excludability, and it is the subtractability or rivalry that distinguishes between them. Some scholars suggest that there are very few real-world examples of "pure" public good with no rivalry,[435] and others even treat both types the same.[436] Moreover, some physical resources may be classified as a CPR regarding one aspect of their provision or use and as a public good with regard to another as the case of a groundwater basin demonstrates.[437] Clearly, there is rivalry in consumption as one person's use of the water leaves less for the others, and it is therefore a CPR. On the other hand and at the same time, protection of the basin from salt water intrusion or pollution is a public good, as such protection is provided to all or none, and it cannot be provided only to some users. For this reason, it is suggested that the classification to CPR or public good should be made with regard to aspects of a resource rather than to its entirety.

5.5.2 Are Parts of Space Economic "Commons" or CPRs?

This section briefly examines select parts of space to find out if they are commons and/or CPRs according to the aforementioned definitions, demonstrating the process of analysis

[435] Robert O. Keohane and Elinor Ostrom, 'Introduction' in Robert Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (Sage Publications 1995); John Harkness Dales, *Pollution, Property and Prices: An Essay in Policy-Making and Economics* (University of Toronto Press 1968).

[436] As reviewed in Jose Apesteguia and Frank P. Maier-Rigaud, 'The Role of Rivalry: Public Goods versus Common-Pool Resources' (2006) 50(5) The Journal of Conflict Resolution 646.

[437] Keohane and Ostrom (1995) (footnote 434).

this chapter advocates for. As this section shows, not all parts of space are commons or CPRs.

5.5.2.1 Commons

Celestial bodies, orbits, and void space are resources used (or potentially used) by multiple users and therefore are economic commons. Those artificial objects in space that have multiple users, such as the ISS, are also economic commons, regardless of who owns them (but not necessarily CPRs, as the next paragraph demonstrates). Those artificial objects with a single user, *e.g.,* a satellite belonging to and serving a single State, are not economic commons.

5.5.2.2 CPR

Article 1 paragraph 2 of the OST provides that "…Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States…". It is therefore legally difficult to exclude potential users. The question remains regarding the subtractability feature of the various parts of space. Some orbits are congested and the use thereof by one actor subtracts from the use of other actors, whereas other orbits might be rather deserted with low subtractability. Void space probably features low subtractability; the moon, asteroids, and minerals seem to have the subtractability feature. Those parts of space that do not feature subtractability, for example, a deserted orbit or void space, are not CPRs. Those parts of space featuring subtractability, such as the geostationary orbit and the moon, are CPRs. The ISS features subtractability, but exclusion is easy, so it is not a CPR. Being a CPR has a meaning in terms of the economically efficient governance regime over the resource, as presented in Section 5.8 below.

5.6 OST Article II, Global Commons and International Law of Property

5.6.1 Property Rights under Domestic and International Law

Property rights are the product of society, and in modern times, they are granted or recognized by the State, in each State according to its domestic laws. There are also rules in private international law regarding recognition of property rights granted/recognized by other States. The picture is more complex with regard to domains and resources outside the territory of any and all States, *e.g.,* the high seas, outer space, and Antarctica,[438] to which many refer as "global commons".

Sprankling[439] asserts that it is time to develop an "international law of property" and that principles and doctrines of international property law have already emerged, one of these doctrines being that of the global commons. However, the common conception is still that property rights arise under the domestic law of a particular State. Accordingly, the theoretical analysis of property rights in this section 5.6 is based on how property rights have been recognized at the national level. Nevertheless, the theoretical part is relevant also to potential property rights if such will be granted/ recognized by a supranational entity or instrument, including the basic principles of the sticks of rights and the type and identity of the holder of rights. If the UN or an international treaty starts granting/recognizing property rights, these will likely follow the same principles, only with a different granting/recognizing authority. Until then, international law can permit, or not prohibit, States' granting/recognizing property rights.

[438] While Article IV of the Antarctic Treaty of 1959 prohibits claiming sovereignty over any part of Antarctica, it does not nullify preexisting claims, nor does it confirm them.

[439] John G. Sprankling, *The International Law of Property* (Oxford University Press 2014).

As outer space is one of the traditional examples of global commons, the next section analyzes the concept of global commons and its contribution - or lack thereof - to our understanding of global commons and the property rights regime applicable to them.

5.6.2 OST Article II and the Concept of Global Commons

OST Article II precludes national sovereignty in outer space, and thereby - so is the common view - renders outer space to be global commons. But, what does it mean for a domain to be global commons and does it or Article II provide a property rights regime?

The concept of global commons is said to be the modern incarnation of Hugo Grotius' principle of mare liberum,[440] freedom of the seas, which rules out national sovereignty and ensures freedom of access to, and movement within the domain. Grutius' view was accepted, whereas opposing views by his British[441] and Portuguese[442] contemporaries were rejected.

The term "global commons" has no formal definition, and it does not appear as such in international treaties. The available definitions by the UN Division of Environmental Law and Conventions[443] and the OECD[444], as well as by scholars such as Buck[445], Vogler[446], and

[440] Hugo Grotius, *Mare Liberum* (1609) In fact, the Romans had declared that the seas were communes omnium naturali jure (common to all humankind) in the 2nd century CE, following the writings of the Roman jurist Marcianus, as was later also recorded in Roman emperor Justinian I's the Digest of Justinian.

[441] William Welwod, *De Dominio Maris* (1615); John Selden, *Mare Clausum* (1635).

[442] The Response of a Portuguese Priest to Grutius' Book (Written in the Context of a Dispute Between Portugal and The Netherlands), Serafim de Freitas, De Iusto Imperio Lusitanorum Asiatico (Of the just Portuguese Asian Empire), 1625.

[443] UN Environment Programme, Division of Environmental Law and Conventions, <http://www.unep.org/delc/GlobalCommons/tabid/54404/> accessed 4 January 2016. The page has since been removed.

[444] Organization for Economic Co-operation and Development, 'Glossary of Statistical Terms, Global Commons' <https://stats.oecd.org/glossary/detail.asp?ID¼1120> accessed 21 May 2018.

[445] Susan J. Buck, *The Global Commons: An Introduction* (2nd ed, Island Press 1998).

[446] John Vogler, *The Global Commons: Environmental and Technological Governance* (2nd ed, Wiley 2000).

Schrijver [447], have a single characteristic - global commons are outside any and all national jurisdictions. Buck also adds a second characteristic which is free access to the domain. Other scholars provide definitions limited to the purposes of their current article.[448] There are three or four traditionally recognized global commons - the high seas, outer space, and Antarctica, and some add the atmosphere. The radio spectrum, the use of which is regulated by the ITU Constitution, might be yet another one. If we follow these definitions, the content of the concept of global common is very limited: It is simply a domain which no State may validly purport to subject to its sovereignty. At most, one can add the free access to the domain and even that is doubtful as it is not guaranteed for all the traditional global commons. OST Article I guarantees free access and movement and so does UNCLOS Article 87, whereas the Antarctic Treaty provides merely freedom of scientific investigation (Article II).

There is a recent inflation in the use of the term "global commons" as newer, sometimes disputed, uses of the concept purport to apply it also to cyberspace,[449] the internet,[450] crop genetic resources,[451] the climate,[452] human genome, immaterial cultural heritage, and even biodiversity, tropical rain forests, science, education, information, and peace[453]. The alleged

[447] Nico Schrijver, 'Managing the Global Commons: Common Good or Common Sink?' (2016) 37 Third World Quarterly 1252.

[448] Bryan H. Druzin, 'The Parched Earth of Cooperation: How to Solve the Tragedy of the Commons in International Environmental Governance' (2016) 27 Duke Journal of Comparative and International Law 73; Stuart Kaye, 'Threats from the Global Commons: Problems of Jurisdiction and Enforcement Commentaries' (2007) 8 Melbourne Journal of International Law 185.

[449] Patrick W. Franzese, 'Sovereignty in Cyberspace: Can It Exist?' (2009) 64 Air Force Law Review 1.

[450] Mark Raymond, 'The Internet as a Global Commons?' [2012] CIGI <https://www.cigionline.org/publications/internet-global-commons> accessed 3 May 2018.

[451] Michael Halewood, Isabel Lopez Noriega and Selim Louafi (eds), *Crop Genetic Resources as a Global Commons: Challenges in International Law and Governance* (Routledge 2013).

[452] Peter-Tobias Stoll, 'The Climate as a Global Common' in Daniel A. Farber and Marjan Peeters(eds), *Climate Change Law, vol 1* (Edward Elgar 2016).

[453] UN System Task Team on the Post 2025 UN Development Agenda, 'Global Governance and Governance

new global commons do not even share the single characteristic, i.e. that no State may validly purport to subject the domain to its sovereignty. The rainforests are - legitimately - under national sovereignty. Moreover, for others, like education, biodiversity and peace, sovereignty is not the issue.

The concept of global commons is used to describe domains that significantly differ in character and legal regime which renders the scope and content of the concept unclear. The four traditional global commons are different from each other and so is their legal regime. Moreover, the many new global commons bring even greater diversity and therefore uncertainty about the meaning of the concept and what is derived from designating a domain as global commons.

The gradual increase of importance of various domains labeled as global commons, and mainly their resources, has led to significant discourse on the topic, as may be evidenced by the many conferences worldwide dedicated to global commons. The inflation in designation of new "global commons" might reflect a perspective that they are of global interest and that there should be international cooperation in the establishment of the regimes on these domains. There is even arguably an emerging "global commons law".[454] Yet, there is a long way to go before a clear and meaningful content is poured into the concept.

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of the Global Commons in the Global Partnership for Development beyond 2015' (January 2013).

[454] Andrew Jillions, 'Commanding the Commons: Constitutional Enforcement and the Law of the Sea' (2012) 1 Global Constitutionalism 429.

5.6.3 Property-right Regimes and the Common Heritage of Mankind

An important question is whether the domains labeled as global commons have a distinct property right regime - *e.g.,* open access or common property - and the short answer is no. Even a limited scope of inquiry focusing on the three most agreed global commons - outer space, the high seas, and Antarctica - reveals that the applicable rules vary between these domains and even within a single domain.

Some of the economic benefits from the high seas are under an open-access regime: Article 87 of the UNCLOS provides freedom of use of the sea routes and air routes above the high seas; the freedom to lay cables and pipelines; the freedom to construct artificial islands and other installations; and the freedom of fishing.[455] All these require no permission, although they need to meet the requirement of the treaty. This is an open access regime (see section 5.6 below for the meaning of open access). However, the deep seabed has a different regime. Article 136 of UNCLOS declared the seabed and ocean floor and subsoil thereof and their natural resources to be the "common heritage of mankind" (CHM)[456] and their mining requires permission from the International Seabed Authority in what seems to be a common property regime (see section 5.7.6 below for the meaning of common property). The drafters of UNCLOS chose to add a designation of CHM to resources to which a common property is to be applied.

[455] The freedom of fishing in the high seas is also provided and elaborated in Part VII Section 2 of UNCLOS.

[456] On the CHM principle see, for example, Kemal Baslar, *The Concept of the Common Heritage of Mankind in International Law* (Martinus Nijhoff 1997).

The OST, while banning national sovereignty in Article II, also explicitly allows the exploitation and use of outer space (Article I).[457] Under the ITU regulations, slots in the geostationary orbit are allocated through the ITU, in what seems again to be a common property regime. However, there is no similar regime to other resources in outer space. Significantly, the Moon Agreement[458] took a similar path to that of UNCLOS by declaring in Article 11(1) all celestial bodies and their natural resources to be CHM - this is in addition to the ban on national appropriation in Article 11(2). In both cases, it seems that the drafters of UNCLOS and the Moon Agreement were of the opinion that barring national sovereignty (or designating a domain to be global commons) is not enough to provide any property rights regime, or at least not a regime of common property. Indeed, Article 11 of the Moon Agreement is perceived as the main reason many States have chosen not to ratify the treaty as they may not wish to introduce the CHM principle, which adds a layer of rules and limitation on top of those included in the concept of global commons.

The Antarctic, to which even freedom of access is not guaranteed, has a regime regarding mining that is totally different from that of the OST and UNCLOS and also different from the regime on other economic benefits from the Antarctic. The 1988 Convention on the Regulation of Antarctic Mineral Resource Activities (CRAMRA), which allowed mining, failed and was replaced by the 1991 Protocol on Environmental Protection to the Antarctic which bans mining altogether. This ban can be renegotiated after 50 years (Article 25(2)). It should be noted that the CRAMRA that allowed mining did not apply the CHM principle to the resources of the Antarctic, and the principle is not mentioned in any of the instruments

[457] See also Philip de Man, *Exclusive Use in an Inclusive Environment: The Meaning of the Non-Appropriation Principle for Space Resource Exploitation* (Springer 2016).

[458] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1363 UNTS 21; 18 ILM 1434 (1979); 18 UST 2410.

constituting the Antarctic Treaty System. However, fishing in the Southern Ocean (south of the Antarctic Convergence) is allowed[459] and so is tourism[460].

Moreover, there is another distinct difference between the various treaties as only one treaty explicitly mentions property rights. The provisions in UNCLOS Part XI[461] and in the 1991 Protocol on Environmental Protection to the Antarctic, which regulate mining, merely regulate the activity of resource exploitation ("activity" is the term used in both instruments). The Moon Agreement took a different course: It specifically provides that no part of celestial bodies and their resources can become the property of any State, entity, or person (Article 11(3)). Comparing the aforementioned variance, one might even deny that the UNCLOS and the Antarctic Treaty System provide any property right regime, and for that matter also the OST. In any case, even the most established regime - that of the deep seabed - does not render national regulation redundant. A permission from the International Seabed Authority to exploit the seabed permits, inter alia, the alienation of mined resources. Thereafter, States may grant/recognize property rights in the mined resources. Indeed, several States adopted national laws of mining of the seabed, including the United States, Russia, the UK and France.[462]

[459] Under the Convention on the Conservation of Antarctic Marine Living Resources (33 UST 3476; 1329 UNTS 48; 19 ILM 841 (1980)).

[460] Tourism is explicitly mentioned in the 1991 Protocol on Environmental Protection to the Antarctic Treaty (30 ILM 1455 (1991)). In addition, several Antarctic Treaty Consultative Meetings discussed tourism and the Treaty Parties adopted guidelines on tourism and guidelines for visitors to the Antarctic, *e.g.,* Resolution 3 (1995), Resolution 3 (1997) and Resolution 3 (2011).

[461] Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 (UNCLOS)(1833 UNTS 3; 21 ILM 1261 (1982)), Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, vol. 33, I.L.M, July 28. 1994, p. 1309.

[462] Michael C. Wood, 'International Seabed Authority: The First Four Years' (1999) 3 Max Planck Yearbook of United Nations Law (UNYB) 173.

In view of this, designating a domain as global commons does not enlighten us as to the applicable property rights regime, as such regimes, if at all established, significantly vary in and between the various domains commonly referred to as global commons.

5.6.4 Back to Property Rights Theory

OST Article II that bars national sovereignty is not enough to provide any specific property rights regime, let alone a regime of common property. "Global commons" is a slippery term that does not imply the property right regimes in the domains and resources it presumably describes. Asserting that outer space is "global commons" does little to promote our understanding of the applicable legal regime as the term is not official and is of limited or unclear content and scope. Therefore, the recent declaration by the Executive Secretary of the US National Space Council that outer space is not global commons[463] neither hinders our understanding of the applicable legal regime nor undermines conventions or poses a barrier to the development of the governance of space natural resources. The declaration carries significant importance in exposing the underlying US policy towards space natural resources, if it meant to suggest that outer space is not (global) common property or legal (global) commons, but rather open access (see section 5.7.6 below for definitions).

There is a steady increase in the importance of the traditional global commons, an inflation of new global commons, and an increase in the discourse on the topic. This may lead to the emergence of a distinct law of global commons, as some believe and aspire, which makes it critical to get the basic concepts right, so this body of law - should it emerge - is built on sound foundations. The next section therefore goes on to review and analyze the general

[463] Scott Pace, Executive Secretary, National Space Council, Lunch Keynote: 'Space Development, Law, and Values', IISL Galloway Space Law Symposium Cosmos Club, Washington, D.C., December 13, 2017.

theory of property rights, including what is "legal commons", which should be applied in the interpretation of the relevant provisions of the OST and other relevant instruments.

5.7 Parts of Space as Legal "Commons"

The economic analysis focuses on the *resource*, whereas the legal analysis should focus on the *rights vis-a-vis the resource* or the legal regimes that governs it, i.e. property rights. If an economic commons is a resource *used* by multiple actors, a "legal commons" is a resource or right *jointly owned* by multiple actors. The following sections dismantle property rights to their basics, and section 5.7 then elaborates on what is "legal commons".

5.7.1 The Artificial Creation of "Property Rights"

Property rights do not exist in nature, nor could they exist for Robinson Crusoe before the appearance of Friday.[464] They are the product of society (which is also an economic system) and its rules. Property rights are granted or at least recognized by the society, through rules, and recognized and respected by institutions and the other members of the society. The concept of "property rights" has occupied the attention of generations of thinkers. The understanding of property and the distribution of property have changed considerably through time and have adapted to the changes of the socioeconomic conditions. The understanding and distribution of property were always influenced by and themselves influencing the utilization of natural resources and the (relative) status of various members of a society.

'Commons' is an economic term used in the legal literature in inconsistent ways that often deviate from its economic definition. Similarly, 'property rights' is a legal term used by

[464] Daniel Defoe, *The Life and Strange Surprizing Adventures of Robinson Crusoe* (William Taylor 1719).

economists in inconsistent ways that often deviate from its legal definition. The concept of property rights is central to the language of economics, and the divergence of some of the economic literature, including by leading economists, from conventional legal understandings of property rights creates "interdisciplinary confusion and bias economic analyses".[465] The deviation from the legal definition also makes cross-disciplinary dialog difficult.[466] This section presents the modern legal conceptualization of property rights and applies it to the context of commons and space natural resources.

5.7.2 The Modern Theory of "Property" and the "Rights" in Property Rights

Property rights have a long history, yet there is no common definition thereof, but rather their definition has changed over time and space. The classic - and perhaps still common in popular culture - concept of property right as an all-encompassing power was expressed in Blackstone's Commentaries on the Laws of England (1765):

> *…the right of property… that sole and despotic dominion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe.*[467]

Similarly, the French Civil Code of 1840 provided that "Ownership is the right to enjoy and dispose of things in the most absolute manner, provided they are not used in a way prohibited by statutes or regulations".[468]

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[465] Daniel H. Cole and Peter Z. Grossman, 'The Meaning of Property Rights: Law versus Economics?' (2002) 78 Land Economics 317; Edella Schlager and Elinor Ostrom, 'Property-Rights Regimes and Natural Resources: A Conceptual Analysis' (1992) 68 Land Economics 249.

[466] Schlager and Elinor Ostrom (1992) ibid.

[467] William Blackstone, *Commentaries on the Laws of England, Book 2* (Clarendon Press, Oxford 1765). Chapter 1 ('Of Property, in General').

[468] Code civil des Français (Code Napoleon), Article 544. English version available online <https://www.legifrance.gouv.fr/content/download/1950/13681/version/3/file/Code_22.pdf> accessed 20 May 2018.

Modern property right theory has a more complex view of property rights. For much of the twentieth century, legal academics thought of property as a bundle of rights.[469] According to this depiction of property, property rights give certain members of the society the right to access a stream of benefits (also referred to as "sticks") from given resources. The "sticks" include the right to access, use, exclude, sell, lease, mortgage, donate, subdivide, etc. The "sticks" regarding a specific resource may be held together by one person or be separated and held by several holders.[470] A rented apartment is a simple example for different sticks held by different persons: The "owner" has the right to sell, lease, mortgage, etc. the apartment; the renter has the right to access and use the apartment, rights she is paying for and are now denied from the owner for the duration of the contract.

Furthermore, property rights are not all encompassing as in the Blackstonian conceptualization. The fact that a person owns a piece of land does not make her "queen of the castle". She may have to pay taxes to the government for this land, need a permit to build her castle and be restricted in the square foot she can build and will have to follow numerous other applicable laws when using it. The airspace above her piece of land is not hers, but the State's, and in many States also mineral resources in the ground, such as oil. Property rights are further often partially shared with others, as in the case of a condominium in which the various apartments' owners share public spaces, such as the elevator, with the other apartment owners.

[469] Jane B. Baron, 'Rescuing the Bundle-of-Rights Metaphor in Property Law' (2013) 82 University of Cincinnati Law Review 57; Gregory S. Alexander, *Commodity and Propriety: Competing Visions of Property in American Legal Thought, 1776-1970* (University of Chicago Press 1997); James E. Penner, 'The Bundle of Rights Picture of Property' (1995) 43 UCLA Law Review 711.

[470] Baron (2013) ibid.

The traditional concept of property rights viewed them as relationships between individuals and things, whereas the bundle of rights theory sees property rights as manifesting in relationships between the members of a society. Under this modern view, property rights establish relationships among the members of a society and determine relative powers of the members vis-a-vis resources and each other.[471]

The bundle of rights theory indeed well explains many facets of property. However, since the 1990s, the "bundle of rights" theory has been provocatively challenged[472], notably by Penner[473], Merrill and Smith[474]. The challenges were answered by eminent scholars, *e.g.,* Epstein[475] and Munzer[476], with others such as Ellickson[477] taking a middle ground. There is even a suggestion to adopt a new concept of property as the "law of things"[478]. Yet, the

[471] Baron (2013) ibid.

[472] See special issue of Econ Journal Watch: Property: a bundle of rights? Econ Journal Watch 8 (3) (2011).

[473] James E. Penner, *The Idea of Property in Law* (Clarendon Press 1997); James E. Penner, 'The Bundle of Rights Picture of Property' (1995) 43 UCLA Law Review 711.

[474] Thomas W. Merrill, 'Property and the Right to Exclude' (1998) 77 Nebraska Law Review 730; Thomas W. Merrill and Henry E. Smith, 'Optimal Standardization in the Law of Property: The Numerus Clausus Principle' (2000) 110 The Yale Law Journal 1; Thomas W. Merrill and Henry E. Smith, 'The Property/Contract Interface' (2001) 101 Columbia Law Review 773; Thomas W. Merrill and Henry E. Smith, 'What Happened to Property in Law and Economics?' (2001) 111 The Yale Law Journal 357; Thomas W. Merrill and Henry E. Smith, 'The Morality of Property Law and Morality: Property Law' (2006) 48 William and Mary Law Review 1849; Thomas W. Merrill and Henry E. Smith, 'Making Coasean Property More Coasean' (2011) 54 The Journal of Law & Economics S77; Henry E. Smith, 'Exclusion versus Governance: Two Strategies for Delineating Property Rights' (2002) 31 The Journal of Legal Studies S453; Henry E. Smith, 'The Language of Property: Form, Context, and Audience' (2003) 55 Stanford Law Review 1105; Henry E. Smith, 'Exclusion and Property Rules in the Law of Nuisance' (2004) 90 Virginia Law Review 965; Henry E. Smith, 'Intellectual Property as Property: Delineating Entitlements in Information' (2007) 116 The Yale Law Journal 1742; Henry E. Smith, 'Governing Water: The Semicommons of Fluid Property Rights Symposium: Property Rights in Environmental Assets: Economic and Legal Perspectives' (2008) 50 Arizona Law Review 445; Henry E. Smith, 'Mind the Gap: The Indirect Relation between Ends and Means in American Property Law Responses' (2008) 94 Cornell Law Review 959.

[475] Richard A. Epstein, 'Bundle-of-Rights Theory as a Bulwark against Statist Conceptions of Private Property' (2011) 8 Econ Journal Watch 223.

[476] Stephen R. Munzer, 'A Bundle Theorist Holds On to His Collection of Sticks' (2011) 8 Econ Journal Watch 265.

[477] Robert C. Ellickson, 'Two Cheers for the Bundle-of-Sticks Metaphor, Three Cheers for Merrill and Smith' (2011) 8 Econ Journal Watch 215.

[478] Henry E. Smith, 'Property as the Law of Things' (2012) 125 Harvard Law Review 1691.

"bundle of rights" theory is still the leading explanation of the essence of property and is used herein.

5.7.3 The Rights ("Sticks") Relevant to CPRs and Space

If property is a bundle of rights, then some of the sticks in the bundle are relevant to the economic discussion of CPRs. Schlager, whose research focuses on institutional analysis of the governance of the commons, and E. Ostrom pointed to five rights that are most relevant for the use of common-pool resources:[479]

> **Access**: The right to enter a defined physical area and enjoy non-subtractive benefits (for example, hike, canoe, sit in the sun).
>
> **Withdrawal**: The right to obtain resource units or products of a resource system (for example, catch fish, divert water).
>
> **Management**: The right to regulate internal use patterns and transform the resource by making improvements.
>
> **Exclusion**: The right to determine who will have access rights and withdrawal rights and how those rights may be transferred.
>
> **Alienation**: The right to sell or lease management and exclusion rights.

This classification is especially helpful in discussing property rights in/to space in general and in the context of space mining in particular. It may be used to analyze the meaning of the 1967 OST. Article I of the OST provides:

[479] Edella Schlager and Elinor Ostrom, 'Property-Rights Regimes and Natural Resources: A Conceptual Analysis' (1992) 68 Land Economics 249; Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010); Charlotte Hess and Elinor Ostrom, 'Introduction: An Overview of the Knowledge Commons' in Charlotte Hess and Elinor Ostrom (eds), *Understanding Knowledge as a Commons: From Theory to Practice* (MIT Press 2011).

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

In terms of the aforementioned five rights, it seems straightforward that Article I grants all States the first right, that of "access"; it is unclear whether the right of "withdrawal" is also granted, i.e. whether withdrawal falls under "use" of space that is free to all States. The rights of management, exclusion, and alienation are given neither to any single State nor to an intergovernmental organization, and therefore they fall by default in the hands of all States collectively or humankind.

5.7.4 Types of Holders of Property Rights and Spacefaring Nations' Rights

An alternative way to talk about the rights that property rights entail is to make a classification by types of holders of (bundle) of rights, rather than a classification of the rights in the bundle. Ostrom and Schlager[480] identified five types of property rights holders, as shown in Table 2 below:

[480] Schlager and Ostrom (1992) ibid.

Table 2: Bundles of Rights Associated with Positions

	Owner	**Proprietor**	**Claimant**	**Authorized user**	**Authorized entrant**
Access	X	X	X	X	X
Withdrawal	X	X	X	X	
Management	X	X	X		
Exclusion	X	X			
Alienation	X				

[Source: Ostrom and Schlager[481]]

A person hiking in a national park is an "authorized entrant", whereas a fisherman with a fishing license in a lake is an "authorized user". Further up the line, a "claimant" can establish rules and restrictions on the access and withdrawal (*e.g.,* "opening hours", purpose of use, identity and quantity of resource units harvested), which is the right of management (a collective-choice right). At the next level, a "proprietor" has, in addition to the rights of a claimant, the right to determine who may access and harvest from a resource. Finally, "owners" possess, in addition to all the aforementioned rights, the right of alienation, i.e. the right to transfer (*e.g.,* sell, lease) a resource (or the management and exclusion rights to it). It is important to note that individuals or collectives may hold any of the various sets of property rights, which means that a collective can be the "owner", "proprietor" etc. of a certain resource. Most of the property systems that are called "common property" regimes involve participants who are proprietors.[482]

[481] Elinor Ostrom and Edella Schlager, 'The Formation of Property Rights' in Susan Hanna, Carl Folke and Karl-Goran Maler (eds), *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment* (Island Press 1996) 127, 156.

[482] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010).

Article I of the OST renders all States at least an "authorized entrant" as there is freedom of access, exploration, and scientific investigation. It can also be argued that Article I renders States more powerful holders, "authorized users", as the freedom extends to "exploration and use". It may, however, be asserted that the term "use", in Article I of the OST, does not include withdrawal, i.e. that the term "use" in the legal text of the OST carries a somewhat different meaning or definition than the term "use" in the previously given definitions, taken from economic literature.

It is important to note, in line with the distinction between the type of resource and the property rights over it (the type of legal regime applicable to it), that any kind of property, including a CPR, can have various types of "holders" (i.e. owner/proprietor/claimant/ authorized user/or authorized entrant).

5.7.5 Identity of Holders of Property Rights and Common Property in Space

There are different "sticks" representing rights to property; some of them, also presented previously, are relevant to CPRs. There are several types of holders of property rights according to the parcel of sticks they hold. The identity of the holders is another question all together, separate from the type of holder (Table 2). The identity of the holders (holder understood as the owner/proprietor/ claimant/authorized user/or authorized entrant) can vary, i.e. it can be an individual, corporation, government, or communal group.[483] The "claimant" can be a person, a government, or a collective. If the holder is a collective, then

[483] John Michael Montias, *The Structure of Economic Systems* (Yale University Press 1976).

we can say it is – indirectly - "common property", i.e. the bundle of rights is jointly held (or indirectly in common) by a limited group of actors.[484]

5.7.6 The Number of Holders of Property Rights, Legal Commons, and Open Access

There are three main options for the number of holders of property rights, zero, one, and multiple (two or more), and they correspond to open access, private property, and common property.

Private property means that there is a single owner of the resource or right in question. *Common property* means that there are two or more owners who jointly own the resource or right in question. The co-owners can comprise of anyone who can legally own property, *e.g.,* individuals, corporations, the State, or a mix thereof. Commons as a legal regime, or legal commons, is common property. *Legal commons* therefore mean that a certain resource or right has more than one owner. If there is a single owner but this owner is the State or a collective, we might view it as a case of private property, as the State or collective represents the entire public/members of the collective and holds ownership in a sort of fiduciary, whereas the public/members of the collective, or all the many individuals which comprise the public/ collective, are the ultimate owners of the resource. *Open access* means that the resource or right in question has no owner. The resource is open to the public so that anyone can use it and its economic benefits without the need for permission. In this case, the number of owners is zero, whereas there is a limit neither on the number or identity of users nor on the extent of their exploitation of the resource.

[484] Charlotte Hess, 'Research on the Commons, Common-Pool Resources, and Common Property - Definitions' (*Indiana University - Digital Library of The Commons*, 2006) <http://dlc.dlib.indiana.edu/dlc/contentguidelines> accessed 31 July 2016.

Admittedly, the open-access regime is confusing because its title - open access - insinuates reference to use rather than ownership. Let us therefore deconstruct the open-access regime. The trait of a resource being open to all may derive from four cases of identity or number of owners: (i) under domestic or international law no one can validly establish ownership over it. The number of owners is and will remain zero; (ii) ownership may be validly established, but no one has yet done so. The number of owners is zero but may change; (iii) the resource has an owner or owners but the owner(s) is/are keeping it open to all, for example, a lakeshore owned by the State or jointly by the State and the municipality which maintains the lakeshore open to all; and (iv) all relevant actors jointly own the resource and therefore all have access to it. For example, if all people in the village/world jointly own a lakeshore, it is open for all of them to use.

The first two cases are open-access regimes. The third case is either private or common property, and the open access is not guaranteed by the lack of ownership but rather by the policy of the owner. The fourth case is of common property, and it is the ownership-by-all that guarantees open access to all, as all are owners.

The first two cases are open access, whereas the third and fourth cases are not, even though the resource is open to the public, and there are practical aspects to this difference. In the first two cases, no one can limit the use of the lakeshore - as there is no owner - whereas, in the third and fourth cases, there are owners and they can regulate the use thereof. For example, while the State which owns the lakeshore declares it to be open for all, it stipulates opening hours, dress code, no-smoking policy, etc. Similarly, in the fourth case, all the owners together, or by a representative managing board, can regulate and limit the

use of the lakeshore. Indeed, open access is characterized by the lack of constraints on both the number of users and the amount that each user may extract,[485] hence the risk of over-harvesting and other unsustainable use, or, in Hardin's famous phrase, the "tragedy of the commons".[486] Indeed, when Hardin coined the phrase "tragedy of the commons", he was actually talking about open access, not common property.[487] The "pasture open to all" he discussed was not and could not be regulated as there was no owner.

Latin terms, often mentioned in this context (*e.g., res nullious*, *res communis*), are purposely not used herein as using them adds a set of concepts to the discourse with their particulars which may complicate, rather than simplify and clarify, the discourse. For example, *terra nullious* has a certain meaning in international law scholarship that is narrower, or at least different, from open access discussed previously and which many associate with *res nullious*. It is not the aim of this chapter to discuss the correlation between *terra nullious*, *res nullious*, and open access. Hertzfeld, Weeden and Johnson[488] were right in warning from the pitfalls of using Latin terms in the discourse on space natural resources.

Common property, it should be emphasized, is by no means limited to socialistic economies, but rather is prevalent even in the most capitalist economies. "Private goods", in the meaning presented in Section 5.5.1 above, is often held by a group of owners and is thus "common property"; this includes the shared spaces in a condominium (*e.g.,* the elevators)

[485] Glenn G. Stevenson, *Common Property Economics: A General Theory and Land Use Applications* (Cambridge University Press 2005).

[486] Garrett Hardin, 'The Tragedy of the Commons' (1968) 162 Science 1243.

[487] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010).

[488] Hertzfeld, Henry, Brian Weeden and Christopher Johnson, 'How Simple Terms Mislead Us: The Pitfalls of Thinking About Outer Space as Commons' (conference paper AC-15 - E7.5.2 x 29369) presented at the 66th IAC / 58th IISL Colloquium, held in Jerusalem in September 2015.

and even the hallmark of capitalism, the corporation, is common property, if it has more than one shareholder. Another symbol of capitalism - the private equity investment funds - is in itself common property. These investment funds are typically limited partnerships for collective investments in various securities, mostly equity. The limited partnership agreement (LPA) sets forth the terms according to which the partnership is governed and operated.

The 1967 OST recognizes or grants rights to "mankind", when providing that "[t]he exploration and use of outer space … shall be the province of all mankind". Mankind, or humankind, is not a clear entity with organs operating in its name. The OST also recognizes or grants rights to all States, when it provides that "Outer space … shall be free for exploration and use by all States".

The aforementioned definitions and differentiations allow us to examine whether the 1967 OST establishes common property in space. According to the OST, certain "sticks", *e.g.,* the right to access, are given to all States, separately. Therefore, the identity of the holder is not a group, and it is not "common property". Other rights, *e.g.,* the rights of management and exclusion, are not held by any single State and thus, by default, are in the collective hands of all States as collective-choice decisions. These rights are therefore "common property" of all States. In other words, private ownership coexists side by side with common property. Such a cohabitation of the private and commons is not rare.[489] It is doubtful whether a right of alienation exists vis-a-vis natural parts of space.

[489] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd. ed, Edward Elgar 2010).

If the picture portrayed so far seems complex, it is precisely because it is so. To avoid confusion and analytical errors, it is necessary to be aware and pay attention to the distinctions between the economic and legal; between the resource and property rights over it; between the resource system and resource units; and between the type of resource, type of holder, and identity of the holder. It is important to consistently follow the definitions and proper uses of the concepts of commons, CPRs, and property rights.

The brief suggestion of possible answers regarding the "commons" feature of parts of space demonstrates the complexity of the question, or questions to be exact, and the need for a well-structured study of the issue in order to arrive at persuasive conclusions.

5.8 Connecting the Economic and the Legal Perspectives: The Appropriate Governance of Space Natural Resources

5.8.1 The Proper Governance of each Space Resource

Section 5.5 above presented the four different types of resources according to economic analysis (see **Table 1**). The different types of resources have different types of suitable and efficient governance and property rights regimes. Therefore, identifying the type of resource each part of space belongs to is critical for choosing the proper management regime for it. An improper regime will necessarily lead to a waste of resources or unsustainable use thereof.

Resources that are "private goods" in the economic sense are normally better governed by a legal regime of private property. This is well established and recognized also by proponents of common management regimes for certain resources.[490] Other types of resources have different types of efficient governance regimes. In particular, as Ostrom

[490] Ostrom and Hess (2010) ibid.

demonstrated,[491] resources that are (economic) CRPs are better managed by the users by way of collective action. For these types of resources, even if other types of management are feasible, *e.g.,* government management or private property, users' management is the proper regime to select because it is more efficient than the alternatives.[492]

There is therefore a connection between the type of resource in the economic sense and the efficient governance thereof, governance that may be established or described in terms of a legal regime of property. Hence, there is a connection between the economic and the legal perspectives.

Another thing to remember when analyzing property right regimes is that property rights rules have distributive effects, i.e. property rights regimes affect the distribution of gains and losses between the various actors. Moreover, when there is a significant variety of technological advancement between the different actors, the distributive effects are even more meaningful,[493] and the exploitation of outer space is depended on a high level of technological advancement. Many of the UN General Assembly resolutions regarding the exploitation of outer space have repeatedly expressed concern regarding the distribution of the benefits from this exploration. The issue is not resolved by the space law treaties. Article I of the OST provides that "[t]he exploration and use of outer space…shall be carried

[491] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge University Press 1990); Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 The American Economic Review 641.

[492] In contrast, Hertzfeld et al. suggest that '[t]he particular usefulness of Ostrom's approach is that it is developed for situations where neither of the two traditional solutions to the tragedy of the commons, complete privatization or a Leviathan to impose rule of law, are feasible'. Hertzfeld, Weeden and Johnson (footnote 487).

[493] Elinor Ostrom and Charlotte Hess, 'Private and Common Property Rights' in Boudewijn Bouckaert and Gerrit De Geest (eds), *Encyclopedia of Law and Economics*, vol 5 (2nd., Edward Elgar 2010); Gary D. Libecap, 'Distributional Issues in Contracting for Property Rights' (1989) 145 Journal of Institutional and Theoretical Economics (JITE) / Zeitschrift für die gesamte Staatswissenschaft 6.

out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development…". The Moon Agreement introduced the principle of common heritage of mankind, but this principle is still vague enough, and, as noted, even this was enough to prevent the treaty from being widely accepted. Even the 1996 UNGA declaration[494], dubbed the 'space benefits declaration' did little to clarify the issue.[495] Pursuing equitable distribution of space benefits requires paying attention also to the distributive effects of each possible property rights regime.

5.8.2 The Governance of Space Natural Resources within a Polycentric System of Space Governance

Chapter 4 presents the case for polycentric space governance, which features separate and semi-independent governance centers for the various sub-issue-areas, space natural resources being one of them. Ostrom's design principles, also reviewed in chapter 4, include that of nested enterprises: When a CPR resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers. Section 5.4.2 above suggested that we need to differentiate between the various parts of space. The previous section noted that we should analyze each resource in order to establish the type of resource they are, and therefore the appropriate governance thereof: a private good by an owner, a CPR by it users and a public good managed by a public authority (what in States is the government). Organizing governance activities in multiple nested layers means that space governance would have numerous governance centers, one of which is the governance center of space natural resources. Furthermore, it means that

[494] UN General Assembly Resolution 51/122: 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, adopted 13 December 1996 (A/RES/51/122).

[495] Elena Carpanelli and Brendan Cohen, 'A Legal Assessment of the 1996 Declaration on Space Benefits on the Occasion of Its Fifteenth Anniversary' (2012) 38 Journal of Space Law 1.

this governance center will have subsidiary governance centers, one for each resource or type of resources. Thus, each space resource will be classified (as private goods, public goods, CPR or toll goods, see Table 1), to establish the proper governance thereof. Moon resources, Mars resources, near earth asteroids, the geostationary orbit etc. will each have their own governance center. It is also possible that various Moon resources or various parts of the Moon will have their own governance center. All these governance centers will be nested within the governance center of space natural resources, which, in turn, will be nested within space governance in general. This means allocation of certain powers to each level of governance.

The result is that each resource or type of resource has a governance system that suits its characteristics, and is nested within the larger system of space natural resources, and all are part of space governance and operate in conformity with the space law treaties and in coordination with other governance centers and the main forums – UN-COPUOS and UNOOSA.

5.9 Conclusions

The discourse on the commons feature of space or whether or not space is commons should be rephrased and relaunched. To begin with, the discourse must differentiate between economic commons and legal commons, i.e. between the resource itself (and its economic features) and the legal regime applied to it. In doing so, we must remember that commons in one sense does not mean commons in the second sense and that an economic commons can be private property in the legal sense of the term.

The second step is to rephrase the questions as they should not refer to space as a whole. Instead, the analysis must be undertaken separately for each part of space or at least categories of parts of space, *e.g.,* planets, starts, moons, asteroids, resource units (*e.g.,* helium, platinum, water); void space; artificial objects such as satellites and the ISS. Even the use of categories needs care because, for example, the category of "earth orbits" may include orbits that are CPRs and orbits that are not. Another important distinction is between resource systems and resource units, because the resource units flowing from a resource can have a different legal regime than the resource system itself.

As this chapter demonstrated, the concept of 'global commons', often applied to outer space, is of limited or unclear meaning and it does not imply the property rights regimes in the domains and resources it presumably describes, including outer space. Therefore, the analysis should follow the following lines: after having identified a specific part of space or category of parts of space, and having established which kind of resource it is, according to the economic definitions, we can associate the efficient governance regime to it, according to the economic literature, and move forward to suggest the appropriate legal regime. Alternatively, or simultaneously, after having identified a certain part of space or category of parts of space, we can ask what kind of legal regime the space treaties provide with regards to it, if any. Only if the discourse on space natural resources will follow the proper definitions and distinctions presented herein, will we be able to both devise sound legal interpretation and craft policy based on the accumulated knowledge on the proper governance of the commons.

By now it should be clear that the EU's statements that "[t]he EU recognises the outer space as a *global common good*, to be used for the benefit of humankind" (emphasis mine), mismatching types of goods (economic analysis) and designated areas outside national jurisdictions (legal analysis) is conceptually erroneous and misguiding and one can hope that it will not be the basis of analysis or policy, nor will other conceptually erroneous assumption regarding the commons feature of space.

The initial economic analysis herein shows that space is made of several parts, most of which - but not all - are economic commons, whereas some are CPRs. Celestial bodies - including asteroids and their minerals - and congested orbits, are all CPRs. CPRs, as Ostrom has shown, are best managed by their users.

The initial legal analysis showed that some legal rights, *e.g.,* access, are held by each and every State, whereas others, *e.g.,* management, exclusion (but not alienation), are held collectively by all States or humankind. In other words, the right of management is common property of all States or of humankind. It is not clear whether the right of withdrawal is also given to each and every State, as part of the freedom of use granted by the OST. Each State is therefore at least an authorized entrant and possibly, if "use" includes withdrawal, an authorized user.

This chapter purports to structure the discourse on the commons feature of space natural resources and their proper governance. Conducting the discourse along these lines will enable application of and contribution to the cutting-edge literature in both the fields of economic sciences and legal theory and conducting a cross-disciplinary discourse on the issue.

The governance of space natural resources should take a multilevel nested structure: there will be a governance center for each space resource, or types of space natural resources. The type of governance will be decided according to the type of resource (i.e. private goods, public goods, CPR or toll goods, see Table 1). These governance centers will be nested within the governance center of space natural resources, which, in turn, will be nested within general space governance. While the governance center of a certain resource will have some powers, *e.g.,* adopting work procedures, standards, coordination, it needs to comply with regulation adopted at the higher level, at the governance center of space natural resources. And while the governance center of space natural resources has some power to adopt rules, it needs to comply with the space law treaties and by synced with space governance in general. By this the governance of space natural resources will suit the type of each resource, will conform to the space law treaties and maintain the polycentric structure of space governance.

Chapter 6
The Governance of Space Warfare

This chapter analyses the governance of space warfare as a 'regime complex'. It maps the regime complex by discussing the various theaters for space warfare and the respectfully applicable rules and mandated *fora*. It finally provides a roadmap for the governance of space warfare under the constraints of global politics. In terms of policy recommendations, it calls for working within the regime complex: expanding its elements and introducing new ones, leading to the gradual development of a flexible network of regimes, covering in the aggregate a large part of the issue area of space warfare.

6.1 Space warfare: Three Types, Five Theaters, and One Regime Complex

Space warfare has made a comeback in terms of attention and discourse. A review of the literature shows a series of writings on the issue during the 1980s[496], probably inspired by the Regan Administration's "Strategic Defense Initiative", colloquially known as the "Star Wars program". There was a sharp decline in writings on the issue in later years and a resurgence of writings since the turn of the 21st century[497].

Space warfare can be divided into three types: (1) space to space attack, taking place solely in space, in which space-based installations attack or are being attacked by other space-based installations or weapons; (2) space to/from earth attack, initiated from space to

[496] See, for example: David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Air University Press 1988); John W. Macvey, *Space Weapons, Space War* (Stein and Day 1985); Daniel Deudney and Robert Pfaltzgraff, 'The Literature of Star Wars' (1985) 39(1) Journal of International Affairs 199; Scott F. March, 'An Interdisciplinary Approach to the Strategic Defense Initiative Debate' (1986) 19(3) Akron Law Review 1; Christopher Lee, *War in Space* (Hamish Hamilton 1986); David Pahl, *Space Warfare and Strategic Defense* (Exeter Books 1987); Alfred R. Garcia, *A Strategy for Space Warfare* (Air War College, Maxwell 1987); David Hobbs, *An Illustrated Guide to Space Warfare* (Prentice Hall 1986); S. Worden and B. Jackson, 'Space, Power, and Strategy' (1988) 13 The National Interest 43; Elvy Pettit, *What to do About ASAT* (U.S. Army War College 1988); and Alfred R. Garcia, *A Strategy for Space Warfare* (Air War College, Maxwell 1987).

[497] See, for example: Jordan David, 'Air and Space Warfare' in David Jordan, James D. Kiras, David J. Lonsdale, Ian Speller, Christopher Tuck and C. Dale Walton, *Understanding Modern Warfare* (2nd ed, Cambridge 2016) 227; Linda Dawson, *War in Space: The Science and Technology Behind Our Next Theater of Conflict* (Springer 2018); James Moltz, 'Military Space: Expanded Use and New Risks' in James Moltz, *Crowded Orbits: Conflict and Cooperation in Space* (Columbia 2014) 121; James Oberg, *Space Power Theory* (Washington, DC, U.S. Government Printing Office 1999); John J. Klein, *Space Warfare: Strategy, Principles and Policy* (Routledge 2012); Eligar Sadeh (ed), *Space Strategy in the 21st Century: Theory and Policy* (Routledge 2012); Damon Coletta and Frances T. Pilch (eds), *Space and Defense Policy* (Routledge 2009); Helen Caldicott and Craig Eisendrath, *War in Heaven: The Arms Race in Outer Space* (The New Press 2007); Michael E. O'Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space* (Brookings Institution Press 2004); Nayef Al-Rodhan, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governance* (Springer, 2012); Natalie Bormann and Michael Sheehan, *Securing Outer Space: International Relations Theory and the Politics of Space* (Routledge, 2009); Bert Chapman, *Space Warfare and Defense: A Historical Encyclopedia and Research Guide* (ABC-CLIO 2008); Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (Routledge, 2005); Jan-Frederik Kremer and Benedikt Müller (eds), *Cyberspace and International Relations: Theory, Prospects and Challenges* (Springer, 2013); Anil Kumar Lal, *Space Warfare and Military Strategy: An Indian Perspective* (Ocean Books 2003); Charles D. Lutes, Peter L. Hays, Vincent A. Manzo, Lisa M. Yambrick and M. Elaine Bunn, *Toward a Theory of Spacepower: Selected Essays* (Department of Defense (DOD), National Defense University (NDU), 2011); Max M. Mutschler, *Arms Control in Space: Exploring Conditions for Preventive Arms Control* (Springer 2013); Brent Ziarnick, *Developing National Power in Space: A Theoretical Model* (McFarland 2015); James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford University Press 2008); and Joan Johnson-Freese, *Space Warfare in the 21st Century* (Routledge 2016).

earth or vice versa, in which case an attack can be launched from a space-based installation aimed at targets on earth – on land or in the sea; or vice versa, from an installation on earth – on land or in the sea, targeting space assets. In both cases the weapon will cross the air space on the way. Anti-satellite weapons (ASAT) are one example for this category[498]; and (3) a cyber-attack targeting space assets. A cyber-attack may start at the virtual domain, but it has effects in the real world, just like the Stuxnet virus caused physical damage to the centrifuges in the nuclear plant in Iran back in 2009-2010[499]. No State has known operative capabilities for the first type (except surveillance), very few for the second, but the third is cheaper and more accessible, and will therefore be the leading model of space warfare.

Space warfare therefore may take place in five different theaters or domains: outer space, air space, open seas, territorial land, and cyberspace. Each theater has different sets of rules of international law, *e.g.,* regarding sovereignty. Extracting the applicable legal rules is complicated: the application of public international law in general, and the laws of war in particular, to the new theaters – outer space and cyberspace – is not self-evident. At the same time, special regimes for space warfare have been established and more were put forward, with partial yet progressive success. In addition, pointing to the adequate international forum is also complicated: due to the five different theaters of warfare, there are several international *fora* that can be said to have mandate over space warfare issues.

[498] On the spread of ASAT capabilities see: Brian Weeden and Victoria Samson (eds), *Global Counterspace Capabilities: An Open Source Assessment* (Secure World Foundation 2019) <https://swfound.org/media/206408/swf_global_counterspace_april2019_web.pdf> accessed 12 August 2019.

[499] On the Stuxnet as the emergence of cyber warfare see, for example: Jon R. Lindsay, 'Stuxnet and the Limits of Cyber Warfare' (2013) 22(3) Security Studies 365; Thomas M. Chen, 'Stuxnet, the Real Start of Cyber Warfare?' (2010) IEEE Network <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5634434> accessed 16 May 2016; John Richard, 'Stuxnet as Cyberwarfare: Applying the Law of War to the Virtual Battlefield' (2011) 29 John Marshall Jornal of Computer & Information Law 1; Sean Collinsa and Stephen McCombiea, 'Stuxnet: the emergence of a new cyber weapon and its implications' (2012) 7(1) Journal of Policing, Intelligence and Counter Terrorism 80.

Space warfare, in its various theaters, face a potential dual problem – (i) lack of appropriate legal rules or *fora*; or (ii) overlapping and possibly conflicting legal rules and *fora*. This dual problem of space warfare is the subject of this chapter.

This chapter builds on chapter 3, in particular on its introduction and synthesis of the concepts of 'regime complexes', 'polycentric governance', and 'fragmentation'. Building on the synthesized lessons from these three similar concepts to governance design in our partially globalized world[500], this chapter draws the roadmap to governance of space warfare and provides policy recommendations on the desired focus of the international efforts to regulate space warfare. This road may also suit other issue-areas in international affairs.

The next section explains the advantages of using the concept of regime complexes to analyze the governance of space warfare and extract policy recommendations. Section 6.3 explains the method used in the chapter to map the regime complex of space warfare and the following three sections map the said regime complex. Section 6.7 presents the governance of space warfare as an evolving regime complex, and section 6.8 calls to embrace this regime complex. Section 6.9 discusses the ways to expand the elemental regimes that constitute the regime complex of warfare, and section 6.10 provides the conclusions of this chapter.

6.2 The Analytical Advantages of Using the Concept of Regime Complexes

The concept of 'Regime Complexes' is not a mere act of classification. It provides the analytical tools for understanding and constructing, to the extent planning is feasible, the

[500] For the concept and implications of a partially globalized world see Robert O. Keohane, *Power and Governance in a Partially Globalized World* (Routledge 2002).

governance of issue-areas in global affairs, including space warfare. The importance – and even necessity - of analyzing complex systems as such is demonstrated in 'complexity studies' in general and in the literature on regime complexes in particular.

A 'complex system' is a system with a large number of different elements capable of interacting with each other and with their environment yet characterized by nonlinearity in the relations among the elements.[501] Typically, complex systems are composed of self-organizing elements. They cannot be controlled or directed centrally, and their problems cannot be solved centrally.[502] Complexity studies do inform us that when it comes to complex systems, knowledge of the elements does not give even a glimpse of the behavior of the whole, and, moreover, may lead to misconceptions and misunderstandings of the elements themselves.[503] The whole is different than the sum of its parts and the dynamics of the whole, shape the behavior of its parts. Therefore, only thinking and analyzing a complex system as such enables proper understanding of the whole as well as its parts. As this chapter demonstrates, the governance of space warfare is a complex aggregate of numerous instruments and *fora* and is therefore a complex system or a 'regime complex'. Complexity theory can advance our understanding of complex systems in general and regime complexes in particular, but although Morçöl made the case to apply it to governance, suggesting a conceptualization of complex governance networks[504], the

[501] On complexity theory see L.A.N Amaral and J.M. Ottino, 'Complex Networks: Augmenting the Framework for the Study of Complex Systems' (2004) 38 The European Physical Journal B 147; on complexity theory and its use for the study of governance see Göktu˘ g Morçöl, 'Complex Governance Networks: An Assessment, Complexity' (2014) Governance & Networks 1.

[502] Morçöl (2014) ibid.

[503] Karen J. Alter and Sophie Meunier, 'The Politics of International Regime Complexity' (2009) 7(1) Perspectives on Politics 13; Amaral (2004) (footnote 501).

[504] Morçöl (2014)(footnote 501).

international relations literature on regime complexes is more developed and is used herein.[505]

The concepts of regimes and regimes complexes are presented in chapter 3. In a nutshell, regimes are implicit or explicit norms, rules, and decision-making procedures, descriptive or prescriptive in nature, that create, reflect and affect actors' expectations, and are institutionalized to varying degrees — from a 'gentlemen's agreement to soft law to treaties. Regimes may be created, observed, enhanced and even enforced by a multilateral forum or international organization, which constitute a part of the regime.

A regimes complex, as conceptualized by Raustiala and Victor,[506] is an issue-area in global affairs for which there is no single, discrete governing regime, and instead the relevant rules are found in several regimes - what they call *elemental regimes*. The elemental regimes are legal agreements created and maintained in distinct *fora* with participation of different sets of actors, and they overlap in scope, subject, and time. The rules in these elemental regimes functionally overlap, and even often conflict, and yet there is no agreed hierarchy between them, or a rule or procedure for resolving conflicts between the rules. The collective of these elements is a *regime complex*: an array of partially overlapping and non-hierarchical regimes, possibly interconnected, and often with conflicting rules, governing a particular issue-area.

Raustiala and Victor note that regime complexes evolve in ways that are distinct from decomposable single regimes and that there are advantages in analyzing interactions

[505] Morçöl (2014) (footnote 500). See also Göktuğ Morçöl, A Complexity Theory for Public Policy (Routledge 2012).

[506] Kal Raustiala and David G. Victor, 'The Regime Complex for Plant Genetic Resources' (2004) 58 International Organization 277.

among regimes systematically, using the concept of regime complexes.[507] Alter and Meunier also note the analytical insights that can be gained by thinking about any single agreement as being embedded in a larger web of international rules and regimes, referring also to complexity studies. They further identify the mechanisms through which a regime complex may influence the politics of international cooperation. [508]

A regime complex means that new elements are not introduced to a clean slate of governance, but rather join the existing elements, and the regime complex as a whole. The regime complex thus derogates from legal consistency and opens the door for forum/treaty shopping. A regime complex has several consequences, some negative and other positive or neutral, notably: changing the strategies and dynamic interactions of actors; reduced clarity of legal obligation allowing States to select their preferred interpretation; opening the door to cross-institutional political strategies ("chessboard politics"), including forum-shopping and regime-shifting; strategic inconsistency and strategic ambiguity; undermining accountability of actors and institutions; cross-institutional competition for constituents, resources, and projects; and greater interaction between the actors.[509]

It is therefore important to think about the governance of space warfare as a regime complex and to think and analyze any of the instruments and *fora* addressing space warfare as being elements in a regime complex. This mode of analysis allows proper understanding of the current governance of space warfare – each of its elements and the

[507] Raustiala and David G. Victor (2004) ibid.

[508] Karen J. Alter and Sophie Meunier, 'The Politics of International Regime Complexity' (2009) 7 Perspectives on Politics 13.

[509] Alter and Meunier (2009) summed up the lessons from a symposium they coordinated on the international regime complexity, including the consequences therefrom, as demonstrated by the various contributors to the symposium. The various contributions were published in Volume 7(1) of Perspectives on Politics (2009).

whole. It also allows drawing a roadmap with feasible and efficient ways to further develop the governance of space warfare, as sections 6.8-6.9 herein attempts to do. Indeed, in the creation of a new instrument or forum addressing space warfare, it is important to think of it as being a future part of the regime complex of space warfare. More broadly, when thinking about the future development of the governance of space warfare it is important to understand it as a regime complex and how a regime complex can develop and evolve. Sections 6.8-6.9 of this chapter draws the roadmap to governance of space warfare based on its analysis as a regime complex.

6.3 Mapping the Existing Regime Complex of Space Warfare

This section maps the existing regime complex of space warfare, by presenting: (i) select legal or quasi-legal instruments such as treaties, guidelines and codes of conduct that constitute or reflect the normative framework(s); and (ii) multilateral forums with appropriate mandate, which constitutes the operative mechanisms. It is by no means an exhaustive list of those regimes, but rather a sample of the main regimes, that is sufficient to portray the meta structure of those regimes, which is, as suggested herein, a regime complex. The regimes applicable to traditional conflicts on land, sea and air are only briefly reviewed, as they are well established and known; the regimes applicable to outer space and cyberspace receives more attention, as they are newer, especially the last one, and less established. However, also with regard to outer space and cyberspace, the point here is not the mapping of all regimes, but to present enough to sustain the assertion of the existence of a regime complex, so as to encourage the analyzes of space warfare under the prism of regime complex, and to provide the methodology for such analysis.

The review of the applicable regimes may be divided in two modes: (i) according to the theater, where a separate account is given to regimes applicable to the different domains of land, sea, air, outer space and cyberspace; and (ii) according to the level of the regime, from the multilateral, to the regional, national and even sub-State or non-State level. This chapter reviews only multilateral regimes and will therefore follow the first mode of division.

6.4 Governance of Conflicts in Traditional Theaters – Land, Sea, and Air

The regimes relevant to the traditional theaters of land, sea, and air are well established and known, and the following is just a brief note on the main relevant regimes. The laws of war are the segment of public international law governing all aspects of international armed conflicts, with two sub categories: (i) *jus ad bellum*, the rules providing when it is lawful for a State to *open* war or to resort to the use of armed force in general, as an exception to the general prohibition against the use of force[510]; and (ii) *jus in bello,* the laws of armed conflict (LOAC), also known as international humanitarian law (IHL)[511], comprising the rules regulating behavior *during* an armed conflict.[512] The laws of war include basic norms and specific rules, and the main legally binding instruments are: the UN Charter of 1945[513]; the four Geneva Conventions as revised in 1949[514] with their

[510] The prohibition is stipulated in Article 2(4) of the UN Charter which reads: "All members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the purposes of the United Nations." United Nations, Charter of the United Nations, 24 October 1945, 1 UNTS XVI.

[511] On the various titles used for the laws of war see Gary D. Solis, *The Law of Armed Conflict: International Humanitarian Law in War* (2nd ed, Cambridge University Press 2016) 20.

[512] On war and international law see generaly: Solis (2016) ibid; Andrew Clapham and Paola Gaeta, *The Oxford Handbook of International Law in Armed Conflict* (Oxford University Press 2014); Stephen C. Neff, *War and the Law of Nations: A General History* (Cambridge University Press 2005).

[513] United Nations, Charter of the United Nations, 24 October 1945, 1 UNTS XVI.

[514] Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field, Aug. 12, 1949, 6 UST. 3114, T.I.A.S. 3362, 75 U.N.T.S. 31; Geneva Convention for the Amelioration of

Additional Protocols adopted in 1979[515] and 2005[516]; the Hague Conventions of 1899 and 1907[517]. There are also numerous other treaties, case law, and customary international law, including instruments of specific nature, *e.g.* referring to a certain type of warfare or weapons. The San Remo Manual on International Law Applicable to Armed Conflict at Sea and the Harvard Manual on International Law Applicable to Air and Missile Warfare discuss the rules of international law applicable to warfare at sea and in the air.

There are numerous relevant institutions with some kind of mandate on issues of warfare in the traditional theaters of land, sea, and air, most notably the UN and its General Assembly and Security Council, the International Court of Justice (ICJ)[518], the International Criminal Court (ICC)[519], and the International Tribunal for the Law of the Sea[520].

In addition to the rules and *fora* on the launch and conduct of warfare, there are multilateral regimes (instruments and fora) banning the use and even possession of certain weapons and the proliferation thereof. These include the Chemical Weapons Convention[521],

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the Condition of Wounded, Sick, and Shipwrecked Members of Armed Forces at Sea, Aug. 12, 1949, 6 UST. 3217, T.I.A.S. 3363, 75 U.N.T.S. 85; Geneva Convention, Relative to the Treatment of Prisoners of War, Aug. 12, 1949, 6 UST. 3316, T.I.A.S. 3364, 75 U.N.T.S. 135; and Geneva Convention, Relative to the Treatment of Civilian Persons in Time of War, Aug. 12, 1949, 6 UST. 3516, T.I.A.S. 3365, 75 U.N.T.S. 287.

[515] Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts, June 8, 1977, 1125 U.N.T.S. 3; and Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of Non-International Armed Conflicts, June 8, 1977, 1125 U.N.T.S. 609.

[516] Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Adoption of an Additional Distinctive Emblem, Dec. 8, 2005.

[517] The Proceedings of the Hague Peace Conferences (Oxford University Press 1920).

[518] See https://www.icj-cij.org/en (last visited July 30, 2019). On the ICJ see Robert Kolb and Alan Perry, *The International Court of Justice* (Hart Publishing 2013).

[519] See <https://www.icc-cpi.int/> accessed 30 July 2019. On the ICC see Olympia Bekou and Robert Cryer, *The International Criminal Court* (Ashgate/Dartmouth 2004); Cenap Çakmak, *A Brief History of International Criminal Law and International Criminal Court* (Palgrave Macmillan 2017).

[520] See <https://www.itlos.org> accessed 30 July 2019. On the tribunal see P. Chandrasekhara Rao and Ph Gautier, The Rules of the International Tribunal for the Law of the Sea : A Commentary (Martinus Nijhoff 2006).

[521] Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, 1974 UNTS 45; 32 ILM 800 (1993).

the Biological and Toxin Weapons Convention[522], the Treaty on the Non-proliferation of Nuclear Weapons[523], and non-multilateral treaties such as the Anti-Ballistic Missile Treaty[524] between the US the Soviet Union, from which the US withdrew in 2002[525], and the 1987 Intermediate-Range Nuclear Forces (INF) Treaty[526] between the two States, from which the US withdrew in August 2019[527]. There are multilateral regimes that include both an instrument and a forum to limit proliferation of certain kinds of weapons, *i.e.*, the Missile Technology Control Regime (MTCR)[528], the Wassenaar Arrangement[529], The Nuclear Suppliers Group (NSG)[530] and the Zangger Committee (ZAC)[531] on nuclear proliferation, and the Australia Group (AG) on chemical weapons and biological weapons [532].

The MTCR, regulating the distribution of missiles and missile technology, also applies to rocket launchers, used to launch satellites and place them in orbit, as they are essentially missiles. While this regime was established to address proliferation of missiles, it does extend to rocket launchers and therefore to space warfare. Moreover, most current ASAT weapons are essentially missiles, and therefore are covered by the MTCR. However, the MTCR does not apply to ASAT missiles launched from aircrafts. Moreover, the MTCR does not ban altogether the development and holding of missiles including ASATs.

[522] Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 33757 UNTC (1997).

[523] 729 UNTS 161; 7 ILM 8809 (1968); 21 UST 483.

[524] UNTC 13446 UNTC (1972)

[525] 'The Anti-Ballistic Missile (ABM) Treaty at a Glance' (*Arms Control Association*) <https://www.armscontrol.org/factsheets/abmtreaty> accessed 2 August 2019.

[526] 'The Intermediate-Range Nuclear Forces (INF) Treaty at a Glance' (*Arms Control Association*) <https://www.armscontrol.org/factsheets/INFtreaty> accessed 2 August 2019.

[527] 'US Pulls out of Nuclear Treaty with Russia' (*BBC News* 2 August 2019) <https://www.bbc.com/news/world-us-canada-49198565> accessed 2 August 2019.

[528] See <http://www.mtcr.info/English> accessed 30 July 2019.

[529] The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, see <https://www.wassenaar.org> accessed 30 July 2019.

[530] See <http://nuclearsuppliersgroup.org/en> accessed 30 July 2019.

[531] See <http://zanggercommittee.org> accessed 30 July 2019.

[532] See <https://australiagroup.net/en> accessed 30 July 2019.

If space warfare will occur, at least in part, in one of these traditional theaters, all the above and other well-known regimes will apply. If space warfare will occur in more than one of these theaters, then the regimes that apply to each and all of these theaters will concurrently apply to space warfare. Such would be the case, for example, of using an anti-satellite missile launched from earth to destroy a satellite in space, like those already in the hands of several States. China[533], the US[534], Russia[535] and India[536] already conducted successful experiments with ASAT missiles. A kinetic ASAT weapon is essentially a missile, which can destroy, damage or jam a satellite orbiting in space.[537] In each of the ASAT tests, the respective State launched an ASAT missile, which destroyed a pre-determined target - a satellite of the same State. ASAT tests conducted so far used missiles launched from land, but such missiles could easily be launched from sea and it is possible that States would develop ASAT missiles that may be launched from the air. Technologically developed armies are already using space assets regularly and The Persian Gulf War of 1991 was dubbed by many as the 'first space war' due to the extensive use of satellites by the US armed forces.[538] Since developed armies, as well as civil society, are dependent on satellite-

[533] Shirley Kan, 'China's Anti-Satellite Weapon Test' (*Defense Technical Information Center* 2007) <http://www.dtic.mil/docs/citations/ADA468025> accessed 30 July 2019.

[534] 'A History of Anti-Satellite Programs (2012)' (*Union of Concerned Scientists*) <https://www.ucsusa.org/nuclear-weapons/space-security/a-history-of-anti-satellite-programs> accessed 31 July 2019.

[535] Amanda Macias and Michael Sheetz, 'Russia Conducted Another Successful Test of an Anti-Satellite Missile, According to a Classified US Intelligence Report' (*CNBC*, 18 January 2019) <https://www.cnbc.com/2019/01/18/russia-succeeds-in-mobile-anti-satellite-missile-test-us-intelligence-report.html> accessed 31 July 2019.

[536] 'The Implications of India's ASAT Test' (*The Space Review*) <http://www.thespacereview.com/article/3686/1> accessed 30 July 2019.

[537] 'What Is ASAT and How Can It Be Used in War?' (*Business News*) <https://www.businesstoday.in/current/economy-politics/what-is-an-asat-pm-narendra-modi-space-missile/story/331585.html> accessed 31 July 2019.

[538] Peter Anson and Dennis Cummings, 'The First Space War: The Contribution of Satellites to the Gulf War' (1991) 136 The RUSI Journal 45; Larry Greenemeier, 'GPS and the World's First "Space War"' (*Scientific American*) <https://www.scientificamerican.com/article/gps-and-the-world-s-first-space-war/> accessed 30 July 2019.

based communication and navigation, destroying an enemy's satellite would cripple its ability to conduct warfare and may paralyze at least parts of its economy and normal civilian life. This makes space assets, notably satellites, prime targets. A future use of ASAT missile means that an attack is launched from land or sea, crosses the airspace and matures in outer space, thus already involving several theaters and multiple applicable regimes.

6.5 Governance of Conflicts in the Theater of Outer Space

While four States are known to have ASAT systems, the development of space-based weapons is conducted under top secrecy with little public information about it.[539] Yet, several States are already on track to establish an independent space force or space command as part of their armed forces, notably the US[540] and France[541], and others have transformed their air force to an air force and space command or aerospace force, notably Russia[542] and Israel[543]. Defense institutions around the world, mainly those of the big powers, have developed or are developing strategies and tactics for warfare in the theater of space. It should be noted that the space forces or commands, and the strategies and tactics for space warfare, include also space warfare that involves, in addition to the theater

[539] For some media items see: Jen Judson, 'Space-Based Laser Weapons Could Ultimately Take out Missile Threats in Boost Phase' (*Defense News*, 14 August 2018) <https://www.defensenews.com/digital-show-dailies/smd/2018/08/14/space-based-laser-weapons-could-ultimately-take-out-missile-threats-in-boost-phase/> accessed 2 August 2019; 'Pentagon Wants to Test A Space-Based Weapon in 2023' (*Defense One*) <https://www.defenseone.com/technology/2019/03/pentagon-wants-test-space-based-weapon-2023/155581/> accessed 2 August 2019; Kyle Mizokami, 'France Is Making Space-Based Anti-Satellite Laser Weapons' (*Popular Mechanics*, 25 July 2019) <https://www.popularmechanics.com/military/weapons/a28509615/france-anti-satellite-weapon/> accessed 2 August 2019; 'The Most Dangerous Space Weapons Ever' (*Space.com*) <https://www.space.com/19-top-10-space-weapons.html> accessed 2 August 2019.

[540] 'United States Space Force' (*Military.com*) <https://www.military.com/space-force> accessed 30 July 2019.

[541] Joshua Posaner, 'Macron to Create French Military Space Force' (*POLITICO*, 14 July 2019) <https://www.politico.eu/article/macron-to-create-french-military-space-force/> accessed 30 July 2019.

[542] 'Space Forces: Ministry of Defence of the Russian Federation' (*Ministry of Defense of the Russian Federation*) <https://eng.mil.ru/en/structure/forces/cosmic.htm> accessed 30 July 2019.

[543] The force is called (Hebrew) זְרוֹעַ הָאֲוִיר וְהֶחָלָל, meaning the Air and Space Arm.

of space, the traditional theaters of land, sea, and air. Attempts to regulate warfare in the theater of space have started in the 1950s, and are continuing in full strength.

6.5.1 Applicability of International Law to Outer Space

The application of international law to outer space was not self-evident. Indeed, one of the first things that outer space law has set out to do was to declare or constitute such an application. UNGA resolution 1721 (XVI) of 1961 provided that "[i]nternational law, including the Charter of the United Nations, applies to outer space and celestial bodies.[544] UNGA resolutions are not legally binding[545], however the issue was again addressed by a UNGA declaration and the 1967 OST, a legally-binding treaty.

The 1963 Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space[546] prescribes in Articles 2 and 4 that all space activities "shall be carried on in accordance with international law". The widely endorsed 1967 Outer Space Treaty has given legal force to this claim in Article I and III. Article I provides that "Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States. . . in accordance with international law." Article III provides:

> *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*

[544] UN General Assembly Resolution 1721(XVI): International Co-operation in the Peaceful Uses of Outer Space, adopted 20December 1961.

[545] Arangio-Ruiz Gaetano, *The United Nations Declaration on Friendly Relations and the System of the Sources of Internatinal Law* (Sijthoff & Noordhoff 1979); Stephen M. Schwebel, 'The Effect of Resolutions of the U.N. General Assembly on Customary International Law' (1979) 73 Proceedings of the Annual Meeting (American Society of International Law) 301.

[546] UN General Assembly Resolution 1962 (XVIII): Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, adopted 13 December 1963.

> *accordance with international law, including the Charter of the United Nations.*[547]

Similar provisions were included in succeeding UN treaties on outer space, UNGA resolutions and annual reports of UN-COPUOS. There is a difference between the first UNGA resolution and the following declaration and treaty provisions. While UNGA resolution 1721 (XVI) of 1961 had set to apply international law to outer space *per se*, the 1963 Declaration and the 1967 OST provide that States, when conducting activities in outer space, should comply with international law.

The relevant provisions of the OST apply beyond the signatory States of the OST. While not all States ratified the OST, Jakhu and Freeland note that some of the provisions of the OST have already become part of customary international law[548], and this includes the provisions on the applicability of international law. Furthermore, international law applies also to non-State human activities in outer space. Article VI of the OST mandates States to ensure compliance of non-State actors under their jurisdiction with the OST. Article IV reads as follows:

> *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*

[547] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 18 UST 2410, 610 UNTS 205, 6 ILM 386 (1967).

[548] Ram S. Jakhu and Steven Freeland, 'The Relationship between the Outer Space Treaty and Customary International Law' (2016) paper presented at the 59th IISL Colloquium on the Law of Outer Space, Guadalajara, Mexico, September 27, 2016, available at SSRN: https://ssrn.com/abstract=3397145 or http://dx.doi.org/10.2139/ssrn.3397145.

> *moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty".*

Thus, whereas in general international law non-State activities need to be imputable to a State in order to trigger State responsibility[549], OST Article VI provides for State responsibility also for non-State activities in space, and thus removes all doubts concerning imputability.[550]International law therefore applies to all human space activities carried on by State and non-State actors. Indeed, "[a]s soon as activities of States entered outer space, the overarching regime of international law which governs the rights and responsibilities of States became automatically applicable there"[551] and international law binds States in outer space "as in all other dimensions"[552].

International law therefore applies to State activities that amount to space warfare and in particular to warfare in the theater of space. Furthermore, in the Advisory Opinion on the legality of the threat or use of nuclear weapons, the International Court of Justice (ICJ) declared that the law of armed conflict "applies to all forms of warfare and to all kinds of weapons, those of the past, those of the present and those of the future"[553] and it therefore

[549] On State responsibility see Ian Brownlie, System of the Law of Nations: State Responsibility: Part 1 (Oxford University Press 1983) 15; Ian Brownlie, Principles of Public International Law (5th ed, Oxford University Press 1998) 435–6; Chorzów Factory (Germany v Poland) (Claim for Indemnity) [1927] PCIJ (ser A) No 8, 21; and the Articles on the Responsibility of States for Internationally Wrongful Acts adopted by the International Law Commission (ILC) in 2001.

[550] Manfred Lachs, *The Law of Outer Space: An Experience in Contemporary Law-Making* (Martinus Nijhoff 1972), 122.

[551] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657, 663.

[552] Manfred Lachs, 'The International Law of Outer Space' (1964) 113 Recueil des cours 1, 89.

[553] Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, I.C.J. Reports 1996, p. 226, International Court of Justice (ICJ), 8 July 1996.

applies to weapons used in space warfare,[554] in general, and in the theater of space, in particular.

The applicability of international law to human space activities means that the laws of war reviewed in the previous sub-section apply to conflicts in the theater of space. This includes the UN Charter, the law of State responsibility, the laws of war including the prohibition on the use of force and the right to self-defense and international criminal law. Furthermore, international telecommunications law, which is not part of the laws of war, but which regulates the use of radio frequencies and the placement of satellites in orbit, is also applicable, considering that warfare in space involves the use – and disruption – of radio frequencies and satellites. The result is the application of a substantial body of laws to conflicts in the theater of space and broadening the mandate of existing international institutions to conflicts in outer space, first and foremost the UN and especially the UN Security Council, and also the ICJ and ICC.

In addition, there are the rules specific to the theater of space and weapons intended to be used in space. The UN has started initiating efforts to maintain outer space for peaceful purposes as early as 1957, the same year in which Russia launched the first artificial earth satellite, Sputnik 1 (launched October 4, 1957). Perhaps the first UN consideration of space warfare was UNGA resolution 1148(XII) adopted in November 1957, by which the UNGA urged the concerned States to give priority to reaching a disarmament agreement which will provide for, *inter alia*, "[t]he joint study of an inspection system designed to ensure that the sending of objects through outer space shall be exclusively for peaceful and

[554] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657, 663.

scientific purposes".[555] A year later, in UNGA resolution UNGA 1348 (XIII), the UNGA expressed the hope and goal that humanity will conduct things better in the new realm of space and "avoid the extension of present national rivalries into this new field"[556].

In the late 1950s and early 1960s, the UN considered proposals for prohibiting the use of space for military purposes and the placement of weapons of mass destruction in space.[557] These efforts resulted in provisions in legally-binding treaties, though of limited nature, and they were followed by several efforts and initiatives at limiting a space arms race. Through the years, and mainly since the dawn of the 21st century, there have been several initiatives to regulate, or even prevent, the weaponization of space and warfare in the theater of space, as reviewed herein below.

6.5.2 The OST

The OST imposes limitation on military uses of outer space by prohibiting the placement anywhere in space of weapons of mass destruction; by prescribing that celestial bodies - but not earth orbit or void space - shall be used exclusively for "peaceful purposes"; and by prohibiting the establishment of military bases on celestial bodies. Article IV provides:

> *States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.*

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[555] United Nations Resolution Regulation 1148(XII): Limitation and Balanced Reduction of all Armed Forces and all Armaments; Conclusion of an International Convention (Treaty) on the Reduction of Armaments and the Prohibition of Atomic, Hydrogen and other Weapons of Mass Destruction, adopted November 14, 1957.

[556] UNGA Resolution 1348 (XIII): Question of the Peaceful Use of Outer Space, adopted 13 December 1958.

[557] 'Outer Space' (United Nations Office for Disarmament Affairs) <https://www.un.org/disarmament/topics/outerspace/> accessed 9 July 2019.

> *The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited.*

It is important to note that the OST does not prohibit the placement of other weapons (not weapons of mass destruction) in space.

There were contentions that Article IV prohibits military uses of outer space altogether, however, by now there is a consensus that only *aggressive* activities are prohibited, while *non-aggressive* military uses of outer space are lawful.[558] Nevertheless, celestial bodies have a more protective regime as they are to be used *exclusively* for "peaceful purposes", and therefore even non-aggressive military activities are prohibited.[559] The OST, therefore, does not prevent a space arms race, and the quest to prevent such an arms race still continues to date.

6.5.3 The Partial Test Ban Treaty and Other Relevant Instruments

Another related treaty is the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (the Partial Test Ban Treaty - PTBT).[560] This

[558] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657, 663; Carl Q. Christol, 'The Common Interest in the Exploration, Use and Exploitation of Outer Space for Peaceful Purposes: The Soviet-American Dilemma' (1984) 18 Akron Law Review 193. Jakhu and Kuan-Wei elaborate on the meaning of 'aggressive purposes' see Ram S. Jakhu and Chen Kuan-Wei, 'Threats to Peaceful Uses of Outer Space: Politics and Law' (unpublished draft).

[559] On the meaning of 'peaceful purposes' and the whether space activities should be exclusively for peaceful purposes see ibid.

[560] Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water 1963 (480 UNTS 43).

is the first treaty to explicitly refer to outer space in general, and to military uses of outer space in particular. The treaty prohibits the conduct of nuclear weapons tests or any other nuclear explosion in the atmosphere, including outer space or under water. The treaty gained widespread acceptance, with 125 State parties, although nuclear powers China and France did not ratify it, and is considered a success, as no nuclear test was conducted in the atmosphere and in outer space since its adoption.[561] Another relevant treaty is the Environmental Modification Convention (ENMOD)[562], which prohibits the hostile use of environmental modification techniques having widespread, long-lasting, or severe effects on the environment, which expressly refers to the manipulation of the dynamics, composition or structure of the atmosphere or outer space.

A non-legally binding, but relevant instrument is the 2002 Hague Code of Conduct against Ballistic Missile Proliferation (HCoC),[563] which attempts to limit the proliferation of, inter alia, ballistic missiles and applies to rocket-launchers. Furthermore, the 2007 Space Debris Mitigation Guidelines [564] are also relevant, since warfare in the theater of space will produce a significant amount of space debris, as the ASAT tests conducted so far have demonstrated[565].

[561] Ram S. Jakhu and Chen Kuan-Wei, 'Threats to Peaceful Uses of Outer Space: Politics and Law' (unpublished draft).

[562] Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, concluded May 18, 1977, 31 UST 333, 1108 UNTS 152.

[563] Inter-Agency, Hague Code of Conduct against Ballistic Missile Proliferation (HCOC) (26 November 2002) <https://www.refworld.org/docid/3de488204.html> accessed 30 July 2019.

[564] UN Office for Outer Space Affairs, Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, Vienna 2010 < http://www.unoosa.org/pdf/publications/st_space_49E.pdf> accessed 11 August 2019. On the space-related soft law instruments see UN Office for Outer Space Affairs, Compendium on Mechanisms Adopted in Relation to Non-Legally Binding United Nations Instruments on Outer Space <http://www.unoosa.org/oosa/en/ourwork/spacelaw/nlbcompendium.html> accessed 12 August 2019.

[565] Sarah Lewin, 'India's Anti-Satellite Test Created Dangerous Debris, NASA Chief Says' (*Space.com*) <https://www.space.com/nasa-chief-condemns-india-anti-satellite-test.html> accessed 2 August 2019; Brian

6.5.4 UNGA Work on PAROS

The OST and the PTBT cover select issues, and efforts to expand multilateral regulation continue under the umbrella of the UN. The UN General Assembly has held three Special Sessions devoted to Disarmament (SSOD) to date: SSOD-I in 1978, SSOD-II in 1982, and SSOD-III in 1988, of which only SSOD-I succeeded in producing a final document.[566] The final document of the SSOD-I of 1978 provided that "[i]n order to prevent an arms race in outer space, further measures should be taken and appropriate international negotiations held in accordance with the spirit of the [Outer Space Treaty]"[567], and the Conference on Disarmament (CD) was mandated with holding these negotiations. In 1985 the CD established an ad hoc committee on the 'Prevention of an Arms Race in Outer Space' (PAROS), which convened annually for almost a decade, and ceased meeting in 1994.[568] Nevertheless, the work of the CD on the PAROS is still in progress, with some results in several initiatives.

The UNGA resolutions on PAROS: in 1981 the UNGA adopted resolution 36/97 C titled "Prevention of an Arms Race in Outer Space,"[569] noted that further effective measures to prevent an arms race in outer space should be adopted by the international community. The resolution urged all States, in particular those with major space capabilities, to actively

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Weeden, '2007 Chinese Anti-Satellite Test Fact Sheet' (*Secure World Foundation*) <https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf> accessed 2 August 2019.

[566] 'Special Sessions of the General Assembly Devoted to Disarmament' (*United Nations Office for Disarmament Affairs*) <https://www.un.org/disarmament/topics/ssod/> accessed 9 July 2019.

[567] 'Resolution and Decisions adopted by the General Assembly during its Tenth Special Session, 23 May - 30 June 1978 s 80' <https://s3.amazonaws.com/unoda-web/wp-content/uploads/2017/05/A-S10-4.pdf> accessed 13 August 2019.

[568] 'Proposed Prevention of an Arms Race in Space (PAROS) Treaty' (*The Nuclear Threat Initiative (NTI)*, 29 September 2017) <https://www.nti.org/learn/treaties-and-regimes/proposed-prevention-arms-race-space-paros-treaty/> accessed 9 July 2019.

[569] UN General Assembly Resolution 36/97 C: Prevention of an Arms Race in Outer Space, adopted December 9, 1981.

contribute to this goal, and requested the CD to consider negotiating agreements for this effect. The UNGA has had PAROS as an agenda item almost annually since 1981[570], with resolutions of similar nature.

The last UNGA resolution of 2018[571] reaffirmed the importance and urgency of preventing an arms race in outer space, recognized that the legal regime applicable to outer space by itself does not guarantee the prevention of such an arms race, and that this regime needs to be enhanced to this effect. The resolution reiterated that the CD, as the sole multilateral disarmament negotiating forum, has the primary role in the negotiation of a multilateral agreement on the prevention of an arms race in outer space, and invited the CD to establish a working group on the issue and urged States to cooperate with the CD in this regard. This resolution reiterates the goal of prevention of an arms race in outer space and the means to achieve this goal – a multilateral legally-binding agreement, negotiated through the CD. It is questionable whether the road so prescribed is the best way to prevent an arms race in outer space, given the deadlock in the CD and the slim chances to achieve such a legally-binding agreement in the foreseeable future. This is not to say that such efforts should not be pursued, but that other roads must also be explored in tandem.

The GGE on PAROS: in its resolution 72/250 of 2017, the UNGA requested the UN Secretary-General to establish a Group of Governmental Experts (GGE), with a membership of up to 25 Member States in order to "consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race

[570] The resolutions of the last 10 years are: 63/40 of 2 December 2008; 64/28 of 2 December 2009; 65/44 of 8 December 2010; 66/27 of 2 December 2011; 67/30 of 3 December 2012; 68/29 of 5 December 2013; 70/26 of 7 December 2015; 71/31 of 5 December 2016; 72/26 of 4 December 2017; and 73/30 of 5 December 2018.

[571] UN General Assembly Resolution 73/30: Prevention of an arms race in outer space, adopted December 5, 2018 (A/RES/73/30).

in outer space, including, inter alia, on the prevention of the placement of weapons in outer space" and decided that the GGE "will operate by consensus, without prejudice to national positions in future negotiations."[572] The GGE was established and held a consultative meeting and its work is ongoing.[573]

6.5.5 UNGA Work on TCBMs

The UNGA resolutions on TCBMs: the PAROS resolution of 1990 recognized "the relevance of considering measures on confidence-building and greater transparency and openness in space"[574]. The UNGA reiterated the need for such measures and has transparency and confidence-building measures (TCBMs) as an agenda item almost annually since 1990, with resolutions to that effect.[575]

The last UNGA resolution on TCBMs of 2018[576] encouraged States to implement the TCBMs proposed by the GGE, reviewed herein below, on a voluntary basis and in a manner consistent with their national interests. It further encouraged States to discuss the prospects for the implementation of the TCBMs within UN-COPUOS and the CD. The resolution called upon Member States and UN organs to support the implementation of TCBMs. The resolution finally decided to convene a joint panel of the UN's First Committee (Disarmament and International Security) and Fourth Committee (Special Political and

[572] UN General Assembly resolution 72/250: Further practical measures for the prevention of an arms race in outer space, adopted 24 December 2017 (A/RES/72/250).

[573] 'Group of Governmental Exerts on Further Effective Measures for the Prevention of an Arms Race in Outer Space' (*UN Office for Disarmament Affairs*) <https://www.un.org/disarmament/topics/outerspace/paros-gge/> accessed 2 August 2019.

[574] UN General Assembly Resolution 45/55: Prevention of an Arms Race in Outer Space, adopted 14 December 1990 (A/RES/45/55).

[575] The resolutions of the last 10 years are: 63/68 of 2 December 2008; 64/49 of 2 December 2009; 65/68 of 8 December 2010; 68/50 of 5 December 2013; 69/38 of 2 December 2014; 70/53 of 7 December 2015; 71/42 of 5 December 2016; 72/56 of 4 December 2017; and 73/72 of 5 December 2018.

[576] UN General Assembly Resolution 73/72: Transparency and confidence-building measures in outer space activities, adopted 5 December 2018 (A/RES/73/72).

Decolonization) to address possible challenges to space security and sustainability. While most of the resolution is declarative, calling upon and encouraging Member States and UN organs to promote the implementation of TCBMs, the joint panel is an opportunity to promote the discussions on, and implementation of, the TCBMs. The 'Draft Concept Note' prepared by the Secretariat in anticipation of the joint panel[577] provides the background for the discussion and suggests the indicative themes of the panel, namely: (i) identification of issues that intersect with both space sustainability and security; (ii) taking stock of the status of recent United Nations processes on space sustainability and security; (iii) exchange of views on international cooperation and coordination, in particular on space science and technology and their applications, and on the characteristics of expert processes in the various United Nations bodies; and (iv) identification of issues where coordinated approaches could advance long sought objectives for space sustainability and security. This is not the first joint panel of these two committees discussing TCBMs.[578] The2014 UNGA resolution on TCBMs[579] was the first to call for such a joint panel of the UN's First and Fourth Committees to discuss space security and sustainability. While there was agreement on the need to safeguard space security, safety, and sustainability, there was disagreement about the ways to do so.[580] While the results of these joint panels are yet

[577] UN-COPUOS, Draft concept note on the joint panel discussion of the First and Fourth Committees of the General Assembly on possible challenges to space security and sustainability, June 21, 2019 (A/AC.105/2019/CRP.19) <http://www.unoosa.org/res/oosadoc/data/documents/2019/aac_1052019crp/aac_1052019crp_19_0_html/AC105_2019_CRP19E.pdf> accessed 31 July 2019.

[578] See, for example, a report on a similar panel convened in 2015: 'As Fourth, First Committees Hold Joint Meeting, Speakers Stress Need for Holistic Handling of Outer Space Security, Sustainability'(*UN - Meetings Coverage and Press Releases*) <https://www.un.org/press/en/2015/gadis3531.doc.htm> accessed 31 July 2019.

[579] UN General Assembly Resolution 69/38: Transparency and confidence-building measures in outer space activities, adopted 2 December 2014 (A/RES/69/38).

[580] Ram S. Jakhuand Chen Kuan-Wei, 'Threats to Peaceful Uses of Outer Space: Politics and Law' (unpublished draft), 675.

to be seen, the exchange of views has the potential to create a certain common ground among Member States.

The GGE on TCBMs: in its 2010 annual resolution on TCBMs, the UNGA requested the UN Secretary-General "to establish. . .a group of governmental experts to conduct a study. . .on outer space transparency and confidence-building measures."[581] A similar GGE was convened in 1991 and submitted a report.[582]

In 2013, the GGE submitted a report, adopted by consensus, which concluded that TCBMs "can reduce, or even eliminate, misunderstandings, mistrust and miscalculations with regard to the activities and intentions of States in outer space." [583], The Report noted that the existing space law treaties include several TCBMs, which "could contribute to, but not act as a substitute for, measures to monitor the implementation of arms limitation and disarmament agreements".[584] The GGE report included a series of TCBMs, including on exchange of information, notifications and allowing of visits as well as coordination and consultative mechanisms aimed at improving interaction between spacefaring nations.[585] A

[581] UN General Assembly Resolution 65/68: Prevention of an Arms Race in Outer Space, adopted 8 December 2010 (A/RES/65/68).

[582] Prevention of an Arms Race in Outer Space: Study on the application of confidence-building measures in outer space - Report by the Secretary General, U.N. GAOR, 48th Sess. U.N. Doc A/48/305 (15 October 1993) <http://www.un.org/ga/search/view_doc.asp?symbol=A/48/305> accessed 12 August 2019.

[583] 'Report of the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities' (2013) A/68/189 <http://www.unoosa.org/pdf/gadocs/A_68_189E.pdf> accessed 9 July 2019.

[584] Ibid.

[585] For a good concise review of the GGE see Christopher D. Johnson, 'The UN Group of Governmental Experts on Space TCBMs: A Secure World Foundation Fact Sheet' <https://swfound.org/media/109311/swf_gge_on_space_tcbms_fact_sheet_april_2014.pdf> accessed 9 July 2019.

2015 Inter-Agency Meeting on Outer Space Activities issued a special report on the role of the UN in supporting implementation of the GGE report.[586]

In addition to the TCBMs it proposed, the GGE provided criteria for proposed future measures to establish whether they would fulfill the function of a TCBM. The 2013 GGE was the last so far and Meyer notes that although the UNGA still adopts resolutions welcoming the work of the 2013 GGE on a consensus basis, they are increasingly eclipsed by new initiatives and resolutions, notably the no-first-placement discussed herein below.[587] While his concern is understandable, the various competing initiatives, as much as they divert and scatter the efforts to regulate or even prevent space warfare, may, in the aggregate, open new paths for doing so.

6.5.6 Proposed PPWT Treaty

In 1981, the UNGA adopted a dedicated resolution calling for the conclusion of a treaty on the prohibition of the stationing of weapons *of any kind* in outer space[588]. In 2008, Russia and China submitted a proposed treaty known as the Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT). The draft was heavily criticized, and the two States submitted a revised draft of the PPWT in 2014.[589] The proposed treaty would prohibit its signatories from

[586] Role of United Nations entities in supporting Member States in the implementation of transparency and confidence-building measures in outer space activities, 13 June 2016 (A/AC.105/1116).

[587] 'Do TCBMs have a Future?' Remarks by Paul Meyer, Senior Fellow, The Simons Foundation, UNIDIR Space Security: the Next Chapter, May 7-8, 2018, Geneva, Switzerland.

[588] UN General Assembly Resolution 36/99: Conclusion of a Treaty on the Prohibition of the Stationing of Weapons of Any Kind in Outer Space, adopted 9 December 1981 (A/RES/36/99).

[589] 'Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (Draft)' (*Ministry of Foreign Affairs of the People's Republic of China*, 16 June 2014) <https://www.fmprc.gov.cn/mfa_eng/wjb_663304/zzjg_663340/jks_665232/kjfywj_665252/t1165762.shtml> accessed 2 August 2019; See also Jinyuan Su, 'The "peaceful purposes" principle in outer space and the

placing objects carrying any type of weapon into orbit, installing weapons on celestial bodies, and threatening to use or using force against objects in outer space. It will not, however, affect States right to self-defense under Article 51 of the UN Charter.[590] The draft treaty also includes confidence-building measures. Both drafts were rejected by the US and therefore no legally binding instrument has been adopted.[591] In discussions on the PPWT the US is persistently against a PAROS treaty and Israel persistently abstains.

Listner and Rajagopalan note that the draft PPWT leaves gaps as it does not apply to ASAT systems and fails to address space debris created by direct-ascent ASATs, such as those tested by China and most recently India.[592] The proposed PPWT focuses on the placement of weapons in outer space, and overlooks ground-based weapons that may target space assets.. Tronchetti and Hao note that while the 2014 draft PPWT was supposed to answer the criticism on the first draft, it mainly represents re-wording and re-organization and maintains the most controversial and debatable aspects of the 2008 draft. Though they predicted failure of the 2014 draft, Tronchetti and Hao suggest that the discussion on the draft PPWT within the CD may eventually lead to legal protection of space assets from select threats.[593] The biggest obstacle to the PPWT is the strong objection by the US[594],

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Russia–China PPWT Proposal' (2010) 26(2), Space Policy 81.

[590] 'Proposed Prevention of an Arms Race in Space (PAROS) Treaty' (*The Nuclear Threat Initiative (NTI)*, 29 September 2017) <https://www.nti.org/learn/treaties-and-regimes/proposed-prevention-arms-race-space-paros-treaty/> accessed 9 July 2019.

[591] In 2017 the CD approved – by majority – 4 draft resolutions concerning on the prevention of an arms race in outer space, but with objection from the US and Israel to all of them and the objection of France, United Kingdom, Ukraine and Georgia to some of them. see UN, First Committee Submits Six Drafts to General Assembly, One Calling for Immediate Start of Negotiations on Treaty Preventing Outer Space Arms Race, (GA/DIS/3591) (October 30, 2017) <https://www.un.org/press/en/2017/gadis3591.doc.htm> accessed 26 January 2018.

[592] Michael Listner and Rajeswari Pillai Rajagopalan, 'The 2014 PPWT: A New Draft but with the Same and Different Problems' (*The Space Review* 11 August 2014) <http://www.thespacereview.com/article/2575/1> accessed 31 July 2019.

[593] Fabio Tronchetti and Liu Hao, 'The 2014 Updated Draft PPWT: Hitting the Spot or Missing the Mark?'

which perceived it as prohibiting space weapons, which the US might hold or develop, but allowing ground-based space weapons of the kind that Russia and China already have, namely, the ASAT systems. In order to be accepted and succeed, a PPWT treaty would have to address the concerns of all major spacefaring nations, especially those of the US. The question then is how the proposed PPWT would be amended to address those concerns?

6.5.7 No-First-Placement

Since 2014, several States[595] have introduced a policy of not being the first State to place weapons in outer space,[596] pursuant to the UNGA Resolution adopted that year, which encouraged "all States, especially space-faring nations, to consider the possibility of upholding as appropriate a political commitment not to be the first to place weapons in outer space".[597] This has become an annual resolution with similar resolutions adopted annually ever since.[598] It was Russia that promoted the no-first-placement (NFP) resolutions[599] which were accepted by majority vote with the US being the major opponent. The EU expressed reservation from the NFP in a formal statement noting:

(2015) 33 Space Policy 38.

[594] Jeff Foust, 'U.S. Dismisses Space Weapons Treaty Proposal As "Fundamentally Flawed"' (*SpaceNews.com* 11 September 2014) <https://spacenews.com/41842us-dismisses-space-weapons-treaty-proposal-as-fundamentally-flawed/> accessed 1 August 2019.

[595] Armenia, Belarus, Brazil, Cuba, Argentina, Indonesia, Kazakhstan, Kyrgyzstan, the Russian Federation, Sri Lanka and Tajikistan.

[596] As noted, including the list of states, in UNGA Resolution 68/50: Transparency and Confidence-Building Measures in Outer Space Activities, adopted 5 December 2013 (A/RES/60/50); UN General Assembly Resolution 68/50: Transparency and Confidence-Building Measures in Outer Space Activities, adopted 5 December 2013 (A/RES/68/50)..

[597] UN General Assembly Resolution 69/32: No First Placement of Weapons in Outer Space, adopted 2 December 2014 (A/RES/69/32).

[598] UN General Assembly resolutions: 69/32 of 2 December 2014 (A/RES/69/32); 70/27 of 7 December 2015 (A/RES/70/27); 71/32 of 5 December 2016 (A/RES/71/32); 72/27 of 4 December 2017 (A/RES/72/27); and 73/31 of 5 December 2018 (A/RES/73/31).

[599] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657, 677.

> *We are equally concerned that the initiative "No First Placement of Weapons in Outer Space" (NFP) does not adequately respond to the objective of strengthening trust and confidence between States...The very idea of "not to be the first to place" is ambiguous and may entice States to prepare to be second or third. Moreover, this initiative does not address the difficult issue of defining what a weapon in outer space is. . .*[600]

Nevertheless, the UNGA adopted the NFP resolution again in its next session. The subsequent resolutions adopted since 2015 reiterate the first resolution's encouragement to declare no first placement and further decide to include the no-first-placement also on the agenda of the next UNGA session, thus perpetuating the resolution.

The ICJ recognized that such unilateral statements are binding, if they are issued with the intention of being binding,[601] and the International Law Commission issued guiding principles on such unilateral statements[602].

Hao and Tronchetti suggest that despite the limited attention the resolution received in academic circles, its adoption represents an important development in the area of space security, but at the same time its hesitant acceptance demonstrates that a universal solution to the issue of space security still lies far ahead.[603] As with regard to the PPWT, this initiative would need to be adopted by all major spacefaring nations in order to have a decisive effect.

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[600] 'Conference on Disarmament - Working Group on the "Way Ahead" - EU Statement on the Prevention of an Arms Race in Outer Space - European External Action Service' (*Europa - EU*, 16 June 2017) <https://eeas.europa.eu/headquarters/headquarters-homepage/28329/conference-disarmament-working-group-way-ahead-eu-statement-prevention-arms-race-outer-space_en> accessed 9 July 2019.

[601] Nuclear Tests (Australia v. France), Judgment, I.C.J. Reports 1974, p. 253.

[602] International Law Commission, 'Guiding Principles Applicable to Unilateral Declarations of States Capable of Creating Legal Obligations' (2006) <http://legal.un.org/ilc/texts/instruments/english/commentaries/9_9_2006.pdf> accessed 29 July 2019.

[603] Hao Liu and Fabio Tronchetti, 'United Nations Resolution 69/32 on the "No First Placement of Weapons in Space": A Step Forward in the Prevention of an Arms Race in Outer Space?' (2016) 38 Space Policy 64.

6.5.8 The EU's Proposals

In 2008, the European Union (EU) launched another initiative to enhance security in space, by putting forward a proposal for a non-legally binding instrument – the International Code of Conduct for Outer Space Activities (ICoC). The Council of the European Union adopted the draft Code of Conduct in 2008[604], the same year in which Russia and China proposed the PPWT treaty, and the EU introduced the draft to the CD on 12 February 2009[605]. The ICoC addressed space security issues, mentioned military activities and the "peaceful purposes" principles, but did not mention arms control. However, this initiative failed to gather enough support and after almost a decade of futile attempts to advance the ICoC, it was eventually shelved. The multilateral negotiations that the EU convened in 2015, demonstrated divergence of opinions and approach, mainly between Western nations and Japan on the one hand and the rest of the world, led by the BRICS nations. It became apparent that no real negotiations on the initiative are feasible and the meeting was thus adjourned and the initiative abandoned.[606]

Nevertheless, the EU has not abandoned efforts to promote multilateral arrangements on space security. In its official statement at the CD in 2017, after expressing reservations for the NFP resolutions, it encouraged States to support initiatives aimed at preventing space from becoming an arena for conflict, while ensuring the long-term sustainability of the space environment. The statement specifically pointed to the idea of elaborating principles

[604] 'Council Conclusions and Draft Code of Conduct for Outer Space Activities' <https://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2017175%202008%20INIT> accessed 9 July 2019.

[605] 'Proposed Prevention of an Arms Race in Space (PAROS) Treaty' (*The Nuclear Threat Initiative (NTI)*, 29 September 2017) <https://www.nti.org/learn/treaties-and-regimes/proposed-prevention-arms-race-space-paros-treaty/> accessed 9 July 2019.

[606] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657.

of responsible behavior in outer space (PORBOS), without excluding the possibility that this may one day result in new legally binding norms.[607]

6.5.9 Guidelines for Long-Term Sustainability

In 2010, UN-COPUOS' Scientific and Technical Subcommittee introduced an agenda item on the long-term sustainability of outer space activities and established a Working Group on the subject matter. After two rounds that introduced several guidelines in 2016[608] and 2018[609], UN-COPUOS, during its 62nd session in June 2019, adopted 21 Guidelines for the long-term sustainability of outer space activities.

The Guidelines provide guidance on the policy and regulatory framework for space activities, safety of space operations, international cooperation, capacity-building and awareness, and scientific and technical research and development.[610] The Guidelines call on States to provide a commitment, in national legislation and/or policy frameworks, for conducting space activities *solely* for peaceful purposes. Nevertheless, the Guidelines recognize that States may have legitimate security interests in outer space, and therefore allow space activities that support national and international security. Pursuing those legitimate interests should comply with applicable international law and should take into

[607] 'Conference on Disarmament - Working Group on the "Way Ahead" - EU Statement on the Prevention of an Arms Race in Outer Space - European External Action Service' (*Europa - EU*, 16 June 2017) <https://eeas.europa.eu/headquarters/headquarters-homepage/28329/conference-disarmament-working-group-way-ahead-eu-statement-prevention-arms-race-outer-space_en> accessed 9 July 2019.

[608] See Report of the Committee on the Peaceful Uses of Outer Space of August 16, 2016 (A/71/20).

[609] See Report of the Scientific and Technical Subcommittee on its fifty-fifth session, held in Vienna from 29 January to 9 February 2018, of April 6, 2018 (A/AC.105/1167) and Report of the Committee on the Peaceful Uses of Outer Space of September 7, 2018 (A/73/20).

[610] 'Press Release: Guidelines for the Long-Term Sustainability of Outer Space Activities of the Committee on Peaceful Uses of Outer Space Adopted' (UN Information Center) <http://www.unis.unvienna.org/unis/en/pressrels/2019/unisos518.html> accessed 30 July 2019. The Guidelines are available online: Draft guidelines for the long-term sustainability of outer space activities (A/AC.105/C.1/L.367) <http://www.unoosa.org/res/oosadoc/data/documents/2019/aac_105c_1l/aac_105c_1l_367_0_html/V1804974.pdf> accessed 30 July 2019.

account the common interests of all humankind. In addition, States are encouraged to work collectively to prevent threats to the peace, safety security or sustainability in or of outer space that might compromise the long-term sustainability of outer space activities.[611]

The contribution of the Guidelines to the prevention of space warfare is limited. While they attempt to limit space activities *solely* for peaceful purposes, they do recognize security interests and considerations. In addition, they are notlegally-binding and originate from a technical and scientific sub-committee. Moreover, non-peaceful purposes were already recognized as lawful and are taking place. Therefore, the expected effect of the Guidelines on the prevention of space warfare is limited.

6.5.10 The MILAMOS

It is yet to be seen if the efforts to prevent a space arms race will succeed. Back in 1999, Bell suggested that "[i]t is inevitable that mankind will weaponize space . . .[t]he United States is [already] in the early stages of a transition from using space assets to support combat operations on the surface of the earth, to using space assets to conduct combat operations in space, from space, and through space".[612] Furthermore, space is becoming a potential conflict arena itself, due to the growing dependence on space-based applications, for civil and military purposes, making space assets prime targets in need of protection. This dependence has led a growing number of States to develop counter-space capabilities that

[611] Guideline 7. On the Guidelines see, for example, Peter Martinez, 'Development of an International Compendium of Guidelines for the Long-Term Sustainability of Outer Space Activities' (2018) 43 Space Policy 13; Gérard Brachet, 'The Origins of the "Long-Term Sustainability of Outer Space Activities" Initiative at UN COPUOS' (2012) 28 Space Policy 161.

[612] Thomas D. Bell, 'Weaponization of Space: Understanding Strategic and Technological Inevitabilities' (1999) Occasional Paper No. 6, Center for Strategy and Technology Air War College < https://apps.dtic.mil/dtic/tr/fulltext/u2/a425531.pdf> accessed 12 August 2019.

can be used to deceive, disrupt, deny, degrade, or destroy space systems.[613] Capabilities enable and drive policy and action and therefore the spread of counterspace capabilities increases the likelihood of hostilities in the theater of space. Jakhu et. al. noted that "there is a dire need to clarify the rules of international law applicable to military space activities during peacetime, as well as those governing the prohibition on the use of force and international humanitarian law, since these serve to minimize the detrimental effects of any future conflict in space, or involving space assets or applications."[614] The MILAMOS project aims to do exactly that.

In 2016, The McGill Centre for Research in Air and Space Law launched an international project for drafting the McGill Manual on International Law Applicable to Military Activities in Outer Space (MILAMOS)[615]. This project follows the footsteps of the San Remo Manual on International Law Applicable to Armed Conflict at Sea, the Harvard Manual on International Law Applicable to Air and Missile Warfare, and the Tallinn Manual on International Law Applicable to Cyber Warfare but will differ from them in several ways. The MILAMOS will clarify the fundamental rules of international law applicable to military uses of outer space by both States and non-State actors in times of peace, in periods of rising tensions, and in times of armed conflict. Moreover, it is intended for use by a wide spectrum of space operators, stakeholders, experts, and interest groups (*e.g.,* officials from across the whole

[613] Brian Weeden and Victoria Samson, *Global Counterspace Capabilities: An Open Source Assessment* (Secure World Foundation 2019) <https://swfound.org/media/206408/swf_global_counterspace_april2019_web.pdf> accessed 12 August 2019.

[614] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657, 659.

[615] McGill University Institute of Air and Space Law, Manual on International Law Applicable to Military Activities in Outer Space <https://www.mcgill.ca/iasl/milamos> accessed 1 August 2019. See also the Woomera Manual on the International Law of Military Space Operations <https://law.adelaide.edu.au/woomera/> accessed 15 May 2019.

government, private space actors, civil society, academics and others) with an interest in the security and sustainability of space activities. Participants in the project include scholars and experts from around the world, from spacefaring nations and from non-spacefaring nations, East and West, North and South, working in their individual capacity (and not as representatives of their respective organizations or nations) as well as representatives of the International Committee of the Red Cross (ICRC) and the Union of Concerned Scientists. Representatives of several States often participate as 'observers' in the drafting meetings of MILAMOS. The project is based on the belief that an objective clarification of existing international law applicable to military uses of outer space carried out by an independent international group of experts might dissuade the actual use of force and avoid future conflicts in outer space.

The MILAMOS will touch many themes, some directly concern space warfare and others are relevant beyond the context of warfare, including (not an exhaustive list): delimitation, applicability of International Law, responsibility for national space activities, peaceful purposes, treatment of astronauts, national registration, registration of space objects, jurisdiction and control, prior consultation, provision of information, military maneuvers, military bases and military installations, ground-based infrastructure, immunities, non-intervention, space debris, space natural resources, liability, freedom of exploration and use, use of electromagnetic spectrum, peaceful settlement of disputes, compensation, harmful interference to spectrum-enabled communications for space activities, weapons of mass destruction, cooperation and mutual assistance, recovery and return of space objects, jamming of satellite communications, jamming and spoofing of radar, interference with TT&C (telemetry and tracking data and sending commands), transit through foreign

national air space, interference with space activities, weapons in outer space, avoidance of harmful contamination, laser dazzling, interference with GNSS, armed attack, sovereignty, international law of State responsibility, prohibition on threat or use of force, self-defense, military space activities, circumstances precluding wrongfulness, reparations, countermeasures, applicability of international cyber law, launch and ballistic missiles, orbital rights, rendezvous and proximity operation, regional security organizations, due diligence, protection of the natural environment, acts of aggression, humanitarian activities including humanitarian assistance and disaster relief.

The MILAMOS, also dubbed the McGill Manual, will be primarily a clarification and restatement of the existing law. In itself it will not be legally binding, but the laws it clarifies and restates are legally binding. The McGill manual is expected to promote the understanding of the legal rules applicable to military uses of outer space and to serve as a reference, *e.g.,* for military personnel, defense officials, and policymakers. In terms of regimes, the Manual will, at least to a certain extent, create, reflect and affect actors' expectations, and may therefore be considered a regime, at least for States that will openly endorse the Manual.[616]

Efrony and Shany recently analyzed the acceptance of the Tallinn manual rules by States with mixed results. They concluded that:

> *(1) it is unclear whether states are ready to accept the Tallinn Rules;*
> *(2) states show uneven interest in promoting legal certainty in cyberspace; and*

[616] On the rationale of the MILAMOS see Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657.

> *(3) a growing need for coordinated response to cyberattacks may induce states to consider more favorably the Tallinn Rules.*[617]

A major difference between the Tallinn manual and the MILAMOS is that the former introduces rules, whereas the latter identifies existing rules from various sources, and while it is more than a compilation, it does not suggest new rules. The force of the MILAMOS and the rules it includes therefore lay in the fact that the rules are already established, which reduces States' discretion in conforming with them. As a result, it is expected to have a greater impact on States' behavior than that of the Tallinn manual.

6.5.11 Conclusions on the Status of the Various Initiatives

The various initiatives reviewed above to introduce instruments regulating or even preventing space warfare need further work, and mainly political will and agreement among the leading actors, in order to bring concrete and significant results. One reason for the insufficient political will is that, while there is approach that sees space as a "sanctuary" to be exempt from wars or even national rivalries altogether, other see space an "ultimate high ground" to be controlled.[618] The Non-Aligned Movement supports legally-binding multilateral agreements, whereas the US is opposed to such and instead supports the like of the TCBMs, China and Russia promote one initiative, while the EU promotes another. And while the CD works on the PPWT, it remains deadlocked on the issue.[619] The fault lines of the ongoing controversies are, again, along the West-East and the North-South, though

[617] Dan Efrony and Yuval Shany, 'A Rule Book on the Shelf?: Tallinn Manual 2.0 on Cyberoperations and Subsequent State Practice' (2018) 112 American Journal of International Law 583.

[618] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657; Bruce M. Deblois, 'Space Sanctuary: A Viable National Strategy' (1988) Airpower Journal < https://apps.dtic.mil/dtic/tr/fulltext/u2/a529843.pdf> accessed 13 August 2019.

[619] Jakhu, Steer and Kuan-Wei (2017) ibid, 672.

even Western nations had disagreements among themselves. It appears that each major State or bloc has a preferred initiative, typically one it sponsors, and it objects to initiatives by others. The result is multiple initiatives and partial progress to date.

6.5.12 The *Fora*

The *fora* relevant to space warfare are mostly affiliated with the UN, first and foremost the UN's Security Council and General Assembly. The UN Committee on the Peaceful Uses of Outer Space (UN-COPUOS) is the main multilateral forum on space issues, assisted by the United Nations Office for Outer Space Affairs (UNOOSA). The UN's First Committee (Disarmament and International Security) and the Conference on Disarmament (CD), the designated UN organ for negotiating disarmament agreements, are particularly relevant and active in the context of space warfare. The two are assisted by the United Nations Institute for Disarmament Research (UNIDIR), which holds annually a Space Security Conference, and by the United Nations Office for Disarmament Affairs (UNODA). The International Telecommunication Union (ITU) is another important multilateral organization with a mandate on issues pertaining to outer space activities, as it allocates slots in the geostationary orbit and radio frequencies that are used, inter alia, by satellites[620].

The periodical Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE) discuss also issues of space security and space warfare[621], but they are less important than

[620] Official website of the ITU, the Radiocommunication Sector (ITU-R) <http://www.itu.int/net/ITU-R/index.asp?category=information&rlink=itur-welcome&lang=en> accessed 13 August 2019.

[621] See, for example, UNISPACE II Report, Vienna, 9-21 August 1982 (A/CONF.101/10 and Corr.1and 2).

the previous forums. So far four such conferences were held, in 1968 (UNISPACE I), 1982 (UNISPACE II), 1999 (UNISPACE II), and 2018 (UNISPACE + 50).[622]

NGOs are also involved in the issue of space warfare, and perhaps the two most active are the Simon Foundation[623], which was a co-founder of UNIDIR's annual Space Security Conference, and the Secure World Foundation (SWF)[624]. Furthermore, there is already an epistemic community on space warfare, made of people involved in the above mentioned initiatives and fora as well as those affiliated with research centers and think tanks like the Space Security Research Group at King's College London[625], the Washington based Center for Strategic and International Studies (CSIS)' Aerospace Security Project[626] and several more around the world.

The UN affiliated organs combine a-political experienced technocrats, notably within UNOOSA, UNODA, and UNIDIR, and States' representatives, notably within the First Committee, UN-COPUOS, and the CD. While the technocrats promote discussion, disagreement among States and blocs of States make progress slow, as both UN-COPUOS and the CD work by consensus. Yet, States' representatives bring with them the political backing that gives force to the outcomes, if consensus is achieved. It is obviously extremely difficult to achieve consensus, but if such is reached it results in a rule that is widely

[622] 'History: UNISPACE Conferences' <http://www.unoosa.org/oosa/en/aboutus/history/unispace.html> accessed 2 August 2019; 'UNISPACE+50' <http://www.unoosa.org/oosa/en/ourwork/unispaceplus50/index.html> accessed 2 August 2019.

[623] A Canadian NGO, see official website <www.thesimonsfoundation.ca> accessed 13 August 2019.

[624] Official website <https://swfound.org> accessed 13 August 2019.

[625] 'King's College London - Space Security Research Group' <https://www.kcl.ac.uk/sspp/departments/warstudies/research/groups/csss/research/space-security-research/space-security-research-group> accessed 10 July 2019.

[626] 'Aerospace Security Project | Center for Strategic and International Studies' <https://www.csis.org/programs/international-security-program/aerospace-security-project> accessed 10 July 2019.

accepted and followed. While progress in the UN affiliated organs is very slow, progress that is made expands multilateral agreement and it is the main track to produce multilateral legally-binding agreements for the long run. The ITU is the most successful forum of them all, as it produced comprehensive, elaborated and legally-binding instruments that regulate the issues under its jurisdiction.[627] The secret to its success is in the fact that it engages mainly with technical issues, on which agreement is more easily reached, and that the laws of physics mandate rules and their adherence, otherwise all States will suffer malfunction in their use of radio frequencies and satellites in the geostationary orbit.

The various NGOs, research centers/institutes and think tanks dealing with space warfare do not produce legally-binding agreements, however they promote the knowledge on the issue, raise and develop ideas and initiatives and contribute to the discussion on the issue. By that they contribute to the slow progressive development of the laws and governance of space warfare. The case of the MILAMOS exemplifies the potential contribution of research centers. The McGill Centre for Research in Air and Space Law is leading the MILAMOS project, which already gained wide support internationally and is expected to produce a manual that will contribute to the understanding – and therefore adherence – of the rules of international law applicable to space warfare. The bottom line is that progress in the governance of space warfare cannot – and need not – come from a single forum or instrument. It can come from different sources in different timetables.

[627] Constitution and Convention of the International Telecommunication Union 1992 (1825, 1826 UNTS).

6.6 Governance of Conflicts in the Theater of Cyberspace

As discussed above, cyber warfare is likely to be the main method of space warfare in the foreseeable future. The first two types of attacks - space to space attack and space to/from earth attack - require extensive investments of massive funds and advanced technological and engineering capabilities, which makes for a high entry barrier only a handful of States can pass. A cyber-attack, on the contrary, has a low entry barrier and an offence is cheaper than defense, which makes it an even more effective attack tool. Technical and financial requirements are relatively low, and there is even no need for a military base in order to launch such an attack, which requires only a room with computers connected to the internet and skilled personnel. For these reasons, cyber-attack is likely to be a more commonly used method in space warfare, and the only one used by States other than the top space powers. Moreover, and especially considering there is no need for a military base and therefore control of sovereign land, a cyber-attack may be launched by non-State actors, notably criminal organizations and terrorist groups. In fact, such an attack already occurred in 2014, when Hamas hacked an Israeli TV satellite and took over its broadcast for a few minutes.[628]

Boucher suggests that a combined space-cyber warfare theatre is emerging. He notes that both space and cyberspace systems are critical in enabling modern warfare and they are merging to become the primary battlefield for global powers in the 21st century.[629]

[628] John Leyden, 'Hamas Hacks Israeli TV Sat Channel to Broadcast Pics of Gaza Wounded' (15 July 2014) <https://www.theregister.co.uk/2014/07/15/hamas_hack_israeli_sat_tv/> accessed 21 October 2018.

[629] Marc Boucher, 'The Emerging Space Cyberwarfare Theatre' (*Space Quarterly Magazine* 2013) <http://spaceref.com/military-space/the-emerging-space-cyberwarfare-theatre.html> accessed 8 July 2019.

It should be noted that disruption of satellite signals may, in some cases, not be considered an attack at all. Jamming, blinding, spoofing, dazzling or interfering with satellite signals is not necessarily an attack.[630] The Tallinn Manual, reviewed below, provides some guidelines as to when cyber activities could amount to an attack.[631]On the other hand, a cyber-attack may be answered by an old-fashioned "real-world" response. The US has already declared its policy in case of cyber-attack:

> *[W]e will respond to hostile acts in cyberspace as we would to any other threat to our country. We reserve the right to use all necessary means – diplomatic, informational, military, and economic – as appropriate and consistent with applicable international law, in order to defend our Nation, our allies, our partners, and our interests.*[632]

Israel was the first to do so, by attacking a building in Gaza from which Hamas hackers allegedly launched or tried to launch cyber-attacks against Israeli targets.[633]

6.6.1 The UN GGEs

Cybersecurity became an agenda item for the UNGA in 1998, pursuant to Russia's initiative to place it on the agenda of the UN's First Committee (the Committee on Disarmament and International Security)[634]. While the First Committee covers cyber-security, the issues of

[630] see Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657, 666.

[631] On this issue see also: Jeffrey Carr, *Inside Cyber Warfare: Mapping the Cyber Underworld* (2nd edn, O'Reilly Media 2012) in Chapter 4: Responding to International Cyber Attacks as Acts of War.

[632] The White House, 'International Strategy for Cyberspace' <https://obamawhitehouse.archives.gov/sites/default/files/rss_viewer/International_Strategy_Cyberspace_Factsheet.pdf> accessed 29 July 2019.

[633] In a Tweet of 5 May 2019, the Israel Defense Forces announced that "We thwarted an attempted Hamas cyber offensive against Israeli targets. Following our successful cyber defensive operation, we targeted a building where the Hamas cyber operatives work" <https://twitter.com/IDF/status/1125066395010699264> accessed 29 July 2019.

[634] 'Developments in the Field of Information and Telecommunications in the Context of International Security' (*UN Office for Disarmament Affairs*) <https://www.un.org/disarmament/ict-security/> accessed 1 August 2019.

internet governance and freedom of expression on the internet are covered by the Second Committee (Economic and Financial Committee) and Third Committee (Social, Humanitarian and Cultural Committee).[635]

UNGA Res. 53/70 of 1999[636] entitled "Developments in the Field of Information and Telecommunications in the Context of International Security" recognized the benefits of information and communication technologies (ICT), but also cautioned from threats to cyber-security. At the request of the UNGA in Resolution 58/32 of 2003[637], pursuant to Russia's proposal, the UN Secretary General established the United Nations Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security (GGE-1). Five more GGEs were later established, including the GGE 2019-2021, to a total of six GGEs[638].

The GGEs fall under the UN's First Committee (disarmament and international security) and the UN Office for Disarmament Affairs (UNODA) serves as the Secretariat to the GGEs. Placing the GGEs in the context of the UN's First Committee was meaningful, as the GGEs decided that issues that are not under the purview of the First Committee - such as espionage, Internet governance, development and digital privacy - are not the focus of the

[635] 'United Nations: Recent Developments in the Field of Information and Telecommunications in the Context of International Security' (*CCDCOE - NATO Cooperative Cyber Defence Centre of Excellence*) <https://ccdcoe.org/incyder-articles/united-nations-recent-developments-in-the-field-of-information-and-telecommunications-in-the-context-of-international-security/#footnote_0_2548> accessed 10 July 2019.

[636] UNGA Resolution 53/70: Developments in the Field of Information and Telecommunications in the Context of International Security, adopted 4 December 1998 (A/RES/53/70).

[637] UNGA Resolution 58/32: Developments in the field of information and telecommunications in the context of international security, adopted 8 December 2003 (A/RES/58/32).

[638] GGE-1 was established according to UNGA resolution (A/RES/58/32) and worked through 2004/2005; GGE-2 was established according to UNGA resolution (A/RES/60/45) and worked through 2009/2010; GGE-3 was established according to UNGA resolution (A/RES/66/24) and worked through 2012/2013; GGE-4 was established according to UNGA resolution (A/RES/68/243) and worked through 2014/2015; GGE-5 was established according to UNGA resolution (A/RES/70/237) and worked through 2016/2017; and GGE-6 was established according to UNGA resolution (A/RES/73/266) and will work through 2019/2021.

Group's work. The GGEs further decided that terrorism and crime, though relevant to cyber-security, are best discussed in other UN bodies.[639]

GGE-1 did not reach consensus and was unable to agree on a report.[640] GGE-2 reached a consensus and submitted its report in 2010[641] acknowledging the benefits and risks from ICT and the need for international cooperation – covering States, the private sector, and civil society - to effectively address them. The report further provided several recommendations on measures to reduce the risks, on exchange of information, policies, best practices and capacity building. GGE-3 made a breakthrough and created the normative framework for international cyber-security, first and foremost by suggesting the application of international law to activities in cyberspace. The group comprised representatives from 20 States, and more importantly includes representatives from the 'cyber powers', *i.e.*, the US, China, Russia, France, the UK, Germany and Israel, and it submitted its report in 2013[642].

As with outer space, the application of international law to cyberspace was not self-evident. The GGE-3 report stated that "the application of norms derived from existing international law relevant to the use of ICTs by States is essential to reduce risks to international peace,

[639] 'UN GGE and OEWG' (*Geneva Internet Platform - Digital Watch*) <https://dig.watch/processes/un-gge> accessed 10 July 2019; UNIDIR and CSIS, 'Report of the International Security Cyber Issues Workshop Series' <http://www.unidir.ch/files/publications/pdfs/report-of-the-international-security-cyber-issues-workshop-series-en-656.pdf> accessed 10 July 2019.

[640] Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security - Report of the Secretary-General, 5 August 2005 (A/60/202) <https://undocs.org/A/60/202> accessed 10 July 2019.

[641] Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security, 16 July 2010 (A/65/201) <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N10/469/57/PDF/N1046957.pdf?OpenElement> accessed 10 July 2019.

[642] Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security (June 7, 2013), A /68/98. See also UN General Assembly resolution 68/243 of December 27, 2013 taking note of the report and requesting he Secretary-General to establish a new GGE, that resulted in the 2015 GGE report.

security and stability.[643] The report recommends further study to promote common understandings on how such norms apply to State behaviour and the use of ICTs by States. In their report on the GGEs, UNIDIR and CSIS noted in this regard:

> *The 2013 report reshaped the political context for discussing cyberspace by upending the widely held but mistaken view that the Internet was "global commons". The idea of a borderless cyberspace that grew out of millennial thinking on the future of international relations was an impediment to negotiations and agreement and it introduced confusion over the role of States and their responsibilities. It is now widely accepted that the Internet has borders and depends on a physical infrastructure that is subject to sovereign control. The recognition of sovereignty usefully embeds international discussion of cybersecurity in the existing framework for obligations, State practice, and understandings among States.*[644]

Perhaps the major contribution of the report of GGE-3 is to suggest the application of international law to cyber activities. It also called for extending State sovereignty, and the norms, principles and rules associated with it, to State ICT activities and with regard to States' jurisdiction over ICT infrastructure within their territory. The report further suggested that in acting on ICT security, States should respect human rights according to the Universal Declaration of Human Rights[645]. In addition, the report recommended that the rules of international law regarding international wrongful acts should apply and be adhered to. In addition, the report called for the introduction of confidence-building measures that include voluntary exchange of views and information on national strategies, policies, best practices, decision-making processes, the establishment of bilateral, regional

[643] Report of the GGE (2013) ibid.

[644] UNIDIR and CSIS, 'Report of the International Security Cyber Issues Workshop Series' 6 <http://www.unidir.ch/files/publications/pdfs/report-of-the-international-security-cyber-issues-workshop-series-en-656.pdf> accessed 10 July 2019.

[645] UN General Assembly, Universal Declaration of Human Rights, 10 December 1948, 217 A (III).

and multilateral consultative frameworks and sharing information on security incidents, and mechanisms for cooperation in law enforcement.

GGE-4, which submitted its report in 2015[646], built on the 2013 report and "examined *how* international law applies to the use of ICTs by States" (my emphasis, E.T.). The 2015 report also "emphasized the importance of international law, the Charter of the United Nations and the principle of sovereignty as the basis for increased security in the use of ICTs by States"[647]. The UNGA endorsed the report and called upon Member States to be guided in their use of ICTs by its recommendations. Indeed, by now there is general acceptance of the applicability of international law to cyber operations and such applicability is generally not contested in the literature.[648]

As with the theater of outer space, international law has been applied to the *activities* of States in this theater. However, unlike with regards to outer space, the attempted application of international law to activities in cyberspace was not made by a legally binding instrument, and therefore it does not have a legally binding force. By the purported application of international law, again, a set of norms and laws was applied (or purported to be applied) and a set of international institutions gained mandate on cyberspace activities. There was also explicit application of basic principles of international law to cyberspace: State sovereignty, sovereign equality, non-intervention in the internal affairs of

[646] Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security (June 26, 2015), A/70/174. See also UN General Assembly resolution 70/237 of December 23, 2015, welcoming the report and and requesting the Secretary-General to establish another GGE.

[647] Report of the GGE (2015) ibid.

[648] 'ESIL Reflection: The Codification of the International Law Applicable to Cyber Operations: A Matter for the ILC? – European Society of International Law | Société Européenne de Droit International' <https://esil-sedi.eu/esil-reflection-the-codification-of-the-international-law-applicable-to-cyber-operations-a-matter-for-the-ilc/> accessed 1 August 2019.

other States, respect for human rights and fundamental freedoms, States should refrain from the threat or use of force in international relations, and the settlement of disputes by peaceful means. The reports furthermore acknowledge the need to develop specific norms for the issue. The 2013 report notes that "[g]iven the unique attributes of ICTs. . .additional norms could be developed over time."[649] Indeed, the group that worked on the 2015 report saw it as one of its tasks to "identify where additional norms that take into account the complexity and unique attributes of ICTs may need to be developed"[650].

The GGEs reports also adopted specific rules, including: States enjoy jurisdiction over ICT infrastructure within their territory; States should not conduct or knowingly support any ICT activity that intentionally damages critical infrastructure; States should take steps to ensure supply chain security; and States should seek to prevent the proliferation of malicious ICT and the use of harmful hidden functions.

GGE-5 did not reach consensus on a final report[651] and the work of GGE 6 is ongoing. GGE-5 failed to reach a consensus and adopt a consensual report due to disagreement on the issues of countermeasures, self-defense, and international humanitarian law (IHL).[652]

All in all, the reports of the GGEs presented a series of recommendations on norms, principles and rules of responsible behavior by States, on confidence building measures, on

[649] Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security (June 7, 2013), A /68/98.

[650] Report of the Group of Governmental Experts on Developments in the Field of Information and Telecommunications in the Context of International Security (June 26, 2015), A/70/174.

[651] 'Developments in the field of information and telecommunications in the context of international security' (*UN Office for Disarmament Affairs*) <https://www.un.org/disarmament/topics/informationsecurity> accessed 23 March 2018.

[652] 'ESIL Reflection: The Codification of the International Law Applicable to Cyber Operations: A Matter for the ILC? – European Society of International Law | Société Européenne de Droit International' <https://esil-sedi.eu/esil-reflection-the-codification-of-the-international-law-applicable-to-cyber-operations-a-matter-for-the-ilc/> accessed 1 August 2019.

the exchange of information, on capacity building measures, on international cooperation and assistance in ICT security, and on how international law applies to the use of ICTs.

The submitted reports were acknowledged by the UN General Assembly, but they are not legally binding. Nevertheless, they represent understandings and consensus reached by all the cyber powers and they include important norms and rules that States are expected to follow. The many States, including all the cyber powers that have entrusted the issue in the hands of the UN and the GGEs are perhaps not likely to easily retract this mandate. Moreover, the States that sent representatives to the GGEs or endorsed the reports are also not likely to easily denounce the basic principles explicitly stipulated in the reports. This does not mean full and consistent adherence, but probably more like adherence to international law in general on which Henkin famously noted: "[a]lmost all nations observe almost all principles of international law and almost all of their obligations almost all of the time"[653]. The GGEs reports, though not legally binding, represent the only widely accepted multilateral guidance to responsible State behavior in cyberspace.[654] Still, the States have chosen not to enter into a legally binding treaty and by that reserved the option not to follow the non-legally binding rules.

6.6.2 The UN OEWG

In 2018, the UNGA launched, through Resolution 73/27[655], another UN-mandated working group – the Open-Ended Working Group (OEWG) – that will work in parallel with the GGEs,

[653] As quoted, for example, in Oona A. Hathaway, Larry Johnson and Fionnuala Ni Aolain, 'An Introduction: The Effectiveness of International Law' (2014) Yale Faculty Scholarship Series 5220 <https://digitalcommons.law.yale.edu/fss_papers/5220> accessed August 3, 2019, and Jianming Shen, The Basis of International Law: Why Nations Observe' (1999) 17 Penn State International Law Review 287.

[654] William H. Boothby, 'Cyber Capabilities' in William H Boothby (ed), *New Technologies and the Law in War and Peace* (Cambridge University Press 2018) 85.

[655] UN General Assembly Resolution 73/27: Developments in the field of information and

and that includes all interested States. The Group will work through 2019-2020 and is due to submit a report – to be adopted by consensus - to the UNGA in 2020. All UN Member States are invited to participate in the OEWG and its process allows for consultation with industry, non-governmental organizations and academia.[656]

The tasks of the OEWG include: (i) to continue to develop the rules, norms, and principles of responsible behavior of States; (ii) to discuss ways for their implementation; (iii) to study the possibility of establishing regular institutional dialogue with broad participation under the auspices of the UN; and (iv) to discuss possible confidence-building measures and capacity-building. The first meeting of the OEWG, chaired by Switzerland, attracted representatives of almost 100 member States.[657]

As with the GGEs' reports, the report of the OEWG (if consensus is achieved and it is submitted) will not be legally binding. However, considering that it will be adopted by consensus, it will represent the opinion of the States that participated in the group, which will also have a political obligation to follow it.

6.6.3 The Tallinn Manual

The Tallinn Manual on the International Law Applicable to Cyber Warfare is a NATO initiated and supported academic study on the rules of international law applicable to cyber conflicts and cyber warfare published in 2013[658]. Tallinn 2.0, released in 2017[659],

telecommunications in the context of international security, adopted 5 December 2018 (A/RES/73/27).

[656] 'Open-Ended Working Group' (*UNODA*) <https://www.un.org/disarmament/open-ended-working-group/> accessed 10 July 2019.

[657] 'UN GGE and OEWG' (*Geneva Internet Platform - Digital Watch*) <https://dig.watch/processes/un-gge> accessed 10 July 2019.

[658] *Tallinn Manual on the International Law Applicable to Cyber Warfare* (Cambridge University Press 2013). The project is hosted by NATO Cooperative Cyber Defence Center of Excellence (CCDCOE) in Talliinn, Estonia.

expands the scope of the first edition to "peacetime international law"[660], addressing incidents that States frequently face. The Tallinn manual is obviously not legally binding, but it does promote the understanding of the legal rules applicable to cyber warfare[661].

Whereas the first Tallinn manual dealt with the law applicable to armed conflict in cyberspace, the second manual deals with a much broader type of cyber operations, both in and out of armed conflict.[662] Tallinn 2.0 encompasses several themes. It discusses the applicability of some basic relevant sections of general international law to cyberspace, namely sovereignty, due diligence, jurisdiction, and the law of international responsibility. Within the discussion on international responsibility, it discusses the themes of internationally wrongful acts by States, State countermeasures and necessity, obligations of States for internationally wrongful acts, and responsibility of international organizations. It also discusses cyber operations not *per se* regulated by international law. The manual also discusses specialized regimes of international law and their relevance to cyberspace, namely international human rights law, diplomatic and consular law, the law of the sea , air and space law, and international telecommunication law. The manual further discusses international peace and security and cyber activities, in particular peaceful settlement,

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[659] *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations* (Cambridge University Press 2017).

[660] Official website of CCDCOE <https://ccdcoe.org/tallinn-manual-20-be-completed-2016.html> accessed 27 October 2016.

[661] On cyber warfare and international law see also: Scott J. Shackelford, Managing Cyber Attacks in International Law, Business, and Relations: In Search of Cyber Peace (Cambridge University Press 2014); Michael Gervais, 'Cyber Attacks and the Laws of War' (2012) 30 Berkeley Journal of International Law 525; Oona A. Hathaway and Rebecca Crootof, 'The Law of Cyber-Attack' (2012) Yale Law School Faculty Scholarship Series, Paper 3852 <https://digitalcommons.law.yale.edu/fss_papers/3852/> accessed 13 August 2019; Pauline C. Reich, Stuart Weinstein, Charles Wild, Allan S. Cabanlong, 'Cyber Warfare: A Review of Theories, Law, Policies, Actual Incidents - and the Dilemma of Anonymity' (2010) 1(2) European Journal of Law and Technology <http://ejlt.org/article/view/40> accessed 13 August 2019.

[662] Eric Talbot Jensen, 'The Tallinn Manual 2.0: Highlights and Insights International Justice: Where We Stand, Where We Fall, and Where We Need to Be' (2016) 48 Georgetown Journal of International Law 735.

prohibition of intervention, the use of force – including the prohibition of the use of force and self-defense, and cyber security. In addition, the manual discusses the law of cyber armed conflict, including the conduct of hostilities, occupation and neutrality.

Tallinn 2.0 is the most comprehensive work written so far describing how international law regulates cyber activities that take place below the use-of-force threshold.[663] Jensen notes that while there are still many areas of disagreement and lack of clarity, Tallinn 2.0 will serve as the starting point for moving forward with the law on cyber operations.[664] It places special emphasis on the right to self-defense and the law of countermeasures.[665]

Unlike the GGE reports, which provides recommendations on national and international conduct, and broadens the scope of norms, principles and rules that apply to activities in cyberspace, the Tallinn manual has set to identify existing applicable rules of law and comment on how they apply to activities in cyberspace[666], though it did eventually expand and introduced new norms.

As noted in section 3.2.7 above, Efrony and Shany recently analyzed the acceptance of the Tallinn manual rules by States with mixed results.

6.6.4 Regimes and *Fora*

In terms of regimes, the reports of the GGEs and the possible report of the OEWG, and the process that led to them – a group working under a UN mandate – established/will

[663] Robert E. Barnsby and Shane R Reeves, 'Give Them an Inch, They'll Take a Terabyte: How States May Interpret Tallinn Manual 2.0's International Human Rights Law Chapter Symposium: Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations' (2016) 95(7) Texas Law Review 1515.

[664] Jensen (2016) (footnote 661).

[665] Christian Schaller, 'Beyond Self-Defense and Countermeasures: A Critical Assessment of the Tallinn Manual's Conception of Necessity Symposium: Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations' (2016) 95(7) Texas Law Review 1619.

[666] Boothby (n 614).

establish rules that are not legally binding. Nevertheless, the reports can be said to create, reflect and affect actors' expectations and the rules they put forward are even partially institutionalized to a certain degree, due to the UN-led procedure. The reports and rules they put forward therefore constitute a regime[667], though a weak one. The Tallinn manuals also, at least to a certain extent, create, reflect and affect actors' expectations, and may be considered a regime, at least for States that openly supported the project.

In terms of fora, there are forums with a recognized mandate, even if limited, to address the issue, *i.e.*, the CD, the GGEs and the OEWG. To the extent that international law, and in particular the UN Charter, apply, the UN institutions, notably the Security Council and the ICJ, may have a mandate. The First Committee of the UNGA is already active on the issue, supported by UNODA, resulting, among others, in the GGE reports. Moreover, the European Society of International Law (ESIL) proposed to involve the ILC in the development of a legal framework for cyberspace and refer to it the question of the interpretation of the international law applicable to cyber operations.[668] In view of all the above, even if we examine only the theater of cyberspace, there is, as Nye observed, a regime complex[669].

6.7 An Evolving Regime Complex

As the above review demonstrates, there is neither an institution with a comprehensive mandate imposing regulations through a hierarchical governance structure, nor is there a single set of norms, rules and procedures applicable to space warfare. There are numerous

[667] See chapter 3 for a definition of a 'regime'.

[668] 'ESIL Reflection: The Codification of the International Law Applicable to Cyber Operations: A Matter for the ILC? – European Society of International Law | Société Européenne de Droit International' <https://esil-sedi.eu/esil-reflection-the-codification-of-the-international-law-applicable-to-cyber-operations-a-matter-for-the-ilc/> accessed 1 August 2019.

[669] Joseph S. Nye, 'The Regime Complex for Managing Global Cyber Activities', The Global Commission on Internet Governance Paper Series No. 1 (2014) <https://www.cigionline.org/publications/regime-complex-managing-global-cyber-activities> accessed 16 May 2016.

sources of norms, regulations and procedures and there are numerous forums with a mandate to discuss, and sometimes adopt, instruments or measures related to space warfare. Nevertheless, it is not a fragmented stockpile of unrelated regimes with no identifiable core or linkages. There are important joint sources of norms, regulations and procedures, *i.e.*, international law and in particular the UN Charter and the OST, which is specific to the issue-area of space. There are also important common forums, notably the UNGA and its First Committee, the UN Security Council, the CD and UN-COPUOS which is specific to the issue-area of space. The various regimes are therefore loosely coupled, and hence there is a regime complex of space warfare as defined herein above.

6.8 Embracing the Regime Complex

As elaborated in chapter 3, there are several reasons for the emergence of regime complexes, and since these reasons will remain in the foreseeable future, so will the regime complexes[670]. Moreover, even (initially) non-complex regimes are likely to become complex. The governance of an issue-area may begin with a centralized and coherent regime, like establishing UN-COPUOS and adopting the OST, and evolve to a regime complex, through the introduction of further forums and instruments initiated by the initial institution(s) and by other forums, including newly established and stakeholders and experts led forums. This path is dictated by the reality of global politics but also represents a rather efficient course of action. Centralization is an efficient way to establish a new regime but not to expand and update it, and the rigidness of a centralized regime often leads to a bypass in order to further develop it. A regime complex is such a bypass. Indeed,

[670] On the emergence of regime complexes see: Vinod Aggarwal, 'Reconciling Multiple Institutions: Bargaining, Linkages, and Nesting' in Vinod Aggarwal (ed), *Institutional Designs for a Complex World* (Cornell University Press 2000) and Kal Raustiala and David Victor, 'The Regime Complex for Plant Genetic Resources' (2004) 58(2) International Organization 277.

the costs and deficiencies drive even initially centralized and coherent regimes towards decentralization or fragmentation, in other words - to become regime complexes.

The various UN organs working to regulate space warfare are deadlocked and have been so far unable to produce binding instruments that have the force of law beyond the treaties adopted in the 1960s.[671] A single overarching regime for space warfare is therefore unlikely and instead we are likely to see an evolution of the current regime complex.[672] However, as elaborated in chapter 3, regime complexes are not necessarily bad and it is possible and even fruitful to work within the regime complex. Moreover, it is the decentralization that renders a regime more robust, flexible, secure and efficient.

In terms of policy recommendations, this thesis suggests embracing the regime complex of space warfare and working within the regime complex, even expanding it, to address the various issues. There are several benefits from embracing the regime complex, first and foremost feasibility. Furthermore, the positive effects of a regime complex, as reviewed in chapter 3, are even stronger in the context of space warfare. The variance in regimes may allow for local-scale experimentation that may promote the pursuit of feasible, effective and sustainable regimes. It may allow, where linkage is not made, gradual development of regimes in increments, allowing agreement on one topic while discussion still continues on another topic. Incremental regimes may allow potential new members to gradually and even partially join the regime, thus lowering the bar for broadening the membership. That

[671] Ram S. Jakhu, Cassandra Steer and Chen Kuan-Wei, 'Conflicts in Space and the Rule of Law' (2017) 66 ZLW (German Journal of Air and Space Law) 657.

[672] Nye asserted similarly in the context of cyberspace (Joseph S. Nye, 'The Regime Complex for Managing Global Cyber Activities', The Global Commission on Internet Governance Paper Series No. 1 (2014) <https://www.cigionline.org/publications/regime-complex-managing-global-cyber-activities> accessed 16 May 2016).

was the case of the 1963 PTBT negotiated and initially signed by the US and the Soviet Union and later acceded by other States. Alternatively, where a linkage is made, it may allow bargains across topics and increase what is on stake – the sum of the linked issues. Indeed, actors often make linkage between issues, and such issue-linkage, considered by Keohane an integral part of international regimes[673], can be fruitful but might also stall the establishment of regimes.[674] Similarly, Young, in discussing the new needs for governance of the Arctic, suggests that a comprehensive Arctic treaty is neither feasible nor necessary, and that the solution is a regime complex. He further argues that a number of the elements of such a complex are already in place and that others are coming into focus at this time.[675]

The flexibility of a regime complex is particularly important in the context of space warfare since the concept and strategy of space warfare as well as the technology and weapons are fairly new or still in the making. It is therefore difficult to prescribe the rules at this stage, except, perhaps, rules banning space warfare or weapons. Moreover, considering the rigidity of rules, developing binding rules at this stage may lead to inadequate rules that are hard to amend, which may be good for warfare/weapons ban, but not for other rules.

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[673] Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton University Press 1984).

[674] On issue linkage see: Robert O. Keohane and Joseph S. Nye, *Power and Interdependence: World Politics in Transition* (Boston: Little, Brown 1977) and its revision by the authors a decade later: Robert O. Keohane and Joseph S. Nye, 'Power and Interdependence Revisited' (1987) 41(4) International Organization 725; Robert D. Tollison and Thomas D. Willett, 'An Economic Theory of Mutually Advantageous Issue Linkages in International Negotiations' (1979) 33(4) International Organization 425; Ernst B. Haas, 'Why Collaborate? Issue-Linkage and International Regimes' (1980) 32(3) World Politics 357; Arthur A. Stein, 'The Politics of Linkage' (1980) 33(1) World Politics 62; James K. Sebenius, 'Negotiation Arithmetic: Adding and Subtracting Issues and Parties' (1983) 37(2)International Organization 281; Michael D. McGinnis, 'Issue Linkage and the Evolution of International Cooperation' (1986) 30(1) Journal of Conflict Resolution 141; Christina L. Davis, 'International Institutions and Issue Linkage: Building Support for Agricultural Trade Liberalization' (2004) 98(1) American Poltical Science Review 153; Paul Poast, 'Does Issue Linkage Work? Evidence from European Alliance Negotiations, 1860 to 1945' (2012) 66(2) International Organization 277; Heather E. McKibben, *State strategies in international bargaining: Play by the rules or change them?* (Cambridge University Press 2015).

[675] Oran R. Young, 'Building an International Regime Complex for the Arctic: Current Status and next Steps' (2012) 2 The Polar Journal 391.

Law in general, and international law in particular, is normally a fixation of the past, what Allot called "a presence of the social past,"[676] and since the law regulates the future, or, in Allot's words is "a conditioning of the social future,"[677] it is the past that conditions the future. This arrangement may not work well in the context of space activities. In a domain as rapidly developing and changing, where the future is unexpected and uncertainty is a permanent resident perhaps more than in any other realm, conditioning of the future according to the past is not desirable. In the context of space warfare, there is hardly any past practice altogether, except for reconnaissance satellites (Earth observation satellite or communications satellite deployed for military or intelligence applications) and ASAT tests. Therefore, the adaptability and flexibility in substantive content and scope that a regime complex allows, are of significant importance. The establishment and development of the various issue-area-specific regimes should therefore be gradual and progressive, maximizing the advantage of adaptability and flexibility and allowing the meeting of the changing needs and adapting to the changing environments.

Though a regime complex is not without issues and challenges, the advantages overweigh the limitations, and, considering also the non-feasibility of a single comprehensive regime, it is the only road to take. The way forward is therefore to embrace the regime complex of space warfare not a as bug but a positive feature.

6.9 Expanding the Elemental Regimes

As elaborated in chapter 3, a regime complex is made of elemental regimes, i.e. of an array of partially overlapping and nonhierarchical regimes, possibly interconnected and often

[676] Philip Allot, 'The Concept of International Law' (1999) 10 European Journal of International Law 31, 32.

[677] Ibid.

with conflicting rules, governing a particular issue-area. As reviewed above, space warfare already has numerous elemental regimes, and even each theater of those reviewed above has numerous elemental regimes of its own. Moreover, other regimes, not established in the context of space warfare, also apply. Progress in the evolution of a regime complex can be made by the evolution of any of its parts or the introduction of a new part or parts, according to what is more feasible. Various parts may have large or small forums or member States, according to what is more feasible and suitable for the specific issue to be addressed.

There are regimes limiting or banning various types of weapons (nuclear, chemical, biological, mines). Similarly, there may be several separate regimes addressing various types of space-related weapons. Regimes may limit or ban the development and holding of ASAT, they may limit or ban the placement of weapons in orbit around earth, on celestial bodies etc. Alternatively, there may be a single regime covering all space weapons. It seems that the Sino-Russian suggested PPWT follows the first pattern, while the US' objection is based on that very point. As in other cases, the broader the coverage of a proposed regime, the harder it is to achieve agreement. The linkage that the US has indicated has its reasons but also delays agreement. During the discussions at the CD, Pakistan has made a linkage to the non-related issue of chemical weapons, another obstacle to achieving agreement on limitations on the weaponization of space. The use of remote sensing for military purposes is yet another specific issue-area, and it is already a common practice by many States and, pending the gathering of sufficient evidence, may be argued to have given rise to a customary rule that allows it.

The development of elemental regimes is typically graduated and with differing pace. Some elemental regimes develop faster than others; some are more comprehensive or more effective than others. Partially overlapping between elemental regimes is common, but it has the positive effect of incrementally creating an expanding coverage of the regime complex. The elemental regimes, loosely coupled, may eventually amount in the aggregate to a more or less comprehensive regime for space warfare.

The governance of space warfare indeed follows the track of a regime complex. There are several forums with partially overlapping mandates, producing various instruments, which are partially overlapping and with various degrees of details and legal force. This evolving regime complex has two features, whose merits were discussed above and, which increases its efficiency: in at least some of the elemental regimes there is a key role for stakeholders and experts (see section 4.4 for the merits); and various UN organs or affiliated or mandated institutions coordinate the various efforts to govern space warfare.

6.10 Conclusions

The concept of 'regime complexes' provides the analytic tools for understanding and constructing the governance of space warfare. A Regime is a subset of norms, possibly institutionalized into a treaty or soft law instrument and often includes a forum. A Regime Complex is a loosely coupled set of separate regimes for a single issue-area. As complexity studies suggests, knowledge of the elementary building blocks of a complex system does not in itself allow understanding of the behavior of the system as a whole, nor understandings the building blocks themselves. The whole is different than the sum of its parts, and the dynamics of the whole shape the behavior of units and sub-parts. Therefore,

only analysis of space warfare as a complex system, a regime complex, will allow understanding both the individual regimes and the governance of space warfare as a whole. This is essential for the proper crafting of new instruments and possibly establish new forums and, generally, for drawing the roadmap to governance of space warfare.

There is no single, comprehensive and integrated regime for space warfare. The governance of space warfare is made up of various separate regimes, partly overlapping, which are interlinked to various degrees, in other words: a regime complex. This regime complex is here to stay, and it has positive features, notably allowing gradual, progressive development of a flexible and adaptable set of regimes. It allows the establishment of partial regimes, where an attempt for a comprehensive regime will fail; and it permits cooperation among actors in some areas at the same time that they have disagreements in others. These characteristics are particularly important in issue-areas with high uncertainty or fast or frequent changes emanating from technological development and changes in global geopolitics, and space warfare is such an issue-area.

Regime complexes are not without issues and challenges, notably all the issues associated with a non-unified and hierarchical regimes and with linkages. However, considering the advantages of regime complexes and the inevitability of a regime complex of space warfare, it is best to embrace the regime complex of space warfare not a as bug but a positive feature, and learn to work within the regime complex. The various elemental regimes allow for local-scale experimentation that may promote the pursuit of feasible and effective regimes. It may allow gradual development of regimes in increments, allowing agreement on one topic while discussion still continues on another topic. It is even inclusive because it

allows various actors to gradually and even partially join regimes, thus lowering the bar for broadening the membership.

The governance of space warfare seems to follow in practice a track of a regime complex. Space warfare has three types and five theaters, each having numerous elemental regimes, *i.e.*, each has a regime complex of its own, nested in the regime complex of space warfare. Moreover, the evolution of the governance of space warfare is enhanced by two positive features - a key role for stakeholders and experts in at least some of the elemental regimes and interconnection and coordination between the various elemental regimes, and efforts to govern space warfare, in this case made by various UN organs or affiliated or mandated institutions.

Chapter 7
Conclusions

7.1 The Problem Driving this Thesis

The initial efforts of building space governance were successful in introducing basic norms, several widely accepted space law treaties, and dedicated UN organs. However, this fairly monocentric system, in which UN-COPUOS is mandated with creating and expanding the *corpus juris spatialis*, reached an impasse with decades-long gridlock and failure to introduce new legally binding regimes. The ongoing structural deficiencies of space governance, results in failure to properly and effectively address even the most pressing challenges in space. In the absence of international regimes, States are going at it alone, whether by developing space weapons, ASAT tests, or by unilateral national legislation allowing and regulating the exploitation of space natural resources, in a steady retreat from multilateral arrangements to national regulation and action. The current system of space governance is at risk of losing its relevance.

The human space quest was led, in its first decades, by national space agencies. However, since the dawn of the 21st. century, the commercial space sector has expanded in scope and, significantly, in the vision and boldness of activities. Gradually, the private sector is taking the lead from national space agencies in what is known as "New Space". The new technological and commercial developments are pushing the boundaries of space law and putting a strain on the outdated system of space governance. The result is an urgent need to revive space governance, which has been the drive of this thesis. In a nutshell, this thesis suggests that a decentralized model of governance, and in particular polycentric governance, will produce better results and enable a continuous evolution of space governance, so it meets the ever-changing challenges and opportunities of space exploration and utilization, and finally, down the road, also habitation.

7.2 Human Evolution, Global Governance and Space Governance

Human grouping increased in scale over the course of history, from small groups of hunter-gatherers to small agricultural settlements to cities and finally States which remain, despite ideas of a global government or a single global entity, the final sovereign. Nevertheless, the evolution of industry, commerce and human society in general makes cross-border interaction highly beneficial to most and even inevitable. Cross-border interaction is already – and still increasing despite all challenges – of vast scale and depth. Norms, rules and institutions were established to enable and facilitate cross-border interaction. Yet, the result of an increasing cross-border interaction, and the lack of a global government or sovereign is difficulties and deficiencies of global governance. Global governance has been in existence for only two centuries, a short period in human history.,Iits form is still developing and there is room, and need,for new and novel concepts and strategies to facilitate and promote global governance. The study of global governance is even younger, and while it started before World War II, it saw the first wave of significant study and literature after World War II, and a second wave of development since the 1990s. Space activities and space governance are still earth-bound and suffer from the same difficulties and deficiencies as global governance, with some unique features. One day, way down the road, space colonies will be self-sufficient and adopt governance systems independent of Earth, but until then, space governance is an issue-area within global governance. The result is that the knowledge on global governance is relevant to space governance and that the concepts and solutions suggested in this thesis are probably relevant to other issue-areas in global affairs, and possibly to global governance in general.

7.3 The Theoretical Framework of the Thesis

This is an interdisciplinary – or even transdisciplinary - research that integrates knowledge and methods from different disciplines and synthesize their insights. The international relations' literature on global governance is essential in any discussion on global governance. In addition, the international relations' literature on regime theory, the predecessor of the literature on global governance, is also an important reference. This is indeed the first pillar of the theoretical framework of this thesis. Within this literature, it is the concept of regime complexes that is of particular relevance to the investigated problem and to the course chosen to address it. International law is an important part of global governance and the international law literature is of relevance to the study of global governance. Within this literature, it is the literature on fragmentation that is relevant to the chosen course of analysis of the problem, and has similarity with the concept of regime complexes, and strengthens the conclusions reached on the basis of the concept and theory of regime complexes. The literature on polycentric governance, while not a first candidate for the discussion on global governance, proved to be extremely relevant and provided important insights. In essence, regime complexes, fragmentation and polycentric governance are versions or conceptualizations of decentralized governance, and they are relevant to the study of global governance, which is, in the absence of a global sovereign, inherently decentralized. The literature on polycentric governance is of particular importance as it provides sound empirical proof and also design principles for robust governance systems, which supplied another pillar of the theoretical framework of this thesis.

7.4 The Case for Polycentric Space Governance

The realities of global politics and the advantages of decentralized governance, and in particular polycentric governance, lead to the conclusion that for space governance to evolve to meet the growing challenges, it must become polycentric. Monocentric or centralized governance is not sustainable, and it is no longer feasible to introduce comprehensive top down arrangements.

A transition to polycentric governance means facilitating and encouraging the evolution of a separate governance center or centers for each issue-area. Thus, each sub-issue-area, *e.g.,* space natural resources, militarization, space debris and space traffic control, will have a separate issue-area-specific governance center or even centers, led by stakeholders and experts with the active participation of UNOOSA. Each governance center will introduce and modify rules and possibly monitor their application. UNOOSA may represent the international public interests, and the interests of those who are not active in the issue-area but are largely affected or are prospective actors. Private actors will also take part in the governance of issue-areas in which they are active. A single issue can have more than one forum, *e.g.,* one multilateral and another industry forum. By dividing space governance to sub-issue-areas, and having forums predominately with stakeholders and experts, who have an interest in establishing rules and knowledge on which rules would suit the issue-area, there are greater chances to establish a governance system. UN-COPUOS, which is arguably already at a crossroad, will need to adopt its functions, *e.g.,* by serving as a forum for multilateral discussions on broad systemic principles that apply across the governance centers. The roles, procedure, and goals of UN-COPUOS, of course, deserve a separate thorough discussion.

The basis of current space governance – the space law treaties and UN organs - will remain, and the governance centers will be an additional layer or component that promotes space governance. This is expected to break the gridlock and enable the introduction of rules that are better suited to the circumstances and more likely to be followed, than rules imposed from the top. Polycentric governance would allow decentralized, incremental evolution of space governance. The governance of each sub-issue-area would evolve at a different pace according to the degree of urgency, type of challenges and agreement between the actors. It would allow the establishment of partial regimes, where an attempt for a comprehensive regime fails; and it would permit cooperation among actors in some areas at the same time that they have disagreements in others. The governance of each sub-issue-area would evolve by different forums with different participants, and by the introduction of various instruments, legally-binding or not, multilateral or national or industry standards or best practices. The aggregate of all these instruments and forums would be a more comprehensive, flexible, and updated governance than a monocentric system of global governance can yield. These characteristics are particularly important in issue-areas with high uncertainty or fast or frequent changes emanating from technological development and changes in global geopolitics, and space activities are such an issue-area. The polycentric model is capable of meeting the challenges facing space governance by providing an efficient, feasible model which is consistent with current space law and is flexible enough to entertain future developments.

In fact, space governance is already on track to become polycentric, increasingly and inevitably, with numerous decision-making centers (governance centers) – often established and led by stakeholders and experts - producing numerous, partially

overlapping, issue-specific regimes. There are well established governance centers, notably the ITU, a governance center in transition on traffic control, and emerging governance centers on space natural resources and space warfare. Still, further action and (re)cognition is required to transform space governance to a polycentric system. In terms of policy recommendations, it means embracing polycentric governance, facilitating the introduction of governance centers and acknowledging their importance and their output. It further means diverting more governance-building efforts in this direction, while mitigating its adverse effects. The advantages of decentralized governance can be maximized, and its adverse effects can be mitigated if governance centers meet Ostrom's 'design principles' for effective institutions, if institutional deference is practiced and possibly if the standards of 'global administrative law' or the 'law of global governance' are applied.

The suggested architecture of space governance is neither a central authority nor a 'power vacuum'; neither anarchy nor State, nor even utopia.[678] Its merits - the merits of polycentric governance - are not limited to space activities and, considering that space governance is an issue-area in global affairs, the conclusions herein may suit other issue-areas in global affairs and global affairs in general.

7.5 The Governance of Space natural resources

Within space governance, the sub-issue-area of space natural resources is of growing interest, due to the immense economic potential from the exploitation thereof. The legal framework is thin and vague, and even the right to mine space natural resources is contested. The 1967 OST provides but vague guidance, granting all States free access to

[678] Compare: Robert Nozick, *Anarchy, State, and Utopia* (Basic Books 1974).

space and the right to explore and “use” it, but banning national appropriation. The 1979 Moon Agreement, focused on this issue, is only now gathering interest from leading spacefaring nations, *i.e.*, Germany, Russia and China, though it seems unlikely that the US, the most important actor, will ratify the agreement. Moreover, even the Moon Agreement, while establishing the principle of the ‘common heritage of mankind’, does not provide a workable framework, but merely includes an undertaking by the signatories States to establish an international regime to govern the exploitation of space natural resources when such exploitation is about to become feasible. Indeed, now that mining space natural resources is about to become feasible, with several projects involving across various States working in this direction, the debate on the exploitation of space natural resources and the distribution of the benefits from them is heating, though with many crippling misconceptions.

The discourse on space natural resources that are widely - but not necessarily duly - regarded as 'commons', is un-structured and is misguided by the confusion of the notion and essence of ‘commons’, between the economic and the legal meanings. In order to conduct a solid discourse, it is necessary to make three distinctions: (i) between commons as an *economic* term and commons as a *legal* regime. The first refers to a type of goods or resource used by multiple users, and the second refers to a property-rights regime, the ownership over the resource. This is a crucial distinction, as an ‘economic commons’, such as a lake, may have different property rights regimes, as it may be private property, government property or ‘legal commons’; (ii) between the different parts of space (*e.g.,* orbits, celestial bodies, and void space), since some may be “commons” (economic and/or legal) and others not; (iii) and between resource systems and resource units. If we get the

questions wrong, *i.e.*, by confusing the terms and mixing different subjects of inquiry, we will not, by definition, find the right answers.

Furthermore, the debate on whether or not space is 'global commons' is misconceived and almost redundant, as the concept of 'global commons', often applied to outer space, is of limited or unclear meaning, and it does not imply the property rights regimes in the domains and resources it presumably describes, including outer space.

Space natural resources is a sub-issue-area of space governance and it should have – and is already on track to having – its own governance center. Furthermore, since there are potentially many space natural resources, *i.e.*, various areas (the Moon, Mars, earth orbits, etc.) and various types of resources (water, helium 3, titanium etc.), it is likely that towards the actual mining, there would be more than one governance center for space natural resources – one for each area or type of resource nested in the governance center of space natural resources. The governance of space natural resources should take a multilevel nested structure: there will be a governance center for each area or space resource, or types of space natural resources. The type of governance will be decided according to the type of resource (*i.e.*, private goods, public goods, CPR or toll goods, see Table 1 in chapter 5). These governance centers will be nested within the governance center of space natural resources, which, in turn, will be nested within general space governance. While the governance center of a certain resource will have some powers, *e.g.,* adopting work procedures, standards, coordination, it needs to comply with regulation adopted at the higher level, at the governance center of space natural resources. And while the governance center of space natural resources has some power to adopt rules, it needs to comply with

the space law treaties and be synced with space governance in general. By this, the governance of space natural resources will suit the type of each resource, will conform to the space law treaties, and maintain the polycentric structure of space governance.

7.6 The Governance of Space Warfare

Space warfare, including weaponization of space and military uses of outer space, is another sub-issue-area of growing interest, stemming from the increasing use of space for military purposes, and the place it is taking in the national security strategies of many States, especially the main spacefaring States. There are scattered regimes applicable to space warfare, and therefore the concept of 'regime complexes' provides the analytic tools for understanding and constructing the governance of space warfare.

Space warfare can be divided into three types and five arenas. The types of space warfare, according to their theater, are: (1) Space to space attack, taking place solely in space; (2) Space to/from earth attack, *e.g.,* using anti-satellite weapons (ASAT); and (3) a cyber-attack targeting space assets. Space therefore may take place in five different theaters or domains: outer space, air space, open seas, territorial land, and cyberspace. Each theater has different sets of rules of international law, and extracting the applicable legal rules is complicated. The MILAMOS project is working on this daunting task and the McGill manual is expected to promote the understanding of the limited and scattered legal rules applicable to military uses of outer space.

The governance of space warfare is made by various separate regimes, partly overlapping, which are interlinked to various degrees, in other words – a regime complex. This regime complex is here to stay, and it has positive features, notably allowing gradual, progressive

development of a flexible and adaptable set of regimes. These characteristics are particularly important in issue-areas with high uncertainty or fast or frequent changes emanating from technological development and changes in global geopolitics, and space warfare is such an issue-area. All in all, the evolution of the governance of space warfare as a regime complex, while not without its limitation, is a positive step.

7.7 The Contribution of the Thesis

The thesis advances the current knowledge by addressing the crisis in space governance from a systemic perspective of the architecture of space governance (as opposed to discussing the content of the norms). It further contributes by introducing to the discourse on space governance the international relations literature on global governance, from which it was largely absent. The thesis takes the current knowledge further by comparing the three concepts – polycentric governance, regime complexes and fragmentation - and demonstrating – as well as building on - cross-disciplinary convergence of the insights from the respective literatures. By that, it applies the empirically tested knowledge on the governance of CPRs to governance in global affairs. The thesis thus contributes to the knowledge on general global governance and to the knowledge on international law, which is a major part of global governance. Moreover, the thesis introduces and applies this new knowledge to space law and launches a discussion on the architecture of space governance. In addition to the theoretical core of the thesis, it provides policy recommendations, sketches how polycentric space governance may look in practice, and discusses the governance of space natural resources and space warfare. To be sure, the thesis could neither encompass all specific issues nor the various mechanisms for the practical implementation of the recommendations. Further research is needed on these important

issues, and this thesis provides the foundations for such research. It lays the basis for further discussion on space governance by providing the necessary historical background and the theoretical and methodological tools for the discourse, including the cutting-edge scholarship on global governance.

7.8 The Final Frontier of Global Society

Space governance is interlinked with global governance, more than just being an issue-area in global affairs. Space applications have revolutionized communication and transportation, facilitating the interconnections that drive globalization. Globalization, with its cross-border interconnection, interdependence, and engagement, increases the need for supra-national regulation, *i.e.*, global governance. In addition, the milestones in the evolution of global governance are linked to space governance, with the ITU opening the first wave of international organizations, and with INTELSAT.which introduced a whole new kind of international organization.

Looking down the road, the exploration and use of space, initially to serve life on earth, will eventually also bring about the habitation of space. Space habitation will be the most important spatial expansion since humans spread from Africa, with implications also to those left behind on Earth. This will be indeed the final frontier of global society.[679]

The emergence of mankind from its cradle to all other territories is a great project, perhaps the greatest in mankind's history. The governance of the new activities and frontiers is a research agenda of the utmost importance. Old problems meet new challenges. Complexity

[679] Eytan Tepper, 'The Final Frontier of Global Society and the Evolution of Space Governance' in Ino Rossi (ed), *New Frontiers of Globalization Research: Theories, Processes, and Perspectives from the Global North and the Global South* (Springer, forthcoming).

is embedded. Space governance is likely to become ever more complicated, as humankind will make further steps into space and with increased presence in space, including factories (as Amazon founder Jeff Bezos is foreseeing) and habitats. Prospective thinking should shift from using simple models to using more complex frameworks, theories, and models to study and handle the diverse challenges facing future space exploration. The technological, economical, legal and sociological developments and even revolutions necessitate a flexible governance regime that will be able to entertain adjustments to suit governance to the needs. A rigid governance system will delay development. Where the unknown outweighs what is known, where we expect new and major discoveries, achievements, disruptions and challenges, adopting a flexible governance system is preferred. I believe that the governance system suggested herein provides just that.

- END -

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