

An Examination of the Major Space Cooperation Forms between States as Models for the Development of Similar Forms for International Joint Ventures on Other Celestial Bodies

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1. Introduction

Space travel and settlement on other celestial bodies has always intrigued humankind since the idea took hold that we can use technology to climb out of the “cradle of mankind”, as Konstantin Tsiolkovski aptly referred to the Earth. Authors have written science fiction narratives envisioning the unfolding of settlements on the Moon, Mars and other celestial bodies. Notable here is the seminal trilogy of Mars settlement authored by Kim Stanley Robinson – each book titled respectively “Red Mars”, “Green Mars” and “Blue Mars” – wherein he provides a complex yet detailed narrative of the first 100 scientists and astronauts to settle on Mars and the eventual expansion of human settlement against the background of a terraforming project to turn Mars into an Earth-like planet to sustain human habitation. His future vision takes into account human nature and specifically the human as a political animal, which results in disputes arising between colonists who wish to terraform Mars and those who wish to protect the original natural environment of the planet as found when the first 100 stepped onto ‘Mars-firma’. Initially the colonists are very dependent on assistance and supplies from Earth, but as time passes new generations are born on Mars with

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tenuous physical and emotional ties with planet Earth. The frustration of being governed from afar without an understanding of local conditions and desires eventually grows into a full-blown revolt against the Earth administration followed by a short and sharp civil war against the Earthly 'princes and empires'. Earth ultimately loses the battle due to its lack of knowledge of local conditions and inability to keep control of its bases on the two Martian moons, Phobos and Deimos, and the space elevator which is destroyed by the freedom fighters. Earth has due to economic conditions no appetite for a drawn-out war and concedes autonomy to Mars. So the human Martian nation is born. However back on Mars internal disputes continue based on new groups having been formed based on ideology, environmental affairs, ethnicity, nationalism and the lines of division and power so well-known in earthly affairs.

There is also a large corpus of non-fictional scientific works that delves into the scientific and engineering planning and economic viability of projects to create human settlements on celestial bodies like the Moon and Mars. Most of these works have appeared since the launch of Sputnik in 1957. However, such serious investigations can be traced back to the works of Konstantin Tsiolkovski, the Russian scientist that first seriously investigated the concept of rocket technology and the manner of human space travel. A recent paper by Shishko¹ provides a scientific framework within which to design and economically frame a settlement project on Mars. Notably, the study acknowledges that a proper legal framework is lacking within which the Mars settlement will have to operate.

While the *Corpus Iuris Spatialis* is currently to a great extent settled in the form of the five international space treaties and various related treaties, international custom and various pieces of 'soft law' in the form of General Assembly principles, amongst others, it has also been State practice to enter into limited and focused multi- or bilateral co-operation agreements. The multilateral International Space Station Agreement (ISS Agreement) between various states is a prime example of contractual co-operation among sovereign states. While many other space-related cooperation agreements exist, the ISS Agreement is regarded as the most comprehensive and closest to what a typical legal framework would look like for space exploration and settlement. However, it is nowhere near what would be actually needed.

Therefore, this paper will briefly examine the most prominent space cooperation forms and will postulate what form such future cooperation could take against the background of existing and developing space law. This will be performed using systems thinking as the analytical framework.

1 R. Shishko, R. Fradet, S. Do, S. Saydam, C. Tapia-Cortez, A.G Dempster, J. Coulton, Mars colony *in situ* resource utilization: An integrated architecture and economics model, *Acta Astronautica*. 138 (2017) 53–67.

2. Space Cooperation Agreements

Space Law can for the purposes of this study be divided as follows: i) the Macro-Law consisting of ‘hard law’ on the one hand – that is binding on states based on consent or conduct – and based upon the five outer space treaties, related treaties dealing with space activity tangentially, and international customary law, and on the other hand ‘soft law’ – that is non-binding and guiding in nature – based upon the United Nations principles, declarations and resolutions, and guidelines issued by various international and regional bodies, like codes of conduct, model laws etc.; ii) the Micro-Law consisting of inter-state cooperation agreements that comes into existence by way of mutual consent in bilateral or multilateral form, and deals with matters or projects specific to the states involved, and is usually guided and informed by the Macro-Law.

As the Macro-Law does not deal with the minutiae of specific space projects, but provides broad overarching or universal rules, it is incumbent upon the field of Micro-Law to ensure binding agreement on a project like the International Space Station (ISS) or a future human settlement initiative. It is, therefore, important that the Micro-Law, especially in the form of bilateral or multilateral agreements, is employed to provide legal certainty on a range of issues expected to arise as part of such a project.

The major space cooperation forms investigated in this study are a mixture of Macro- and Micro-Law in the form of international treaties, as well as bilateral and, multilateral agreements. This is thoroughly analysed by Voronina who identifies the following legal forms, amongst others, as the most important as it relates to space activity cooperation: i) the United Nation Committee on the Peaceful Uses of Outer Space (UN COPUOS) as an organisational form based on treaty; ii) UNISPACE Conferences; iii) regional space cooperation such as the European Space Agency as an organisational form (ESA); iv) international satellite organisations as organisational forms; v) the International Space Station based on agreement; and vi) soft law instruments devised to address new or contemporary trends such as commercialisation, space traffic management and space debris.²

The existing framework of space law that mostly originated from the Cold War era can be regarded as the First-Generation Space Law (FGSL). Voronira’s acknowledgment of the new and contemporary trends such as commercialisation, space traffic management and space debris as legal forms of space cooperation, is also a harbinger of the new direction that the legal development of Space Law must take.³ FGSL will over time give way to the

2 A. Voronina, *The How’s and Why’s of International Cooperation in Outer Space: International Legal Forms of Cooperation of States in Exploration and Use of Outer Space*, University of Nebraska, Lincoln, 2016.

3 See note 2.

Second-Generation of Space Law (SGSL) as new forms of space activities based on commerce arise and the volume of space activities increases. Over time this might lead to the reinterpretation and/or replacement of the FGSL. Voronina sets out the international law principal of cooperation as follows:

“States that engage in exploration and use of outer space must cooperate to maintain international peace and security, or alternatively are under the obligation of result, and should cooperate, whenever feasible, in the economic, social and cultural fields as well as in the field of science and technology and for the promotion of international cultural and educational progress, or alternatively are under the ‘obligation of effort’. In the latter spheres the duty to consider cooperation in good faith transforms into the obligation to cooperate in practice only pursuant to relevant provisions of specific international agreements.”⁴

Therefore, generally, there is an overarching obligation in international law – as a frame to negotiate space law – on states to cooperate, and that obligation can be generated in practice by way of international agreements. Against this background it is apt to consider Voronina’s analysis of the various legal forms of cooperation in the space industry so as to ascertain if any basis exists that can give rise to the necessary legal framework for future human settlement initiatives. The following types are identified and discussed: treaties, organisations/institutions, conferences and hybrids of the aforementioned. In addition, soft law will also be considered.

2.1 United Nations Committee on the Peaceful Uses of Space (COPUOS)

COPUOS was the first multilateral forum (organisation) for cooperation in space activities and is considered, together with the launch of Sputnik, by the ESA to be the start of the Space 2.0 era.⁵ The field of space was considered so specialised that the United Nations (UN) decided that the General Assembly cannot deal with these affairs on its own, and thus created a separate Committee for this purpose. COPUOS therefore became the originator of international space law in the form of five treaties and four sets of guiding principles, what can be considered as the FGSL and Macro-Law, and is continuing to act as the leading international forum for the progressive development and codification of hard and soft space law.

It is notable that as far as any human settlement initiative is concerned, at some point a similar law-giving body will be needed within the new human settlement community as it becomes larger, more sophisticated and outgrows the initial international cooperation agreement and the directives imposed from planet Earth. The chances are that this law-giving body might arise from a new constitution that will regulate the celestial society as a whole on

⁴ See note 2.

⁵ ESA, What is Space 4.0? Undated, www.esa.int/About_Us/Ministerial_Council_2016/What_is_space_4.0, (accessed 25.08.17).

democratic and human rights principles. Ideally, these principles must be embedded in the international cooperation agreement itself as a framework by which the settlers can negotiate an appropriate and localised legal system for themselves.

2.2 UNISPACE Conferences

Ten years after the creation of COPUOS, the first universal conference on space affairs was held under the auspices of COPUOS and is since known as the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE). During UNISPACE I at issue was the equitable sharing of any benefits from space between spacefaring states – then only the US and the USSR – and the non-spacefaring states. The question was how to give effect to the notion that the exploration and use of outer space is “the province of mankind” as set out in the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty)* against the background of the Cold War and the logical unwillingness of the US and the USSR to open their space capacity to others, a move that would naturally be in violation of their respective national interests. UNISPACE II took place in 1982 and for the first-time private space players were also represented, although very limited in number. UNISPACE III was held in Vienna in 1999 and considered many issues, including cooperation between States. It was also during this Conference that the Vienna Declaration on Space and Human Development was issued.⁶

The decisions made by UNISPACE are non-binding in nature, but allows for the deliberation between states and other role-players on important space issues that can result in non-binding decisions and guidelines which over time can turn into customary international law or become codified into a treaty.

In this respect UNISPACE can be considered a model to be used by the celestial settlers to establish a platform for discussion and deliberation on various issues regarding the new world they are inhabiting which can eventually move towards becoming law by way of their law-making mechanisms.

2.3 Regional Space Cooperation

The European Space Agency (ESA) was the first regional space organisation and is a truly successful model for international space cooperation. ESA is a major space actor with its own launch vehicles, various exploration and scientific projects, like the Galileo-program, and also is partner to the ISS project. ESA also contributes to the creation of space law through its internal

⁶ See note 2.

procedures, establishment of and entering into international agreements, and its international space practices.⁷

ESA may still serve as a model for a new conglomeration of states that wish to cooperate in a large space initiative, such as human settlement. While ESA is a regional organisation based on geographic proximity of the various state-participants, technological advancement in industrial production, transport and communication have created the environment for such an international organisation between states geographically separated from each other, joined by the political will to bring to fruition a certain space project or initiative. It might be such an organisation that will bring together all the will-power and resources to establish a human settlement initiative. In this regard the ESA's Moon Village initiative is notable.

2.4 International Satellite Organisations

During the 1970's a range of international organisations focusing on artificial satellite projects were created. The International Maritime Satellite Organisations (INMARSAT) was established to assist maritime communication on the oceans. The International Telecommunications Satellite Organisation (INTELSAT) was established to strengthen radio and television broadcasting, and a Soviet counterpart, the Intersputnik International Organisation of Space Communications (INTERSPUTNIK), was also created within the Cold War environment.⁸

Most of these satellite organisations were privatised since the year 2000 due to the fact that they are real business concerns that sell their satellite services and the onerous and slow decision-making abilities need to be more agile than is generally possible for these organisations as multilateral member-state organisations. These organisations might be insightful in relation to their establishment of state cooperation focused on a specific project, but the achievement of a true multilateral space project involving human space travelers in orbit, is the next to be discussed.

2.5 International Space Station (ISS)

The ISS signaled the start of the Space 3.0-era and is a monumental achievement in international cooperation. The project required the unprecedented cooperation of all participating states in the form of compromise on many aspects, such as differing specifications, standards, assumptions and legal frameworks. It is the latter which allowed for dealing with various cooperation issues and thus to "define and shape the dynamics of this ambitious project".⁹

7 See note 2.

8 See note 2.

9 See note 2.

Since the participating states had very differing legal traditions, the only manner in which to establish a proper and practical legal regime was to create an International Space Station Agreement (ISS Agreement). After the Cold War Russia was also admitted as a participating country and as a major space-partner had to be accommodated by redrafting the ISS Agreement. The new Intergovernmental Agreement (IGA) was signed in 1998. Thus, a new legal regime was created consisting of four levels of legal agreements, with the most important the IGA as the basis, and the Crew Code of Conduct. Interestingly, the IGA's objective is to establish a long-term international cooperative framework among the participants based upon genuine partnership.¹⁰ It is this successful partnership that has brought humankind the longest Earth-orbiting manned spacecraft without any known major disagreements, violations of sovereignty and scandal. It is, therefore, this partnership that forms the basis upon which states can in future participate in an ambitious and historical program like the human settlement initiative. As any human settlement initiative is so much larger in scope than that of the ISS, the lessons learned from the ISS are limited, but is most certainly at the very least a credible point of departure.

2.6 New and Contemporary Trends

The most important trend in space currently is that of commercialisation and globalisation and is considered to be the start of the Space 4.0-era.¹¹ Private interests are the driving force behind this trend as they not only fill the vacuums left by governments, but actually replace government services in many instances, or at the very least, partner with government in executing space activities. Therefore, to date, private interests have taken up positions within the satellite industry, construction of launch vehicles and the provision of launch services, construction and operation of space cargo vehicles, private manned space flights, and space tourism. This demands a legal regime that can deal with all the new issues that are emergent within this new private space environment, such as ownership, use of limited resources such as spectrum and geostationary orbital positions, safety and liability/insurance. Other new issues have become pertinent, such as that of space traffic management, given the growing body of space of objects in orbit. It demands a solution similar to the air traffic control-system devised by the international organisation, the International Civil Aviation Organisation (ICAO). Related to this is the growing problem of space debris. Non-binding technical measures were introduced in 2007. COPUOS devised the Space Debris Mitigation Guidelines that were adopted by the UN General Assembly. However, these are not legally binding rules yet, although an argument exists that through continuous use by spacefaring states it can become international

¹⁰ See note 2.

¹¹ See note 5.

customary law.¹² While these guidelines mitigate the increase of space debris, they do not assist in reducing the existing corpus of space debris in orbit. This is still an issue under investigation.

Another trend is the move towards a human settlement initiative, either on the Moon or on Mars, or both. The poor support of the *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* (*Moon Agreement*) has resulted in legal uncertainty with regard to human settlement of celestial bodies. Currently Article II of the *Outer Space Treaty* prohibits “national appropriation by claim of sovereignty by means of use or occupation, or by any other means”. Therefore, establishing a permanent human settlement on the Moon or Mars could be at odds with this provision, even if established for scientific purposes only, depending on the interpretation of this provision that will differ from State to State. Providing legal certainty in this respect means that a new treaty or amendment to existing treaties may have to be considered as part of the solution.

These new trends require a multilateral engagement of the global community with the various emerging issues to find a solution. In effect what this means is that the time for the Second-Generation of Space Law (SGSL) has arrived as the new Macro-Law. If the current Macro-Law allows the construction, launch and in-orbit construction, and transit to celestial bodies, but the interpretation that permanent human settlement is a form of national appropriation becomes the settled law, then any permanent human settlement project is doomed from the start as it would be in breach of the *Outer Space Treaty*. Clearly, this calls for unprecedented international cooperation to resolve by way of an amended or new international treaty and the possible establishment of new institutions or the reform of existing ones.

Despite this uncertainty, many more legal issues arise from any human settlement project. This can be discerned by having regard to the human settlement initiative as a whole.

3. Systems Analysis of a Human Settlement Project

In broad scope a human settlement initiative will consist of the following stages, also known as the super-system: i) Earth research and development within an enabling economic environment (**Terra System**); ii) launch, orbit, orbital assembly, space travel and transit to the celestial body including orbital insertion and landing (**Transit System**); and iii) human settlement, including working towards partial and full self-sustainability while receiving assistance via pay-loads from Earth (**Settlement System**). Shishko refers to this as a system-of-systems with the various systems interlinked.¹³

12 See note 2.

13 See note 1.

While the super-system is supported by the existing *Corpus Juris Spatiales* or FGSL that provides the overarching legal framework, each stage or subsystem is distinctly unique and will give rise to different – yet overlapping challenges – that deserve different legal frameworks. It will also ask for consideration of the type of legal form that any cooperation will necessitate.

Of greater importance is that any prospective human settlement initiative will be in breach of Article II of the Outer Space Treaty as long as there exists an intention to effect national appropriation. Therefore, all subsystems of the super-system, including the Terra System and the Transit System, will in such a case be illegal.

Therefore, for the sake of completing this analytical exercise of a human settlement initiative, it is assumed that the participant states and/or private sector actors do not wish to settle permanently on the intended celestial body, but intend to perform scientific investigation on and use the celestial body. This could imply that at some point the human settlement will have to move on to another geographic area or will have to be thoroughly representative of the terrestrial states to such a degree that the permanency does not constitute any national appropriation. Representivity could imply that a resource share body will have to be created to distribute any benefits equitably across the globe as envisaged in the Moon Agreement or that an open model of settlement be created where any state or private actor can join when they can, like the ESA's Lunar Village model.

Having set the prerequisites in accordance with the FGSL, the sub-systems of the Super-System now deserves investigation.

3.1 Terra System

The Terra System, according to Shishko in referring to a possible Mars human settlement, consists of various elements or 'terrestrial enablers'.¹⁴ It is accepted for the sake of this analysis that this is also applicable to any celestial body, including the Moon. Each element is briefly discussed with reference to the applicable legal regime:

Commodity and Capital Markets: This element is regulated mostly by national law in each state. The economic drivers for outer space travel, exploration and celestial body settlement will also play a seminal role in these space activities coming to fruition. In this respect, mining of minerals on asteroids, mining of Helium³ on the Moon, and planet Earth survivalist issues that pushes colonies onto Mars, will be of great importance as it will set up a set of motivations and financial frameworks that will make these activities possible. The national and international legal regimes will play an important facilitative role in this regard.

Industrial base: Regulated by national policy and law in each state as well as international cooperation agreements between States;

¹⁴ See note 1.

Space research and development: Regulated by national law as well as international cooperation agreements;

Ground networks: Regulated by national law, international cooperation agreements between States and the FGSL;

Spaceports: Regulated by national law, international cooperation agreements between States and the FGSL;

Prospective colonists: Regulated by national law, international cooperation agreements between States and the FGSL;

Benign legal regimes/treaties: As stated before the settlement may be in violation of Article II of the Outer Space Treaty if the settlement is intended to perform national appropriation. Therefore, amendments to the Outer Space Treaty will be necessary or the Moon Agreement must be revived in a more commercial-friendly manner.

3.2 Transit System

Shishko refers to the Transit System as the “Interplanetary Supply Chain”.¹⁵ This part of the Super-System is, therefore, not only a to-and-fro transit system, but also a supply chain. It consists, amongst others, of the following elements and applicable legal regimes: launch vehicles; logistics systems/propellant depots; in-space propulsion; deep space habitat; interplanetary internet; and the Mars descent/ascent vehicles.

These elements are regulated by the applicable law of the supplier states, international cooperation agreements and ultimately the FGSL. Of specific importance is the Micro-Law parameters provided by the international cooperation agreement akin to the ISS Agreement. It will deal with jurisdiction, liability, criminal law, intellectual property ownership, and any other matter or issue that can arise from the Transit System or stage.

3.3 Settlement System

Shishko indicates that the Mars colony will consist of the elements set out below.¹⁶ It is submitted that that any human settlement on another celestial body will also generally exhibit the same characteristics. The applicable legal regime in each instance will also be elucidated:

Habitation Systems: Regulated at a high level by the FGSL and more specifically by the international cooperation agreement with reference to jurisdiction, criminal law, labour rules, ownership of celestial body relics and samples, intellectual property ownership and any other issue that might arise. The Colonists, Education, Work and Leisure Systems will form a subsystem to the Habitation System;

Other Systems: The following systems will be regulated by the international cooperation agreement based on the International Standards Organisation

¹⁵ See note 1.

¹⁶ See note 1.

(ISO) standards or other agreed standards: Power Systems; Communication and Navigation System; Environmental Control and Life Support and Health Systems; Logistics and Maintenance Systems;

Surface Mobility: Regulated on a high level by the FGSL and more specifically by the international cooperation agreement.

The Settlement System will over time also develop as it grows larger and older and will probably move through the developmental stages of human settlements on Earth. A brief reflection of this will be discussed *infra*.

3.4 Reflection

The Super-System should, apart from the local laws of States and the FGSL, be regulated by a bespoke international cooperation agreement (Settlement Agreement). Like the ISS Agreement the Settlement Agreement must be accepted as a treaty that falls under the auspices of the Vienna Convention on the Law of Treaties. The Settlement Agreement should also form the basis from which all other relationships and space activities flow in the form of bilateral and multilateral agreements. This will include relationships with private players. It is to be noted that by the time this initiative comes to pass private players might be so advanced and influential that they could be considered as major partners almost on the same basis as that of States. Private players will not necessarily challenge States in sovereignty, but can play a *de facto* leadership role in many respect.

A consideration would also to opt for organisational cooperation as discussed *supra*. Given the magnitude of the human settlement initiative it would make sense to establish a Human Settlement Initiative Organisation under the UN or COPUOS authority to draw in global participation and benefit sharing. Such a strategy might allay fears of any State acting in breach of Article II of the Outer Space Treaty as any participation in any permanent settlement by most if not all States on Earth should not be considered appropriation to establish sovereignty as such.

Furthermore, in accordance with the visions of Robinson's 'Red Mars', 'Green Mars' and 'Blue Mars', a permanent settlement under UN or COPUOS auspices can over time and due to distance, loosen its ties with Earth. This may especially be the case once the colonists have settled long enough for second and third generations to be born on Mars. These generations will likely have no real connection with Earth. Under these circumstances interference from Earth might become an irritant and eventually turn into revolt with secession as an inevitable result. This scenario is more probable in the long term on Mars than the Moon due to the distance involved, however, such an independence movement on the Moon can also not be discounted.

The possible stages of such a secession/independence process can be viewed as follows:

Initial Stage: A small number of astronauts and scientists will visit the celestial body, survey, explore, experiment, and return to Earth for analysis and scoping of a celestial body settlement project. This takes place under the auspices of the FGSL and the Settlement Agreement;

First Stage Settlement: A small number of colonists will settle, build the habitat and explore the celestial body. The FGSL and international cooperation agreement remains applicable;

Second Stage Settlement: The colonists will also initiate work to become self-sustaining as supply missions from Earth will be expensive and limited. Still the FGSL and Settlement Agreement remains applicable;

Third Stage Settlement: With self-sustainability mostly achieved the numbers of colonists will grow and the habitat will expand. A new legal celestial body-based authority will be established to create unique local law necessitated by local conditions and ensure compliance. The powers and influence of the Earth authorities will slowly wax and wane over time as new law develops on the celestial body;

Fourth Stage Settlement: A new identity emerge among the colonists, and especially more so as the first-generation babies are born on the celestial body. The settlement becomes fully self-sustainable. The first local and customised governance system and law starts taking shape;

Fifth Stage Settlement: the settlement confirms its independence and formally declares itself sovereign in terms of the International Law on Statehood and Secession.

It is important, however, to note that these stages are speculative and that a human settlement initiative can deviate from this and take a myriad of other paths to arrive at a new form of independence, perhaps not even known on Earth at the moment.

Such new forms of independence can be informed by the rediscovery of systems of old that never became mainstream. For instance, Malan's work titled, *Politocracy: An assessment of the coercive logic of the territorial state and ideas around a response to it*, posits that the ideas of Hobbes became the mainstream framework for power that allowed the concept of the geographical state (the Leviathan) to become dominant. According to Malan, philosophers like Locke gave it a constitutional basis and Grotius established the law regulating these new entities called States, known as International Law. To date this has led to the legal duality of individual rights and the power of the State. Malan contrasts this with the lesser known ideas of communities that exist between the two extremes of individualism and statehood that forms nations, as derived from the ancient Greek *polis*. According to this idea like-minded communities, like geographical communities or cultural communities, can come into existence that fill the space between the two extremes and can be accommodated by devolving maximum powers to those communities. In this sense, a human settlement

community can be acknowledged by any Earth-authorities that exercise control over it to have certain devolved powers and autonomy. This community will then be known as a *politocracy*. This debate on future forms of autonomy and sovereignty will continue.

4. Conclusion

Various space cooperation forms have come into existence since 1958 with differing purposes from which lessons can be learned for future forms of cooperation. As far as any human settlement initiatives are concerned, the closest form that can be used as a point of departure is the ISS Agreement and any number of the institutional forms discussed *supra* for a proposed human settlement authority on Earth, but also eventually one for the celestial body itself. The FGSL will continue to play an overarching role as Macro-Law while the Settlement Agreement will inform the minutiae of the project as Micro-Law. As indicated earlier, under the current international legal regime, a permanent settlement that approximates national appropriation on another celestial body would be problematic given the provisions of Article II of the Outer Space Treaty. This means that the FGSL will have to make way for the SGSL where various forms of appropriation are recognised.

The issues that could arise from any human settlement initiative are linked to its Super-System and subsystems. While the FGSL forms the broader legal framework, most of the issues are to be dealt with in the Micro-law of the Settlement Agreement.

These questions should be addressed and ventilated early enough so as to ensure legal certainty and a conducive environment for space activities and settlements on celestial bodies. Proper international cooperation and benefit sharing can provide a realistic measure to counter Robinson's dystopian civil war between Mars and Earth.

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